**Life Sciences in Greater Cambridge**
**Skills Gaps and Solutions**

A Report for the GCP

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On the Life Sciences Sector in Greater Cambridge

**September 2010**

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**Executive Summary**

Greater Cambridge is the UK's leading Bioscience cluster and the most developed biotech cluster in Europe.

UK reports on the life sciences sector in recent years, all point to similar conclusions: that the UK has research quality, and it is internationally recognised as excellent but that we must continue to work to turn this excellence into commercial success. This message is certainly pertinent to Cambridge University who have recently topped the QS World University rankings and have consistently come second only to Harvard University in the QS Life Sciences rankings.

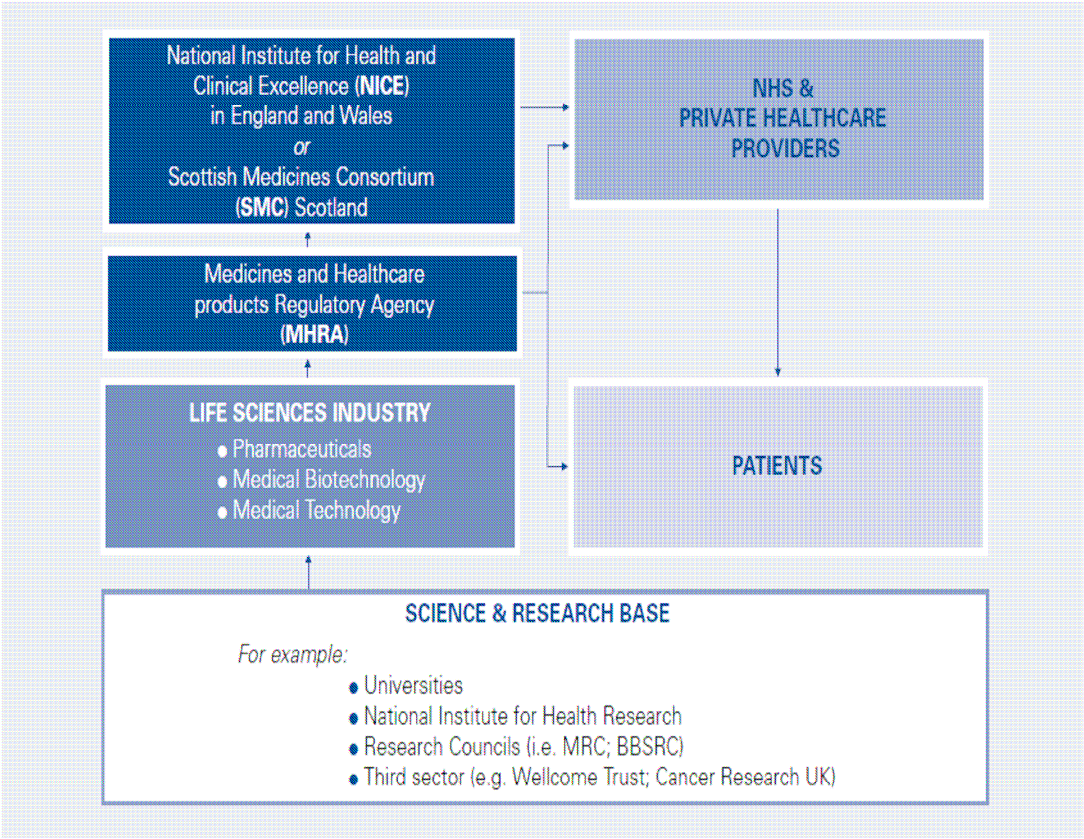
This report explores the issues around skills and skills gaps in one of Greater Cambridge's most valuable and exciting industries – the life sciences. Greater Cambridge and the UK have the research excellence to inspire innovation. Keeping the best scientists in Britain continues to be a challenge as global competition entices both companies and individuals to locate abroad. Nurturing networks and relationships that support innovative enterprise is vital, as is the development of business and management skills for commercial success. Continued success will depend on an education system that not only offers bioscientists, scientific excellence but also work experience that is geared to industry. Industry links should be embedded into the heart of higher education, so that academic excellence seamlessly translates into commercial success.

Whilst parts of the life sciences sector are clearly breaking new ground and moving into unchartered territory, older parts of the pharmaceutical industry face a "patent cliff", which will see the end of the patent period for a number of 'blockbuster' drugs over the next few years. The Office for Life Sciences (OLS) estimates that this will be the equivalent of $140 billion in sales. Such warnings suggest that it would be sensible to look at the whole issue of skills development in the industry.

The Life Science or Bioscience Industry is comprised of organisations concerned with the science of living things. Its three main sectors are:

- Pharmaceuticals,
- Medical biotechnology,
- Medical technology.

The Life Science industry structure is a complex interplay between sectors, subsectors, support sectors, regulators, academia, academic spin out and industry. The chart below, sourced from a BIS economics 2010 report provides a helpful overview.




The Life Sciences industry has a number of idiosyncrasies that set it apart from other markets. These include lengthy and precarious product development timescales for new products and complex development of medical devices; high levels of technological uncertainty; high research and development (R&D) intensity; high development costs and up-front investment, unique intellectual property rights and a distinct funding cycle in product development.

Strong cooperative relationships between Industry, research, regulatory bodies and other assessment agencies and healthcare providers are vital to the process for new products. The process of getting new products or technologies onto the market is long and complicated. Long before new medicines, treatments and technologies reach the market, they are subject to years of meticulous testing and medical trials to establish their reliability, safety and cost-effectiveness. The process is expensive and financial and regulatory restrictions make it harder for new technologies and research to be carried into the market, which can be especially difficult for emerging SMEs.

There is a conflict between, on the one hand - the excellent regulation provided by NICE, which safeguards the patient and the consumer (and goes some way to ensuring cost effectiveness) and on the other hand - the frustration felt by some that NICE are holding up innovation. However the claim that the NHS should be a more active purchaser from the life sciences sector needs to be critically examined. There is an assumption that, as the main customer for the national sector, the NHS is

somehow obliged to increase purchases. Not withstanding cost implications, and of course NICE regulations about testing and quality, there is also the question about using a government monopoly (NHS) to "assist" a sector. However new treatments save lives and can dramatically improve recovery rates – and as the Bioscience review reflects, "…. The UK is the laggard in Europe in the uptake of new drugs despite the fact that so much discovery takes place here. This demonstrates the difference between 'research' and 'innovation". The Review and Refresh of Bioscience 2015

The UK Life Science Industry is made up of 6,500 organisations employing around 191,000 employees. And overall employment is growing at an average annual rate of 1.3%.

Both the biotechnology and healthcare sectors are heavily comprised of SMEs, whereas the pharmaceutical sector contains a higher number of larger corporate organisations.

They are mostly small in size. 66% of the industry is companies that employ 1-24 people, in turn accounting for only 8% of the total workforce. Conversely only 8% of the industry is companies employing more than 250 employees and yet this accounts for 61% of the total workforce.

It is an industry that spans academia, academic spin out, SMEs and large corporate companies. In 11% of cases businesses describe themselves as a University Spin-Out Company. Businesses in Science and Engineering Research and Development are significantly more likely to be University spin-out companies (22%), than compared with businesses in Pharmaceuticals (8%) or Manufacturers of Medical and Surgical equipment (4%).

Greater Cambridge is the UK's leading Bioscience cluster and the most developed biotech cluster in Europe. It is made up of more than 185 biotech companies, 17 of the UK's publicly quoted biotech companies and a quarter of the public biotech companies in Europe. Over 250 service providers support these companies. There are more than 30 university research institutes and 20 international pharmaceutical companies.

Greater Cambridge has a world class reputation for Bioscience, strongly supported by Cambridge University which has been home to 20% of the world's Nobel Prize winners in medicine and chemistry.

We can break down the Life Science industry in Greater Cambridge into 3 Tiers of diminishing technicality.

- In Tier 1 is the core high tech companies, by this we mean that they have products and processes , which are the commercial result of investment in the research and development of new scientific and technology

applications. They are involved in research and development and they have patents.

- Tier 2 consists of organisations with expertise in technology itself, often supporting those in tier 1. These organisations may have patents but are often consultancies, Cambridge Consultants Ltd, for example.

- Tier 3 comprises those organisations that support high tech companies. They are not involved in new technological expertise or research. Marks & Clerk patent attorneys is an example of this kind of company. PR and marketing companies would also feature here and general high tech business support companies. There are also manufacturing companies producing simple products for high tech products.

Sector Support

One Nucleus was formed in April 2010 by the merger of two regional life science networks – Cambridge-based ERBI and the London Biotechnology Network (LBN). The merger of ERBI and LBN recognises that the Cambridge-London network is an international life science "super cluster".

The network provides a wide range of support including Bio Partnering events business mentoring, training and education in all aspects of bioscience business and strong links to other international bodies.

Life Sciences Jobs & Workforce Skills

The Life Science Industry is a high tech industry that employs many highly skilled people but is underpinned by a number of support roles with a lower skills base.

Many bioscience start-ups in the UK originate from academia. As such the founders are often academics who do not necessarily want to run a company or have all the skills to become the Chief Executive Officer. A model developed by universities is to place experienced 'launch CEOs' with the company to take it through these early stages although this has had varying success.

Having effective leadership and management allows a company to develop the right strategy and will increase the chances of commercial success. The quality of the leadership and management team is also an essential element determining investors' view of the company but SMEs face significant barriers in competing with large companies in attracting the best talent.

A growing number of scientists and top managers leave the UK to work in the US or in the major European bioscience clusters. Encouraging leaders and managers from countries with established and developed bioscience sectors to return to the UK would help strengthen the sector. The UK should also do more to draw in talent from overseas to return in a non–executive role.

Setting up a new biotechnology company needs more specific knowledge than is usually found within general (and local) business support services. As IP is the lifeblood of any biotechnology company, the ability to access unwanted, or under-exploited, IP from the 'parent' pharmaceutical company is as important as having the right team in place to run the spin out.

Career Choice

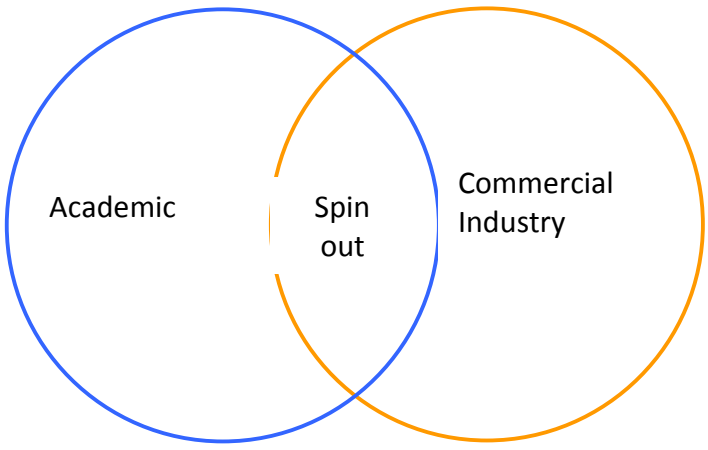
There are perhaps three reasons why people might think about bioscience as a career. First, and foremost, there is an increasing need for treatments and cures for unmet medical needs that can probably only be addressed by the innovative approach of biotechnology (e.g. cell therapy, monoclonal antibodies, gene therapy). This is a cutting edge area that should excite the brightest and the best.

The number of students studying chemistry, biology and maths at 'A' level or equivalent has risen (by 11.6%, 8.6% and 20.1% respectively) over the last five years, and applications to study Science Technology Engineering and Maths (STEM) subjects at HE level are increasing. However, in some areas, we need to do more to ensure that UK graduates leave with the relevant core skills and disciplines to equip them to enter the life sciences workforce. This is not therefore an issue of a future skills shortage in these subjects areas, rather it is about bringing the content of A level and HE courses closer to industry.

Employees in the Life Sciences sector are highly skilled, they are slightly more like to be male and they are 91% likely to be white. 76% of graduates, post graduates and doctorates have relevant work experience and this is increasingly important to employers. Bioscience recruitment is markedly international, 31% of graduates, postgraduates and doctorates are recruited from overseas. But there are of course a variety of roles that don't require scientific knowledge at an HE level. These positions account for around 20% of employment.

Employment projections for 2010-2016 suggest an annual growth rate of 1.3%, and a projected net requirement of 50,000 people. Split into occupations this translates as 12,000 people required to work in Managerial Occupations, 9,300 technicians and 9,200 professionals.

It is useful to look at the industry in terms of three interlocking themes:



Academic
Students staying in Academia move from BSC to MSc to PhD. Next they will typically work in Postdoc positions/ Senior Scientist, then Lectureship/ Chair/ Project leader positions moving up to Heads of Department, Fellowships, Professorships.

There are also a number of Academic support roles. These include Lab technicians and support staff. Depending on the technical level of knowledge required, some of these roles require a degree but some such as lab assistants who wash glassware and provide chemicals don't.

Spin off
Academic spin off companies rely on University Staff and there are issues here in conflicting education and commercial cultures, and allowing staff with entrepreneurial interest time to pursue spin off work.

Commercial Industry
Depending on the organisation and how technical it is there are a huge variety of roles in industry

Workforce Skills Shortages
In its Life Sciences Labour Market Survey 2009 (Semta and Cogent), researchers found that 39% of employers reported having vacancies that were hard-to-fill in biological and medical sciences, chemical sciences, and engineering.

The following causes were identified:

- Insufficient information, advice and guidance to students;
- Complex and multi-layered nature of Life Sciences industry;
- Incomplete information on full range of employment pathways
- science graduates.
- High cost and specialist nature of some biological sciences laboratory-based courses.

However, just because "Hard to fill" vacancies are reported across the sector especially at professional and technical levels, it should not be assumed that there is therefore, a skills 'shortage' problem in these areas. Hard to fill does not mean "unfilled" and there is no suggestion of a 'dumbing down' of requirements to fill the vacancy.

Interestingly, SEMTA continues to boldly state on its overview web-page of the sector that "39% of bioscience companies report hard-to-fill vacancies and 22% have skills shortages - five times greater than other sectors." This is in contrast to the most recent Labour Market research 2009 by SEMTA/Cogent which suggests that only 10% of all establishments in the sector have HFVs (page 18) - moreover on the question of hard to fill vacancies, 49% state that this has had no effect on the

business operation. SEMTA is “in the process” of updating this web page with the latest Labour Market Information.

In life sciences this is particularly pertinent because it is an international marketplace with intense international competition for the best scientists. Increasing the supply of high calibre technologists and professionals in the sector may have the adverse effect of driving more people to work abroad.

Skills Gaps

The report highlights the idiosyncrasies of the life sciences sector and shows that there are a number of skills issues which need addressing.

Lack of experience is cited as the main reason for a skills gap in the workforce. Many businesses have arranged for training in the past 12 months. Average cost per person trained was £645. In house and commercial training providers were the most common sources of training.

Out of all provision only FE recorded some “very poor” performance. Interestingly, 54% believe that apprenticeships are useful to the sector’s needs, however when narrowed down to SIC 73.1 (Research and experimental development on natural sciences and engineering) most (52%) do not think that apprenticeships have any role to play.

Semta found that the key reasons for skills needs having changed are, not surprisingly, the development of new products and services and the introduction of new technology or equipment.

Graduates need industry experience and those that get it, make contacts that lead to employment. It is a natural progression. It would be interesting to look at intern programmes from Cambridge University out to local businesses: SMEs get free work, graduates acquire experience, with potential for future employment.

The sector is highly skilled but this obscures the fact that many SME managers and innovators have little knowledge of the world of commerce. In larger companies this is not a problem because there are robust internal processes, support systems, and training options available to bright graduates. But in SMEs this skills deficiency can be a genuine barrier to commercial progress.

Equally, one should not assume that highly skilled means appropriately skilled, and there are many examples of companies employing PhD graduates to undertake quite basic technician tasks.

This report suggests that there are several areas of improvement which need addressing and offers the following recommendations:

- Continue to build on STEM subject uptake at undergraduate level;
- Gear education to industry earlier;
- Provide more information for students about the Industry and job roles;
- “Selling” the Greater Cambridge Cluster opportunities to students;
- Encourage increased collaboration between HE courses and Industry, resulting in more students with work experience, intern opportunities (free work) for industry;
- Academic Spin-outs – Useful for MSC/PhD/Post Doc work experience, sector research, innovation and university finances.
- Develop and deliver short courses, seminars, workshops focussing on commercial skills for those already in the industry.
- Beyond commercial skills – Working with One Nucleus, develop a programme of courses that help companies with regulation procedures, best ways to work with NICE for example, patent updates, and accessing funding.
- Ensure that non-technical, non professional roles are not left out of the skills equation for the sector
- Explore ways to match up the demand for technical craft level skills in the sector with available government funded supply of skills – with particular reference to the Higher Skills @ Work fund and adult apprenticeships.

## 1. Introduction

Greater Cambridge is the UK's leading Bioscience cluster and the most developed biotech cluster in Europe. As the Office of Life Science comments:

> *"*The Life Sciences industry is highly knowledge-intensive. It depends on the ability of companies to access highly skilled and innovative scientists, clinicians and technologists in order for it to compete in an increasingly global market place.
>
> "The UK has a strong scientific heritage, second only to the US in terms of academic excellence in higher education. UK researchers have won over 20 Nobel Prizes in Life Sciences related disciplines, and even though the UK is home to just 1% of the world's population, it undertakes 5% of the world's science, producing 9% to 11% of academic papers.
>
> "Life sciences is one of the high-tech strategic industries that will play a vital role in building a stronger Britain of the future; driving growth and prosperity as well as continuing improvements in healthcare delivery; and meeting future challenges such as an ageing population and obesity."
> Office for Life Science Blue print paper 2010 1.1

Much work has been done on the life sciences sector in recent years, whole new organisations have been set up to encourage and protect its growth and these together with others already in existence have produced myriad reports and a long list of recommendations surrounding the industry's future (e.g. The Review and Refresh of Bioscience 2015 - by the Bioscience Innovation and Growth Team). In essence they all have some very similar messages in common: That here in the UK our research quality is internationally recognised as excellent but that we must continue to work to turn this excellence into commercial success. As the UK's leading Cluster and with its internationally acclaimed institutions and organisations, this message could not be truer for Cambridge University who have recently been topped the QS World University rankings and have consistently come second only to Harvard University in the QS Life Sciences rankings.

This report explores the issues around skills and skills gaps in one of Greater Cambridge's most valuable and exciting industries – the life sciences. Greater Cambridge and the UK have the research excellence to inspire innovation. Keeping the best scientists in Britain continues to be a challenge as global competition entices both companies and individuals to locate abroad. Nurturing networks and relationships that support innovative enterprise is vital, as is the development of business and management skills for commercial success. Continued success will depend on an education system that not only offers bioscientists, scientific excellence but also work experience that is geared to industry. Industry links should be embedded into the heart of higher education, so that academic excellence seamlessly translates into commercial success.

The Patent Cliff

Whilst parts of the life sciences sector are clearly breaking new ground and moving into unchartered territory, older parts of the pharmaceutical industry face a "patent cliff", which will see the end of the patent period for a number of 'blockbuster' drugs over the next few years. OLS estimates that this will be the equivalent of $140 billion in sales. Such warnings suggest that it would be sensible to look at the whole issue of skills development in the industry.

This report examines different aspects of the sector. First it looks at some definitions of the life sciences sector, then, in chapter 3 it explores the structure of the industry, and delves into the regulatory issues which dominate its workings. In chapter 4, the Greater Cambridge cluster is explored in the context of the UK industry as a whole, before looking in detail at the skills issues in the sector. Finally some conclusions are drawn and recommendations offered.

**2. Life Sciences – Definition**

The Life Science or Bioscience Industry is comprised of organisations concerned with the science of living things. Its three main sectors are:

- Pharmaceuticals,
- Medical biotechnology,
- Medical technology.

The broader definition takes in any of several branches of science, such as biology, medicine, anthropology, or ecology, that deal with living organisms and their organisation, life processes, and relationships to each other and their environment. Life Sciences refers to the scientific study of the living world as a whole – a combination of various disciplines including biology, zoology and botany with newer, more specialised areas of study, such as biosciences, biochemistry, biotechnology, bio-informatics, genetics, pharmaceutical studies, food science and technology and environmental science

The Government Office for Life Sciences focuses its definition on pharmaceutical, medical biotechnology, and medical technology sectors and the NHS.

More broadly we can talk about Life Sciences relating to 'organisms', like plants, animals and human beings and the following fields of science:

- Agrotechnology
- Animal Science
- Biochemistry
- Biocontrol
- Biodynamics
- Bio-engineering
- Bioinformatics and biocomputing
- Biology
- Biomaterials
- Biotechnology
- Biomedical Engineering
- Biomedical Imaging
- Biomedical Systems
- Biomolecular Engineering
- Biomonitoring

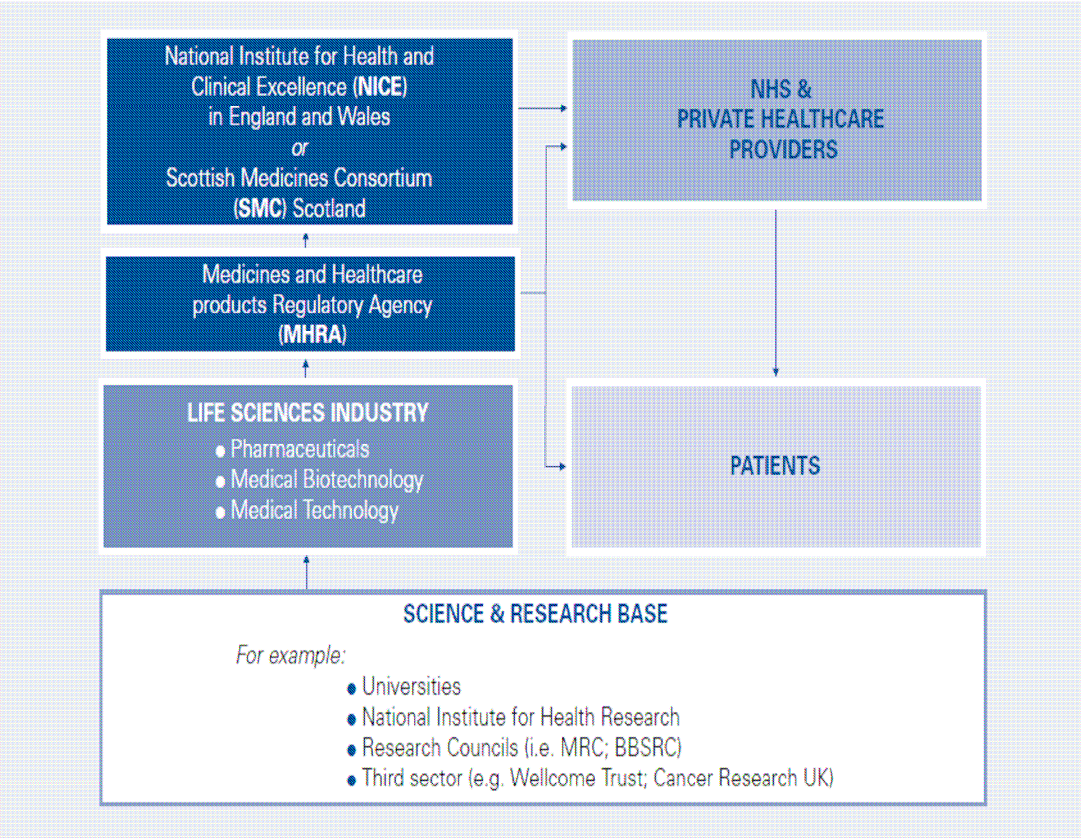
- Biophysics
- Biotechnology
- Cell Biology
- Ecology
- Environmental Sciences
- Food Sciences
- Genetics and Genomics
- Medical Imaging Techniques
- Molecular Biology
- Nanotechnology
- Neuroscience
- Plant Science
- Proteome and Proteomics
- Smart BioPolymers
- Tissue Engineering

Encompassing companies in the following sub-sectors:

- Biotechnology
- Pharmaceuticals
- biomedical technologies
- life systems technologies
- nutraceuticals
- cosmeceuticals
- food processing
- environmental
- biomedical devices

**3. What does the structure of the Life Science Industry look like?**

The Life Science industry structure is a complex interplay between sectors, subsectors, support sectors, regulators, academia, academic spin out and industry. The chart below, sourced from a BIS economics 2010 report provides a helpful overview.




(2010) BIS Economics Paper No.2: *Life Sciences in the UK – Economic analysis and evidence for 'Life Sciences 2010: Delivering the Blueprint*' p 4

Sector Issues

The Life Sciences industry has a number of idiosyncrasies that set it apart from other markets. These include lengthy and precarious product development timescales for new products and complex development of medical devices; high levels of technological uncertainty; high research and development (R&D) intensity; high development costs and up-front investment, unique intellectual property rights and a distinct funding cycle in product development.

The process for new products

Strong cooperative relationships between Industry, research, regulatory bodies and other assessment agencies and healthcare providers are vital to the process for new products.

The process of getting new products or technologies onto the market is long and complicated. New products must pass through a very large number of stages before coming to market and plenty will fail along the way. Optimism rises once a product

reaches the late trial stages, for example human trials. This is often referred to as 'the pipeline' and we will take a closer look at what it means for the industry later on.

This process is expensive and financial and regulatory restrictions make it harder for new technologies and research to be carried into the market, which can be especially difficult for emerging SMEs.

It is not only the private sector that undertakes research and development in Life Sciences products. Public and third sector research also plays a vitally important role in the discovery and development of new drugs and other health technologies.

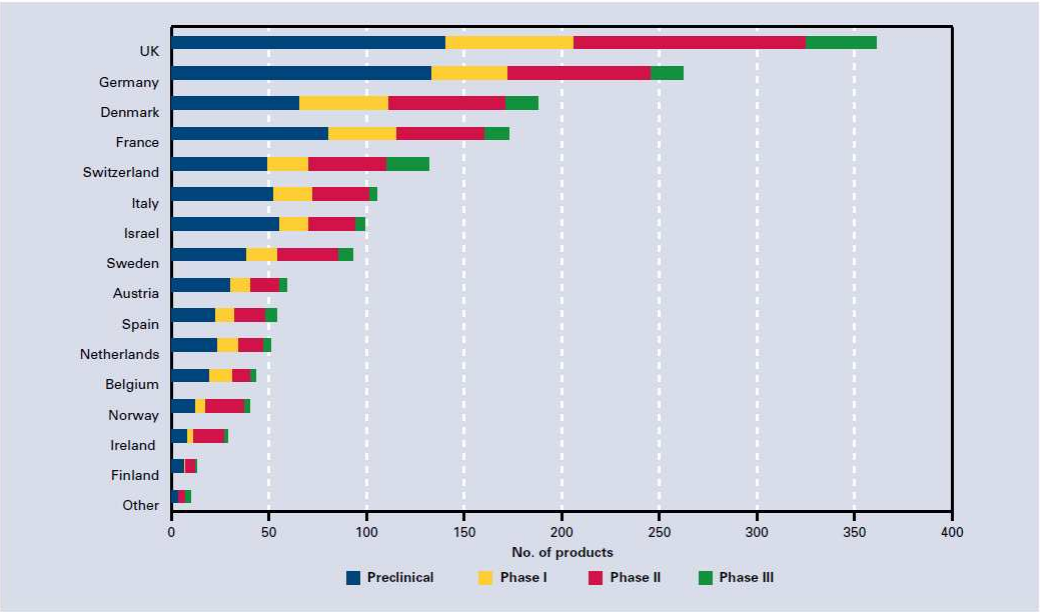
The National Institute for Health Research (NIHR) and two of the seven UK Research Councils –the Medical Research Council (MRC) and the Biotechnology and Biological Sciences Research Council (BBSRC), provide the largest public sources of health research funding.

One of the greatest issues facing the industry is funding from institutional investors to emerging biotech companies. This is critical to the future of early stage biotech companies and as the pharmaceutical industry increases its reliance on biotech companies to develop products, which can be licensed to them in their later stages of development. The relationship between the pharmaceutical industry and emerging biotechnology SMEs needs be supported and nurtured.

The UK pipeline

An excellent indicator of the health and future success of a country's medical biotechnology sector is the number of products in its development pipeline, particularly the number that have reached the later trials stage, for example human trials. Ernst & Young research shows that the UK had the largest development pipeline in Europe in 2007. Recently this share has diminished as Germany and France have increased their shares, following deliberate government strategies to improve throughput.

**Figure 3.8: European Product Pipeline by Country, 2007**




*Source: Ernst & Young (2008)*

(2010) BIS Economics Paper No.2: *Life Sciences in the UK – Economic analysis and evidence for 'Life Sciences 2010: Delivering the Blueprint*' p35

Regulatory Bodies and Regulation
Long before new medicines, treatments and technologies reach the market, they are subject to years of meticulous testing and medical trials to establish their reliability, safety and cost-effectiveness.

In Europe, the **European Medicines Agency** is responsible for regulation. New medical technologies are subject to conformity assessment procedures, based on the merits of the product, and prior to the manufacturer affixing a CE mark of conformity. Manufacturers of higher risk products must obtain an EC Certificate of conformity from a Notified Body. Once CE marked, a medical device can be placed on the market in any EU country.

In the UK, the following main bodies regulate and assess new medicines, treatments and technologies:

- The **Medicines and Healthcare products Regulatory Agency** (MHRA);
- The **National Institute for Health and Clinical Excellence** (NICE) in England
- and Wales;
- The **Scottish Medicines Consortium**; and
- The **All Wales Medicines Strategy Group** (AWMSG).

Regulatory criticism

Recent EU Clinical Trial directives have not so far resulted in standardisation of implementation and there is a risk that the UK could price itself out of the drug development market, as other countries impose regulations with greater flexibility.

The National Institute for Clinical Excellence has faced criticism for obstructing development:

> "Currently, the perceived problem for UK industry is that NICE appraisals do not operate in a way that is supportive of innovation, or uptake and access to medicines and therefore dissuade companies from investing in the UK"
> Sir David Cooksey in January 2009 in his *Review and Refresh of Bioscience*

> "The main challenge for the industry is to provide the NHS with value for money with its new products. In Britain, as in all countries, we need innovative products, but we don't have a bottomless pit of money to pay for them. We are about to enter a lean period in terms of NHS funding, where money for new interventions is not going to be as freely available as it might have been in the past six or seven years."
> NICE.

There is a conflict here between, on the one hand - the excellent regulation provided by NICE, which safeguards the patient and the consumer (and goes some way to ensuring cost effectiveness) and on the other hand - the frustration felt by some that NICE are holding up innovation. The process for new technologies is already lengthy, complicated and risky usually relying on heavy investment. NICE regulations increase the risk investors make when they back new products. However the claim that the NHS should be a more active purchaser from the life sciences sector needs to be critically examined. There is an assumption that, as the main customer for the national sector, the NHS is somehow obliged to increase purchases. Not withstanding cost implications, and of course NICE regulations about testing and quality, there is also the question about using a government monopoly (NHS) to "assist" a sector. The idea that there should be more 'streamlined' processes to encourage more innovative drugs into the NHS system, may be good for the life science sector but to what extent is there a danger that, with less NICE intervention, undue pressure could be applied to purchase larger amounts of life science innovations by a national health service which is meant to have the consumer (patient) at its heart, rather than the pharmaceuticals or biotechnology company?

Moreover if, as is claimed in Bioscience 2015, the main focus is to "secure a leading place on the global stage for the UK's medical bioscience industry..." (p3 review & refresh...), is there not an equal danger that the NHS and its consumers could be used as a testing ground for international sales?

However new treatments save lives and can dramatically improve recovery rates. As the Bioscience review reflects, "it is possible that, in the short term, the NHS drug bill will be reduced, but in the long term these delays and the increased risks for the

investor must inevitably result in higher prices or determine that new drugs will not be developed in the UK because their development here is unsustainable. The UK is the laggard in Europe in the uptake of new drugs despite the fact that so much discovery takes place here. This demonstrates the difference between 'research' and 'innovation". The Review and Refresh of Bioscience 2015

Monopsony and The NHS

When there is one main purchaser but many different sellers, there is a monopsony. This is a feature of the Life Science Market, when considering the role of purchaser that the NHS plays.

"The public sector can exert significant buyer power in a number of markets; that is, it can act as a monopsonist. This buying power means that a monopsonist might be able to exploit their bargaining power with multiple suppliers of a product to negotiate more favourable prices for a product. However, concentration of purchasing decisions in a single agency can also enable a monopolist to gain all the benefits from the transaction, by setting the highest price that the monopsonist can pay which often happens in respect of patented medicines in the NHS. Of the £671 billion in UK Government spending projected for the financial year 2009/10, around 18% or £119 billion is planned for health care" BIS Economics Paper No.2 p23

Bioscience 2015 identified six key areas of activity including:

"**Build a mutually advantageous collaboration between the NHS and industry for patient benefit** through the creation of a National Clinical Trials Agency (NCTA). The NCTA, sponsored by the Department of Health (DH) in collaboration with Research Councils UK, should support excellence in clinical trials and clinical research within the NHS; " p9

International Competition

The Bioscience Industry operates in an international market, which is increasingly competitive. This market is not only competitive in terms of researching, developing and selling new products and technologies but as a workplace too and in terms of location for emerging companies or existing companies looking to relocate. There is competition both for recruiting people and in attracting companies, choosing their location.

Within this world market, the UK has a very strong position. Indeed, the UK is a world leader in bioscience, ranking second after the US, which holds approximately 50% of the market, with particularly strong growth areas in regenerative and stratified medicine. Within Europe, the UK leads on biotechnology at all stages of clinical development and on medical technology. The UK's pharmaceutical industry leads on research and development, investing around 4.5bn, which is over a 25% of all UK Business Research and Development

## 4. UK Sector Coverage and the Greater Cambridge Cluster

The UK has three BioScience areas: in order of size these are:

- Cambridge
- London
- Oxford.

Greater Cambridge is the UK's leading Cluster. Clusters are very beneficial to the industry and while these regional centres of excellence do not yet parallel the international profile of super-clusters such as the Life Science Cluster in Boston US, the government has made it clear time and again that nurturing clusters is vital to supporting the growth of this industry.

Employment profile of the Industry

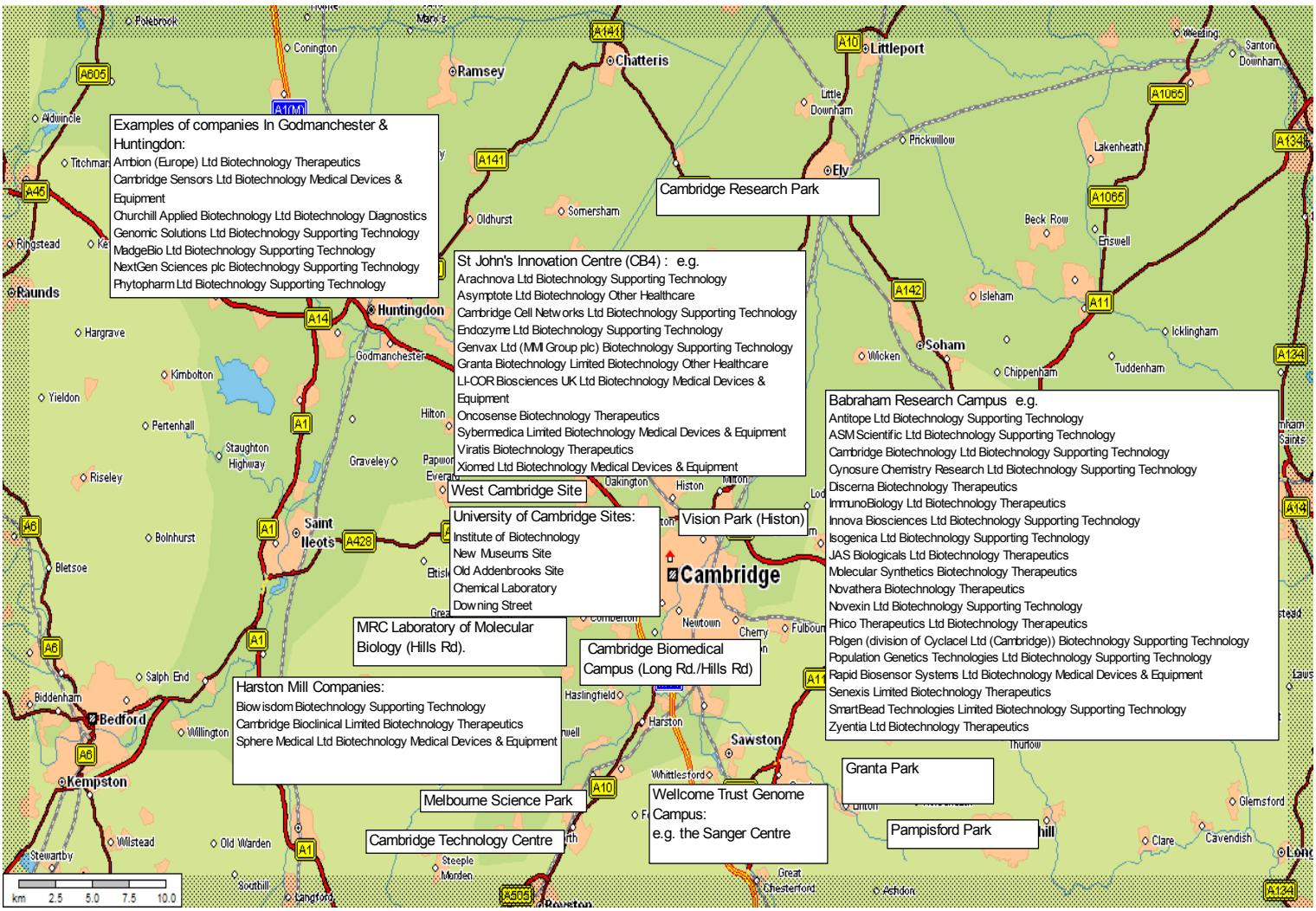
The UK Life Science Industry is made up of 6,500 organisations employing around 191,000 employees. And overall employment is growing at an average annual rate of 1.3%.

Both the biotechnology and healthcare sectors are heavily comprised of SMEs, whereas the pharmaceutical sector holds a higher number of larger corporate organisations.

They are mostly small in size. 66% of the industry is companies that employ 1-24 people, in turn accounting for only 8% of the total workforce. Conversely only 8% of the industry is companies employing more than 250 employees and yet this accounts for 61% of the total workforce.

It is an industry that spans academia, academic spin outs, SMEs and large corporate companies. 15% of companies in the sector use Industrial Biotechnology. In 11% of cases businesses describe themselves as a University Spin-Out Company. Businesses in Science and Engineering Research and Development are significantly more likely to be University Spin-Out Companies (22%), than compared with businesses in Pharmaceuticals (8%) or Manufacturers of Medical and Surgical equipment (4%). Later we will see that this has some large implications for skills strategies, a one size fits all approach will certainly not suit this industry.

## The Greater Cambridge Cluster Explored

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Greater Cambridge has a world class reputation for Bioscience, strongly supported by Cambridge University which has been home to 20% of the world's Nobel Prize winners in medicine and chemistry.

The Greater Cambridge Life Sciences sector comprises:

> 180 biotech companies
> 250 specialist service providers with biotech expertise
> 30 research institutes and universities
> 20 multi-nationals in pharmaceuticals, ag-bio and food
4 leading hospitals involved in research
14 Nobel prize winners in medicine and chemistry since Crick and Watson (2 in 2002)
Half of the UK's top 15 LSE quoted biotech companies, 25% of Europe's top 50 publicly quoted companies, and 40% of the US top 10.
29 publicly quoted biotech companies, 17 UK, 8 US, 2 Canadian and 2 European (excluding pharmaceutical companies)
USA quoted biotech companies with a presence in the region include Amgen, Millennium, Genzyme, and Gilead Sciences
10,000 people employed **directly** related to biotechnology business together with 3,500 researchers in 350 research groups. 25,000 in total in relevant academic biotech pharma R&D
The biotech sector breakdown is:
32% develop (bio)pharmaceutical products
23% develop pharmaceutical services, e.g. discovery tools, bio-informatics, CROs etc
10% supply biotech contract services
8% involved in human healthcare diagnostics 20% involved in other areas

Biotechnology, out of all of the region's Life Sciences sub-sectors, has become the largest employer in the cluster employing 5,343 people and responsible for 44% of all the money raised across the cluster. 88 separate investment deals took place in the biotechnology sub-sector over the last 3 years and future funding requirements for Biotechnology are 41% of all total capital for required for the cluster as a whole.

"The rapid emergence of biotechnology within the cluster has been driven by multiple factors including the world-leading science in Cambridge, but also by a new breed of entrepreneurs with experience gained from the region's successes such as Acambis and Cambridge Antibody Technology, who have had the drive and ambition to start a new generation of companies." Andy Richards, co-founder of Chiroscience Cambridge Network, news article[1].

The Sanger Centre for genomic research (Wellcome Trust Hinxton), the Babraham Institute providing immunology research and the laboratory for Molecular Biology are all recognised as world leading research centres.

We can break the Life Science industry in Greater Cambridge down into 3 Tiers of diminishing technicality.

- In Tier 1 is the core high tech companies, by this we mean that they have products and processes , which are the commercial result of investment

[1] http://www.cambridgenetwork.co.uk/news/article/?objid=22471

in the research and development of new scientific and technology applications. They are involved in research and development and they have patents.

- Tier 2 consists of organisations with expertise in technology itself, often supporting those in tier 1. These organisations may have patents but are often consultancies, Cambridge Consultants Ltd, for example.

- Tier 3 comprises those organisations that support high tech companies. They are not involved in new technological expertise or research. Marks & Clerk patent attorneys is an example of this kind of company. PR and marketing companies would also feature here and general high tech business support companies. There are also manufacturing companies producing simple products for high tech products.

Sector Support

**The merging of sector support for London and Cambridge**

One Nucleus was formed in April 2010 by the merger of two regional life science networks – Cambridge-based ERBI and the London Biotechnology Network (LBN). Together they form a commercial, clinical and academic powerhouse. London and Greater Cambridge are home to at least 60% of the UK's life science industry base, four of the UK's five Academic Health Science Centres and three of the world's top six universities. The merger of ERBI and LBN recognises that the Cambridge-London network is an international life science "super cluster

The network provides a wide range of support including Bio Partnering events business mentoring, training and education in all aspects of bioscience business and strong links to other international bodies.

One Nucleus is sponsored by MedImmune, as Corporate Patron, and Corporate Sponsors include Barclays Corporate, Deloitte, IQ Cambridge, London First, Taylor Wessing, UCB and World Courier.

One Nucleus's mission "is to maximise the global competitiveness of our members. For our science and technology-based members, that means being global leaders in the research, development and commercialisation of healthcare innovations that radically improve the quality of people's lives around the world. For our business and professional services members, it means delivering exceptional services that significantly enhance the business performance of their clients." (website)

One Nucleus is actively involved in the region's training and development for the life science sector. In 2004 it carried out research into business needs which resulted in the development of a range of sector specific courses around the following subject areas: project management; commercial awareness; presentation skills and health & safety.

One Nucleus is currently the Beyond 2010 sector representative for the Life Sciences. Beyond 2010 is an EEDA inspired sector based training programme. It offers training grants to SMEs in ten different sectors (including life sciences) wishing to undertake workforce training especially for courses that are outside the mainstream. Up to 70% of the cost of a training programme (up to a maximum grant of £2500 available per business) is available from the European Social Fund and East of England Development Agency. To date almost 60 companies from the life science sector have participated in the 2010 programme. Considerably more would have taken up the opportunity if they had been eligible; many small life science businesses have been bought up by larger international companies even though they continue to operate in an SME vacuum. Because of this change of ownership, they are no longer eligible for Beyond 2010 funding.

**5. Life Sciences Jobs & Workforce Skills**

The Life Science Industry is a high tech industry that employs many highly skilled people but is underpinned by a number of support roles with a lower skills base.

Life science jobs can be split into various categories:

Research and Development

The most skilled category is Research and Development. This is where the investment in human capital brings the greatest returns:

- Research Scientist
- Process/Development Scientist
- Product Development
- Academic Research

Communications

Communicating extremely technical scientific concepts to customers, investors and the public provides a huge challenge that requires a thorough scientific grounding and excellent communication skills.

- Public & Investor Relations
- Technical & Medical Writing
- Clinical Trial Management

Sales & Marketing

As with all sectors, sales and marketing is vital to the industry. However in life sciences the emphasis on new products and processes makes this role a critically important one, and as we shall see later on, dealing with a monopoly purchaser (monopsonist) poses challenges often unknown to other sectors.

Business Services .

- Consultancy
- Business Intelligence
- Business Development

Legal

There is enormous scope for people with a scientific background within the legal sector. Increasingly scientific degrees are required for roles such as intellectual property lawyers or patent attorneys. These roles involve the protection of ideas. For many science companies their entire value is based on their intellectual property so protecting and preserving it is top priority.

Finance

- Equity Research
- Venture Capital
- Accountancy
- Investment Banking

Technology Transfer

Technology Transfer Offices are usually based in or around universities or scientific campuses. They are responsible for protecting and commercialising promising ideas and projects resulting from research. Technology Transfer Executives will liaise with scientists who have a commercially valuable idea, assess it's commercial potential, manage the patent process (if necessary) and ensure the idea is exploited to its maximum potential.

Academic Excellence

The UK faces competition from Europe Asia and America in where life science companies choose to locate and where people choose to work. We cannot afford to loose some of our best scientists to the rest of the world. As a recent BIS report comments:

> "The UK is facing increasing competition from European neighbours and from Asia, with countries taking specific steps to attract life sciences companies. Only by making the most of its strengths will the UK be able to achieve its vision for a diverse and integrated life sciences sector which sustains high-value added employment, and drives economic growth and improved health and well-being." BIS Blueprint 1.7

Management Issues

Many bioscience start-ups in the UK originate from academia. As such the founders are often academics who do not necessarily want to run a company or have all the skills to become the Chief Executive Officer (CEO). A model developed by universities is to place experienced 'launch CEOs' with the company to take it through these early stages although this has had varying success. Individuals with experience of different stages of business development should be encouraged to move between companies, helping management teams adapt when the company moves into different stages of development.

Having effective leadership and management allows a company to develop the right strategy and will increase the chances of commercial success. The quality of the leadership and management team is also an essential element determining investors' view of the company but SMEs face significant barriers in competing with large companies in attracting the best talent.

Retaining and attracting leaders and managers

A growing number of scientists and top managers leave the UK to work in the US or in the major European bioscience clusters. We believe that encouraging leaders and managers from countries with established and developed bioscience sectors to return to the UK would help strengthen the sector. The UK should also do more to draw in talent from overseas to return in a non–executive role.

Setting up a new biotechnology company needs more specific knowledge than is usually found within general (and local) business support services. These organisations often only have limited experience of intellectual property (IP), science

based, Venture Capital funded spin-outs. Individuals within pharmaceutical companies need more knowledge of how biotechnology works, and greater connectivity with the entrepreneurial community, before contemplating becoming involved and setting up a business. This needs the establishment of advice networks, an information pack, and the identification of the right people to provide assistance (mentors, investors and entrepreneurs), in order for pharmaceutical company spin-outs to be 'investment ready'.

As IP is the lifeblood of any biotechnology company, the ability to access unwanted, or under-exploited, IP from the 'parent' pharmaceutical company is as important as having the right team in place to run the spin out. Enabling the transfer of IP out of pharmaceutical companies and in to biotechnology is part of the responsibility of pharmaceutical companies to ensure long term drug development continues, and is therefore of importance and value to all involved. If this can be combined with pump-priming seed funding from pharmaceutical companies that would also do a lot for the health of the spin outs created.

Image and attractiveness

There are perhaps three reasons why people might think about bioscience as a career. First, and foremost, there is an increasing need for treatments and cures for unmet medical needs that can probably only be addressed by the innovative approach of biotechnology (e.g. cell therapy, monoclonal antibodies, gene therapy). This is a cutting edge area that should excite the brightest and the best.

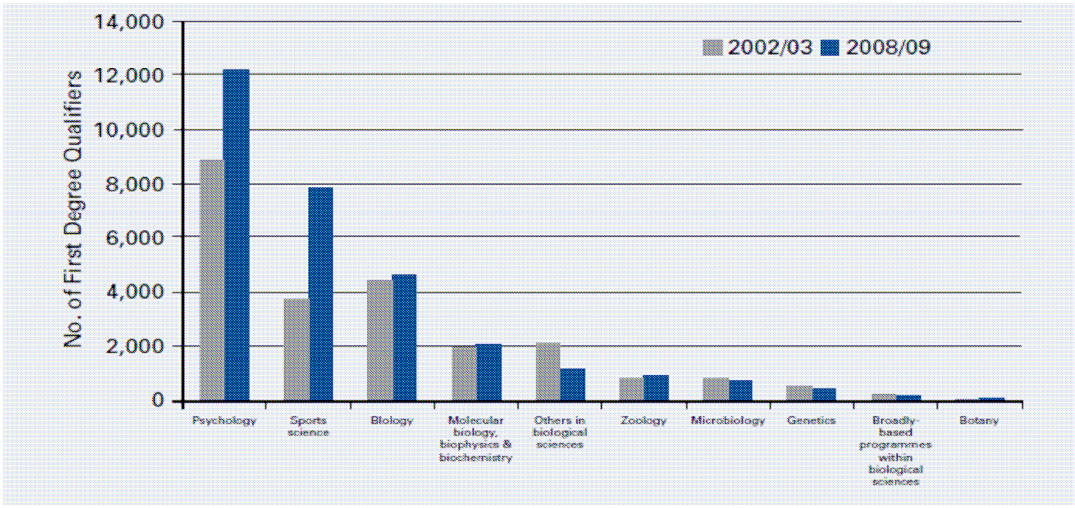
Biotechnology ought also to appeal to the altruistic and idealistic side of bright young graduates and provide the motivation and drive that might not be so readily accessed in other ideas – in the end, you are helping people and improving public health. Most medical researchers will admit to this kind of inspiration. Employees can also expect a decent salary and standard of living from working in a sector that has expectation of success and a guaranteed market for their products. And, finally, bioscience is increasingly a global business, so people involved in it can expect to benefit from networking and collaboration with the most talented individuals from their peers all around the world – giving a breadth of outlook not offered by many other sectors.

The number of students studying chemistry, biology and maths at 'A' level or equivalent has risen (by 11.6%, 8.6% and 20.1% respectively) over the last five years. The UK's HE system is a national asset. Applications to study Science Technology Engineering and Maths (STEM) subjects at HE level are increasing. As centres of research excellence, HE Institutions (HEIs), in partnership with industry, are key drivers of economic growth and lay the foundations for innovation. This excellence has been, and continues to be, a strong pull to attract and retain life science business interests in the UK. However, in some areas, we need to do more to ensure that UK graduates leave with the relevant core skills and disciplines to equip them to enter the life sciences workforce.

A levels and HE

From talking to both Cambridge University and UEA we know that applications in STEM subjects have increased. The graph below shows the same increase nationally. This is not therefore an issue of a future skills shortage in these subjects areas but of bringing A level and HE courses closer to industry.

**Figure 4.10: First Degree Qualifiers in Biological Sciences in 2002/03 and 2008/09**




*Source: HESA*

Market Failures Present in The Provision Of Skills

The complex, cross-cutting and fast-moving nature of the Life Sciences market means that employers may be unable to accurately judge what types of jobs will be required in the future and which skills will be needed for employment in the industry.

The market may also not provide sufficiently strong signals about the demand for particular skills set which may increase the uncertainty which employers and employees may face. This may lead to under investment in the critical skills required, including insufficient information and guidance to those interested in pursuing a career in the Life Sciences.

Furthermore, the current system does not incentivise students to complete sufficiently vigorous courses in pertinent disciplines. The high degree of choice in science and bioscience courses enables students to avoid difficult but essential modules in Higher Education (HE). Also, HE biological sciences courses rarely demand A-Level or equivalent maths for entry and, linked to the point above, this often means graduates enter the labour market with relatively low level maths skills.

The evidence shows that there is also a lack of general (not sector specific) skills training in the Life Sciences industry, which could be due to the fact that science based courses, as well as in other disciplines, at HE level often lack any business

or leadership skills elements.

As a result, employers in Life Sciences are reporting that some graduates entering the labour market are not fully prepared for all the requirements of the job as well as reporting hard-to-fill vacancies, especially in biological and medical sciences, chemical sciences and engineering

What Graduates, Tutors and Recruitment advisors have to say

"Graduate courses are still not well enough tailored to industry, weighted too heavily in the interests of academic progression and research, as one would expect from institutions hoping to encourage progression through the academic ranks…But this is to the detriment of industry, where there are '60 to 80 applicants for most roles' and employers favour a year in industry, something that is not a component of many degrees." Life Science recruiter

"Many of the larger companies run their own grad schemes and obviously take on bright grads with little work experience from the top universities." Biochemistry Tutor Oxford University

"Increasingly grads are doing jobs that don't really use their degree because there are so many applicants. Whereas before someone with a PHD might have gone in at Senior Scientist level or Group leader, this is becoming less likely and grads are now going in at lower level jobs" Life Science recruiter.

"Contracting opportunities are increasing in an industry worried about reducing margins." Life Science Recruiter

"I've been told to do internships, it's competitive but the Uni has told us very little about industry, like what sort of jobs are out there, recently, I know have gone into roles like medical sales, I didn't even think about roles like that before, a module on all the different careers options would be really helpful" Biochemistry Student Cambridge.

"I think it feels like a very international workplace. Everyone thinks the best jobs are in America because that's where the money is. I'd say at least 50% of my department is overseas students, I'd like to work abroad for a bit" Biochemistry Student Oxford

"I'm often asked at trade fairs by tutors, why they can't get their students into industry, industry wants industry experience, good communication skills, commercial skills that aren't always part of academic courses" Life Sciences Recruiter.

Workforce Characteristics

Employees in the Life Sciences sector are highly skilled, they are slightly more like to be male and they are 91% likely to be white. 76% of graduates, post graduates and

doctorates have relevant work experience and this in increasingly important to employers.

- Bioscience recruitment is markedly international, 31% of graduates, postgraduates and doctorates are recruited from overseas.

- Unsurprisingly most of the jobs in the sector require qualifications at an HE level. The joint sector skills council (Semta / Cogent's) 2010 study factsheet, found that 58% of the total work are qualified to NQF L4 – compared to just 33% for the UK average. A large proportion of Employees will have not only BSc's but an MSc or PhD and whether going into technical, practical work or bioscience recruitment or sales it is generally expected that employees will come from a bioscience degree background.

- But there are of course a variety of roles that don't require scientific knowledge at an HE level. These positions account for around 20% of employment.

- 53% of employees fall into the 25-44 age group, after that 34% for 45-59. Whilst only1% are 16-19, 6% 20-24.

- The gender split is slightly more male – 54%. Women employees are most prevalent in the following roles within the industry: secretarial occupations (66%), sales and customer service occupations (53%) and least prevalent in the skilled trades (16%) and personal roles (10%).

- The industry is predominantly comprised of people of white ethnicity, at 91%.

Projections

Employment projections for 2010-2016 suggest an annual growth rate of 1.3%, and a projected net requirement of 50,000 people. Split into occupations this translates as 12,000 people required to work in Managerial Occupations, 9,300 technicians and 9,200 professionals.

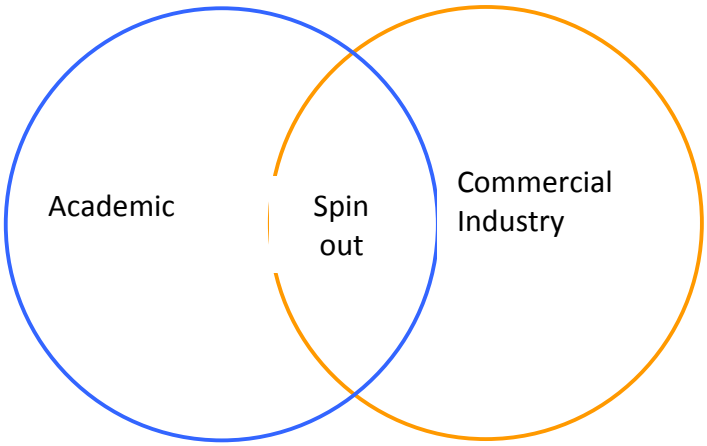
Right across the Life Science subsectors, job roles fall into and between academic and commercial; and scientific and professional work, demanding a wide variety of different skills.

Semta/Cogent lists the following figures for job roles across the industry:

| |
|---|
| Managers and Senior Managers 23% |
| Professionals 25% |
| Associate Professionals (Technicians) 19% |
| Admin and Secretarial 11% |

Skilled Traders 4%
Personal Service <1%
Sales and Customer Service 2%
Process, Plant and Machine Operatives 10%
Elementary roles 6%

It is useful to look at the industry in terms of three interlocking themes:




Academic
Students staying in Academia move from BSC to MSc to PhD. Next they will typically work in Postdoc positions/ Senior Scientist, then Lectureship/ Chair/ Project leader positions moving up to Heads of Department, Fellowships, Professorships.

There are also a number of Academic support roles. These include Lab technicians and support staff. Depending on the technical level of knowledge required, some of these roles require a degree but some such as lab assistants who wash glassware and provide chemicals don't.

Spin out
Academic spin out companies rely on University Staff and there are issues here in conflicting education and commercial cultures, and allowing staff with entrepreneurial interest time to pursue spin off work.

Commercial Industry
Depending on the organisation and how technical it is, there are a huge variety of roles in industry

We can group job roles in this sector as follows:

- Professional engineers, scientists and technologists. Associate professionals and technicians
- Management positions
- Consulting positions

- Sales
- Customer services
- Communications - marketing and PR
- Legal roles, particularly intellectual property and patent law
- Administrative and secretarial occupations
- Personal service occupations
- Skilled trades
- Process, plant and machine operatives
- Elementary occupations

Individuals enter the sector at a number of different levels; for most scientific roles and top research roles a PhD. Is usually required.

It is not surprising that the majority of jobs roles in the Life Science industry require a degree. Whether they are research, technical or professional, employees need an in-depth knowledge of their sector's science.

However there are a number of jobs which do not require a science degree for example: lab assistants, administrative secretary, finance roles etc.

Workforce Skills

> **"** The future of a flourishing UK life sciences industry lies in integration and collaboration, across industry, academia and the NHS. It is vital to its continued success that the supply of high-calibre skilled employees is maintained." OLS

A number of studies have identified a shortage of supply in important skills areas. These include both technical and employability skills.

In its Life Sciences Labour Market Survey 2009 (Semta and Cogent), researchers found that 39% of employers reported having vacancies that were hard-to-fill in biological and medical sciences, chemical sciences, and engineering.

The following causes were identified:

- Insufficient information, advice and guidance to students;
- Complex and multi-layered nature of Life Sciences industry;
- Incomplete information on full range of employment pathways
- science graduates.
- High cost and specialist nature of some biological sciences laboratory-based courses.

However, just because "Hard to fill" vacancies are reported across the sector especially at professional and technical levels (p19), it should not be assumed that there is therefore, a skills 'shortage' problem in these areas. Hard to fill does not mean "unfilled" and there is no suggestion of a 'dumbing down' of requirements to fill the vacancy. Rather, one suspects that higher salaries may attract the right calibre of applicant. One should not forget that an employers ideal labour market is

one where the labour required is in abundant supply. This not only improves choice and depresses labour cost, but also keeps existing labour 'on their toes'. It is interesting to note that in a third of cases reported by the SEMTA/Cogent report, the action taken was to "increase the recruitment effort" Half of all respondents confirmed that these hard to fill vacancies had "no impact on their business operations". (p23).

In life sciences this is particularly pertinent because it is an international marketplace with intense international competition for the best scientists. Increasing the supply of high calibre technologists and professionals in the sector may however, have the adverse effect of driving more people to work abroad.

SEMTA reports (p7 Dec 09 – skills and the future...) that "less than one third of those graduating from any 'core' biological sciences courses entered work in Bioscience..." the report goes on to conclude that any problems relating to recruitment are "very unlikely to be resolved by attempts to increase the number of people on these (degree) courses: the answer is more likely to lie in the need to increase the attractiveness of work in that sector/occupation." (p7)

More men work in the sector than women by a significant margin – 62% men to 38% women. Semta p 13

Skills Gaps
Lack of experience is cited as the main reason for a skills gap in the workforce. (p26).

The report finds skills gaps in science related posts and asks how these might be resolved. However the multiple choice list (p 28) does not include short course options, seminars or conferences – all of which, one would have thought could be instrumental in bridging science skills gaps.

This is reinforced by the findings that many businesses have arranged for training in the past 12 months. Average cost per person trained was £645 (p39). In house and commercial training providers were the most common sources of training. (P44) – although a quarter have used FE and HE for specific (and perhaps publicly funded?) courses.

Interestingly, SEMTA continues to boldly state on its overview web-page of the sector that "39% of bioscience companies report hard-to-fill vacancies and 22% have skills shortages - five times greater than other sectors" (http://www.semta.org.uk/employers/science_bioscience/sector_overview.aspx)
This is in contrast to the most recent Labour Market research 2009 SEMTA/Cogent - bmg) which suggests that only 10% of all establishments in the sector have HFVs (page 18) - moreover on the question of hard to fill vacancies, 49% state that this has had no effect on the business operation (page 24). SEMTA is "in the process" of updating this web page the latest Labour Market Information.

Out of all provision only FE recorded some “very poor” performance. Interestingly, 54% believe that apprenticeships are useful to the sector’s needs, however when narrowed down to SIC 73.1 (Research and experimental development on natural sciences and engineering) most (52%) disagree that apprenticeships have any role to play. (P29/30)

Semta found that the key reasons for skills needs having changed are, not surprisingly, the development of new products and services and the introduction of new technology or equipment.

Graduates need industry experience and those that get it, make contacts that lead to employment. It is a natural progression. It would be interesting to look at intern programmes from Cambridge University out to local businesses: SMEs get free work, graduatess get experience and perhaps contacts are made there for future employment.

## 6. Conclusions & Recommendations

This report has highlighted the idiosyncracies of the life sciences sector and shown that there are a number of skills issues which need addressing.

The sector is highly skilled but this obscures the fact that many SME managers and innovators have little knowledge of the world of commerce. In larger companies this is not a problem because there are robust internal processes, support systems, and training options available to bright graduates. But in SMEs this skills deficiency can be a genuine barrier to commercial progress.

Equally, one should not assume that highly skilled means appropriately skilled, and there are many examples of companies employing PhD graduates to undertake quite basic technician tasks.

This report suggests that there are several areas of improvement which need addressing and offers the following recommendations:

- Continue to build on STEM subject uptake at undergraduate level;
- Gear education to industry earlier;
- Provide more information for students about the Industry and job roles;
- "Selling" the Greater Cambridge Cluster opportunities to students;
- Encourage increased collaboration between HE courses and Industry, resulting in more students with work experience, intern opportunities (free work) for industry;
- Academic Spin-outs – Useful for MSC/PhD/Post Doc work experience, sector research, innovation and university finances.
- Develop and deliver short courses, seminars, workshops focussing on commercial skills for those already in the industry.
- Beyond commercial skills – Working with One Nucleus, develop a programme of courses that help companies with regulation procedures, best ways to work with NICE for example, patent updates, and accessing funding.
- Ensure that non-technical, non professional roles are not left out of the skills equation for the sector
- Explore ways to match up the demand for technical craft level skills in the sector with available government funded supply of skills – with particular reference to the Higher Skills @ Work fund and adult apprenticeships.

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