Life Sciences & Pharmaceuticals:

A Future Skills Review with Recommendations to Sustain Growth in Emerging Technologies
Contents

Foreword
Invitation for Feedback
Executive Summary
1.0 Introduction and Scope
2.0 Strategic Overview
  2.1 The Emergence of Bioscience and Biotechnology
  2.2 Biotechnology-Driven Micro Scenarios
  2.3 Global Drivers of Change
  2.4 A New Industry Scenario
3.0 Strength in Depth - The UK Position
4.0 Sectors
  4.1 The UK Pharmaceutical Industry
    4.1.1 Insight – the Industry today
    4.1.2 Foresight – the Industry by 2020
    4.1.3 Summary and Recommendations – Pharmaceuticals
  4.2 Medical Technology and Biotechnology
    4.2.1 Insight – the Industry today
    4.2.2 Foresight – the Industry by 2020
    4.2.3 Summary and Recommendations – Medical Technologies
  4.3 The UK Health Sector
    4.3.1 Insight – the Sector today
    4.3.2 Foresight – the Sector towards 2020
    4.3.3 Summary and Recommendations - Health Sector
5.0 Skills Recommendations

Appendices

1. Life Science and Pharmaceuticals SIC Codes
2. Pharmaceutical Industry Factsheet
3. Pharmaceuticals Destinations, HESA 2008
4. Cogent Regional Factsheets
   4.1 North West of England
   4.2 South East of England
   4.3 East of England
Three Sector Skills Councils, Cogent, Semta and Skills for Health, have collaborated to produce this research report into the future of skills in the Life Science and Pharmaceuticals sectors. These are high-tech sectors with growth potential and challenges driven by rapid technological development in the next decade. The potential reaches beyond business and will significantly affect quality of life across the globe.

Our purpose was to bring together a view on skills across the sectors, from research to development and through manufacture to the end user: from concept to treatment. To do this, we have reviewed the skills capacity and capability of the Pharmaceutical and Medical Technology industries for evidence of skills shortages and gaps, and we have suggested recommendations that may inform policy development or targeted intervention to facilitate the flow of critical scientific and technical skills.

The research has been produced as a component of the first National Strategic Skills Audit of the UK Commission for Employment and Skills in 2010. It is one of six cluster reports focused on the emerging technologies identified in the New Industry; New Jobs and Jobs of the Future papers from Government during 2009.

The UK has significant strength in depth in the Life Science and Pharmaceuticals sectors. As industries that deal with people and their medical treatments, the businesses rely on more than just the technology, they rely on knowledge creation, innovation, quality assurance, safety, competence and the highest levels of regulatory compliance and ethical codes of conduct. At the heart of the matter is the appliance of science. We have therefore focused on the scientific and technical workforces, from the supply and demand of the skills to their development during the careers of employees in the industries.

This work is just a beginning. We plan to return to it and strengthen its futureskills scenarios. We believe a concerted approach is the way forward. Our recommendations take this slant and suggest joint venture with a wide range of stakeholders – Higher Education, Professional Bodies, Regions, National Skills Academies, the Office for Life Science, and the industries themselves. We plan to test these recommendations in the year ahead.

To close, I must thank our partner Sector Skills Councils for their contributions. In particular, Helen Lindsay (Semta, Manager Research), and Ian Wheeler (Skills for Health, Research Manager), and through them to their teams. Last, but not least, I must express my gratitude to colleagues at Cogent and to the Science and Research team in particular.

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An Invitation for Feedback

We would be pleased to hear from organizations with an interest in our recommendations. This will help us shape an action plan in the coming year.

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Executive Summary

Strategic Statement
Bioscience is, without doubt, destined to be the science of the twenty-first century. Couple the science of the century with the technology of the century - digital technology - and the stage is set for the emergence of medical biotechnology and a revolution in the science-based industries, their business models and the skills infrastructures that have maintained pharmaceuticals, life sciences and medical technologies at the forefront of healthcare systems in the developed world.

Life Sciences and Pharmaceuticals are strategic sectors in which the UK is a world leader. The Pharmaceutical industry invests more in R&D than any other business sector, increasingly in the area of medical biotechnology. The NHS, on the other hand, is one of the most mature and advanced healthcare services in the world. Covering the entirety of the UK population, its healthcare network, its skilled resource of healthcare scientists, its clinicians, and its vast patient databases, constitute a powerful platform for the development of new medical biotechnologies.

Further, the public sector, through the NHS and Higher Education, is not only the main provider and investor in specialist skills supply and scientific research, it is also the dominant purchaser of healthcare solutions.

These sectors, if nurtured and facilitated, can be engines of economic growth, provided the sectors can find new, collaborative ways forward and source the new high-tech skills in the right place at the right time.

• What new and/or changing factors will influence skill/employment demand in the future?

Societal factors will drive creative healthcare solutions across the economies of the developed and developing world. But in both instances, there is downward pressure on cost. In the latter, this will be due to weight of population and poverty; while in the former, public sector funds post-recession are predicted to be squeezed for some considerable time.

Notwithstanding the societal factors, technology-driven change for the industry has been in the pipeline for some time, for example the merger and acquisition activities in the Pharmaceuticals industry. This, and the new business paradigm that accompanies it, is the main driver of demand for skills.

Together, the public sector as funder/provider of skills and purchaser of healthcare, and the industry as the technological innovator/purchaser of skills and vendor of healthcare solutions, must fashion a new way of working together. In the UK, the strength of both parties is of great potential.

Skill Demand Drivers
• What are the factors driving the demand for skills?

Rapid assimilation of biotechnologies and competitive advantage are key drivers. In the Pharmaceuticals industry, for example, there is already evidence of a shift to 'generics' as the patent lifetimes of so-called the 'blockbuster' drugs of the twentieth century expire. This opens up competition from low-cost manufacturers. The response of the established industry has been to invest in assimilating new technology and fast-track knowledge transfer into new products, especially in the area of bio-pharmaceuticals. The factory of the future, a Pharmaceuticals scenario reported herein, will be a very different factory from that of today. The wider scope of biotechnology will also extend to include stratified medicine, synthetic biology and regenerative medicine, streamlined clinical trials, and, ultimately, a shift from the 'cure' to the 'prevention'. A new business paradigm may therefore be in payment-by-results for a biotechnological health management service, rather than for single-item solutions such as drugs or treatments. This will require a much wider, more interdisciplinary, and generally higher skill set drawn from the physical sciences, the life sciences and informatics.

Current Skills Needs
• What are current skill needs?

The industry employs approximately 150,000 people in Pharmaceuticals (70,000), Medical Technologies (50,000) and Medical Biotechnologies (30,000). The skills involved are predominately higher skills. For example, in the Pharmaceuticals industry over 70% of the workforce are at the Technical/Process Operator level or above. Typically, a large higher skilled workforce is supported by a significant technical workforce, and for manufacture, this is marked by a significant Process Operator workforce. Manufacturing and Research in the UK are intricately linked and strengthened by the local skills supply, the proximity of a significant supply-chain Chemical industry and the national demand from the Health sector. There is also a significant export market.

• What have been the trends in demand for skills?

Employment has been stable over the past decade. The Sector Skills Agreements of Cogent and Semta, underpinned by research, have demonstrated the vital importance of a secure supply of higher level skills from Higher Education, especially those in the physical and life sciences.

• What is the evidence of current skills mis-matches and deficit/surpluses in skills?

The research has established that the most critical, and hard-to-fill occupations, are those of the scientific and technical variety. In the Pharmaceutical sector, for example, the industry absorbs at least 1,000 graduates per year, of which 46% are from scientific backgrounds – mainly chemical and biological sciences. The split of this intake between graduate and postgraduates is 60% and 40% respectively. However,
the scientific and technical occupations are not only hard-to-fill, there is evidence that 25% of the graduates may be being directed to occupations that are lower than the indicative level of their qualification. This may be an artefact of the occupational classification as applied to the industry, but it requires further investigation.

The Sector Skills Councils hold evidence that the scientific and technical occupations are hardest to fill, and that employers articulate significant skill gaps in this workforce.

Future Skills Needs

- What is the likely demand for skills/employment in the future?
  In general skills will be higher and ‘wider’ (more interdisciplinary).

The scenarios developed in this report lead to the conclusion that the emerging technologies in the Pharmaceutical and Biotechnology sectors have significant growth potential, with new demand for new treatments and replacement demand for out-moded technologies and products. The age profile of the workforce suggests a significant workforce replacement demand due to retirement in the years leading to 2020 while the older technologies and products will naturally decline introducing ‘negative’ skills demand in the same period. The net effect is predicted to be stable employment overall, provided the UK retains capability in the emerging technologies.

The scenarios of section 2.4 give a clear indication of change in all spheres of the industry from R&D to manufacturing. The complexion of skills will change with increasing interdisciplinarity and the change in manufacturing processes will stimulate a requirement for significant workforce development.

Although future demand for employment is predicted as stable relative to 2010 levels, the skill profile will change significantly. This will be driven, not only by the new technologies, but by a paradigm in which there will be greater technical service working with the client Health sector to establish efficacy of treatment. These factors portend a period of skills inflation which will be reflected not only in the supply of skills from the education sector but also the need for upskilling of the workforce.

- What is the likely supply of skills/employment in the future?
  Projecting stable employment to 2020 alongside the skill gaps and shortages identified, raises concerns over the conclusion that higher level skills supply might just be sufficient for future demand (see below). It also emphasises the need to ensure that a secure vocational supply of the Technical and Process Operator workforce is addressed.

Comparable evidence for Technical and Process Operator roles is less precise, due to the lack of established destination data for vocational qualifications. There is, nevertheless, evidence of replacement shortfall in this area - in some sectors up to 50% the expected demand.

- Can supply meet future demand?
  Although the industries recruit significant numbers of the graduate supply each year, this is but a tiny fraction of the supply from Higher Education in a given year. Supply is therefore technically deemed to be sufficient to meet demand in this area. Simply raising the numbers of graduates in shortage or hard-to-fill disciplines would be a weak lever to activate, given the low gearing of supply to demand for a given sector. Accordingly, other interventions are necessary (see recommendations below) to improve security and quality of supply.

In the Pharmaceutical and Medical Technology sectors, it is likely that occupational levels will continue to require a higher skills complement relative to other sectors. Thus, a large proportion of the Technical workforce will be at graduate level. Some Process Operators will be highly skilled. And graduate skills in the workforce of today will become increasingly postgraduate in the industry of tomorrow. In the case of the latter, this skills inflation will exacerbate the hard-to-fill status of the scientific and technical roles and may tip these roles into a skills shortage situation.

Regardless of potential shortages, there will be significant skills gaps. This is to be expected for a rapidly changing sector. The influx of large volumes of newly skilled people, the need for greater interdisciplinary awareness, retirement replacement demand, and new project working models, will all have attendant workforce development demands.

Consequently, it is in workforce development that this report places a top priority for action to facilitate capability. In a strategic sector, where the UK occupies a prime position, workforce development should be afforded skills investment priority. Suggested interventions are detailed in the recommendations (below). They range from Higher Apprentices to technical Foundation Degrees and technical workforce Masters provision.

With the exception of highly specialized courses, workforce provision at the tertiary interface (level 3-4) in scientific and technical areas has become extremely weak since the demise of the Polytechnic system in the mid 1990’s. In the case of the chemical sciences, by way of example, only a handful of Higher Education Institutions are left offering such provision. This situation demands an intervention strategy.
Executive Summary

Geography

Regions of high concentration in the industry are the South East, the North West, and the East of England for the Pharmaceuticals sector. These regions employ, respectively, 24%, 21% and 12% of the total workforce. For the Medical Technologies sector the same regions are cited with the addition of the Midlands. The regions also coincide with clusters of population, density of discovery/venture companies, regional skills priorities, and the locations of providers of suitably qualified graduates from Higher Education.

Recommendations

The strategic actions already in train with the Office for Life Science are endorsed. This report focuses on workforce development of security of supply and quality of supply of relevant skills.

In addition, industry-tailored recommendations arising from this work are summarized below. Further details of the recommendations are given in Section 5, together with suggested organisations for inclusion. The Sector Skill Councils will take these recommendations forward, pending wider stakeholder feedback.

1. Future Skills Scenario Planning
   - An employer-validated scenario planning study of the workforce should be undertaken by the Sector Skills Councils and reported within a year. This should be facilitated under the auspices of the Office for Life Sciences.
   - The graduate level of recruitment should be monitored more closely and mapped to occupational roles.
   - Robust vocational destination analysis should be developed for industrial Technical and Process roles.

2. Information Advice and Employment Opportunity
   - Action should be taken to improve information, advice and guidance on career pathways.
   - Work experience opportunities for those considering employment in the sector should be facilitated.
   - Employer-recognised graduate ‘employability benchmarks’ should be developed.
   - Targeted technical Apprenticeships and Higher Apprentices should be facilitated.

3. Technical Skills Gaps and Workforce Development
   - Workforce-targeted technical Foundation Degrees (such as Working Higher, see Case Study, Section 4.1) and technical Masters in the fields of Biotechnology and Bioscience should be supported, funded/co-funded, delivered, and taken up by employers.
   - A network of technical Foundation Degree providers should be established in the priority regions to deliver a more employer-driven curriculum across the technical, the commercial and the regulatory. The skills funding mechanism should take account of the shared value of skills to the individual, the business and the local strategic position of the industry.
   - A ‘Bio Primer’ technical series in Industrial Biotechnology and Industrial Bioscience should be considered with industry and for industry. Specialist learning modules should be built around this series.

4. Technical Skills Shortages and Skills Supply
   - The scope for Masters preparation/conversion courses with an industrial internship for those considering a career in the industry should be considered.

5. Strategic Skills Investment
   - The Sectors Skills Councils and the National Skills Academies should consider if the proposals above could be furthered by wider partnerships and funding under the Joint Investment Scheme announced in the Skills for Growth White Paper.
   - The changes and skills developments must be embraced by the industry and facilitated by Government for the sector to be well-placed to retain its global premier status.

In Conclusion

The recommendations and actions will require stakeholder support and underpinning within the policy and funding structures in education and skills, and in accordance with the intent laid out in:

- the UKCES publication Towards Ambition 2020.¹
- the 2009 Skills White Paper Skills for Growth.²
- the 2009 Higher Education Paper Higher Ambitions.³

Government (BIS) and the skills bodies and stakeholder organizations listed should also consider the measures above to:

"stimulate increased provision and participation in strategically important skills areas, including significant skills shortages and emerging sectors and skills – significant private investment expected, but incentivised by price premiums to public funding to increase provider commitment and marketing"²

³ Higher Ambitions, HM Government, 2009
This report is produced by Cogent, Semta and Skills for Health, the Sector Skills Councils for, respectively, the pharmaceutical industry, the bioscience sector and the health sector. It has been produced as a component of the first National Strategic Skills Audit of the UK Commission for Employment and Skills in 2010. It is one of six cluster reports focused on emerging technologies, as identified in the New Industry; New Jobs and Jobs of the Future papers from Government.\(^4\)\(^5\) The Life Science and Pharmaceuticals cluster is one in which the UK has a strong presence and one which portends a transformational effect on the nature of employment and skills in the short and medium terms.

The report is the combined intelligence of the Sector Skills Councils (SSCs). As such it is underpinned by the existing labour market research on skills and is supplemented by literature research on recent publications at national and international level on the drivers and constraints that will shape the future of these industries. The research was conducted in parallel with an associated ‘Pharmaceuticals and Medical Devices’ report from the Institute of Employment Research (Warwick University) for the same National Strategic Skills Audit.

The Life Science and Pharmaceuticals industries are intricately interconnected and potentially extensive in their future skills outreach. The research therefore required scoping boundaries and has applied SIC (Standard Industry Classifications) codes, imperfectly, to achieve this as a first approximation.\(^6\) A major limitation of this approach, at least for categorization purposes, is that in a futures environment, the technology platforms used by industries do not necessarily equate to distinct sectoral boundaries. In the absence of absolute SIC demarcations, the following sectors have nonetheless been used to direct the research and to structure the report. While Life Science cuts across all, the sectors chosen for treatment approximate to the ‘footprints’ of the SSCs – mainly Cogent (24.41 and 24.42) and Semta (33.1 and 73.1). The report is accordingly structured around

- Pharmaceuticals (‘upstream’ SICs 24.41, 24.42)
- Medical Technologies (‘upstream’ SIC 33.1, 73.1)
- Health Care (‘downstream’ SICs various)

The first two are treated as the ‘upstream’ developments of the scientific and technological solutions; the third addresses the impact ‘downstream’ in the healthcare ‘client’ sector. Cross-cutting themes are sector interoperability, change diffusion, and the increasing accessibility and power of digital technology.

The report takes a structured approach to skills assessment.

In section 2 the strategic impact of biotechnological development and global drivers are developed from the existing literature. This provides the context of change and future potential.

Section 3 reviews the education and training supply, the research capability, the manufacturing capacity, and the policy environment around skills for life sciences. This gives an indication of the UK ability to respond to the changes emerging from the scenarios of section 2. This section also explores the potential for the UK to remain an attractive centre of excellence in a globally competitive arena.

Section 4 provides skills insight on the three named sectors as they stand today, and a perspective of future fit with emerging technologies.

Finally, section 5 draws out suggested recommendations in the areas of skills policy, in-depth skills research, skills supply and workforce development.

It should be noted that the geographical context of national labour market data used in this report has been limited, where practicable, to that for England and Wales. However, the projections and external reference positions are often unavoidably national (UK) or global. The projections and UK references are therefore without prejudice to policies of the devolved administrations of Scotland and Northern Ireland that may pertain to Life Sciences, the Pharmaceutical industry and the National Health Service.

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\(^6\) SIC listing in Appendix 1
2.0 Strategic Overview

Extract from: Life Science Blueprint, July 20097

The UK is a world leader in life sciences (pharmaceuticals, medical biotechnology, and medical technology). 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.

The UK ranks second in the world after the US and has established itself in future growth areas such as regenerative and stratified medicine. The pharmaceutical sector is the leading sector for investment in research and development (R&D), investing £4.5bn in R&D in the UK in 2007 alone, representing over a quarter of all UK business R&D. The UK medical biotechnology sector leads Europe in the number of drugs in all stages of clinical development. The medical technology sector is growing rapidly with the largest share in Europe at just over 2,000 companies, the majority of which are small and medium enterprises.

The NHS is a unique selling point for the UK, and has the potential to add significantly to the UK’s attractiveness as a base for life sciences, providing high-quality healthcare to all, and offering a competitive advantage with its vast patient databases for clinical trials and investigations. There is also a vital role for the NHS as a value-creator and an engine of economic growth, leading the way in the uptake of innovative medicines and technologies, deepening collaboration with industry, and helping the industry to flourish and grow. In turn, a flourishing life sciences industry will help generate the step-change innovation needed to maintain quality of services and productivity into the future.

However, the UK’s leadership position is threatened and the life sciences industry is facing a number of challenges which must be addressed if it is to fulfil its potential as a major driver of growth. The UK’s share of global patient enrolment in clinical trials has dropped from 6% in 2000 to 2% in 2006. The pharmaceutical sector is facing a patent “cliff”, equivalent to $140 bn in sales, as several blockbuster drugs come off patent over the next few years, and must in any case look to new business models to replenish its pipeline. For medical biotechnology companies, the continuing challenge in accessing finance places at risk the future pipeline of these innovative companies and has the potential to limit growth across this sector. In addition, business and leadership skills are vital to the commercial success of the SMEs that make up the majority of companies. Such skills are also crucial for medical technology companies, as is a mechanism for building relationships with clinicians within the NHS to support the development of new and innovative medical technologies.

This will, in short, change in many of the operating environments of the commercial Life-Science and Pharmaceutical sectors. Many of these are well documented but few reports have the integrated skills demand which is the main thrust of this report.

In order to arrive at an assessment of the skills impact, this report takes a strategic overview of the essential technology micro-drivers and global macro-drivers. This, together with an insight of the size and shape of the current workforce, underpins the conclusions as to the future skills complexion of the workforces.

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7 Life Sciences Blueprint, HM Government, Office for Life Science, July 2009
Bioscience is, without doubt, destined to be the science of the twenty-first century. In less than fifty years from the origin of modern bioscience, as marked by the seminal publication of Watson and Crick midway through the twentieth century,8 the elucidation of the chemical structure of Deoxyribosenucleic Acid not only revealed the means by which biological information could be encoded in a ‘four-letter’ molecular ‘alphabet’, it ushered the term ‘DNA’ into common parlance. Couple the science of the century with the technology of the century – digital technology - and the stage is set for the emergence of biotechnology and a revolution in the science-based industries, their business models and the skills infrastructures that have maintained pharmaceuticals, life sciences and medical technologies at the forefront of healthcare systems in the developed world.

With so much change on the horizon, it is not surprising that the foresight literature in these sectors is well-documented.9,10 Much information is available on: the advance of scientific knowledge through publications and commercial exploitation through patent activity;11,12 on new product pipelines through clinical trials;12 on business positioning through mergers and acquisitions;13 on the new business activity and innovation through IPOs (initial public offerings);14 and, on analysis of policy models that best direct and harness change.12

2.1 The Emergence of Bioscience and Biotechnology

Brief micro scenarios driven by the biotechnological developments which are most likely to impact on skills in the short and medium terms are summarised as follows.

Biologics

Today, scientific capability at the interface between biology and chemistry allows finely tailored chemical and molecular design of drugs to be realised through biological control. Hitherto the science involved processes that entailed intensive, multi-staged chemical processes. Where chemists once exclusively searched libraries of chemical reactions to produce drugs, chemists and biologists now access libraries of microorganisms to produce biopharmaceuticals or drug precursors by biological means. The medicinal products produced in this way are known as biologics.11 Production of vaccines are a further example of a biologic. This area will continue to develop as rapidly as it has done in recent years.

Diagnostics

Where ‘personalised medicine’ once meant the assessment of therapy for an individual, ‘personalised medicine’ in tomorrow’s healthcare system promises the certainty of diagnostics analysis with enhanced efficacy of treatment options offered at the level of the individual or groups (e.g. ethnic groupings) based on biomarkers and pharmacogenomics (detailed knowledge of drug efficacy or toxicity based on pharmacology and genetic variation). With an emphasis on in vitro diagnostics, risks are lower and regulatory constraints (and costs) will reflect this. This area is therefore predicted to develop rapidly.

Therapeutics

As the commercialisation of synthetic biology, stem-cell research and artificial genomes becomes commonplace, the advent of regenerative, replacement, predictive and preventive medicine will come to the fore and challenge the established business models of healthcare. The key areas of science that support this development forms the discipline of Systems Biology. This encompasses increased understanding and control of the structure, functions and molecular interaction within living organisms. The most important advances will be in proteomics, (cell structure), metabolomics (cellular chemical processes), and transcriptomics (gene expression). This area will develop at a slower pace than the others above, not only because of the complexity of the science, but also because experimental therapeutics are in vivo, involve higher risk and will be subject to greater scrutiny for legal, ethical and regulatory reasons.

11 The Bioeconomy to 2030: Designing a Policy Agenda, OECD, 2009
14 Diagnostics 2009, Moving Towards Personalised Medicine, Price Waterhouse Coopers
15 Biotech: Lifting Big Pharma’s Prospects with Biologics, Price Waterhouse Coopers, May 2009
2.2 Biotechnology-Driven Micro Scenarios

**Bioinformatics**

Bioinformatics is the application of information technology to molecular biology. As records are moved to digital format and this is coupled with enhanced media bandwidths, global communications and evermore powerful computers to facilitate construction and interrogation of terabyte-sized datasets, the nature of research, treatments and product development will alter at pace. This area will continue to develop rapidly as has been the case for all information technologies in recent decades. Existing regulatory structures on freedom of information, data protection and medical ethics will come to the fore for this area as pharmaceuticals becomes more integrated as a health management service for ‘personalised medicine’.

**Intellectual Property**

Intellectual property will be vital to innovation in future markets that will be more fragmented, more competitive and more specialised. Driven by the pace of change and the highly specialised requirements and development costs of biotechnologies, no single corporate is likely to bear all the risk of product development. It is therefore expected that relationships across the commercial interface will change. There will be greater scope for alliances between corporates and SMEs, an increasing trend to collaborative arrangements, patent pooling within business consortia and cost-benefit relationships between the developers of the biotechnology and the users who also control access to the population and regulatory frameworks. This will challenge national and global legal, ethical, statutory and regulatory frameworks.

2.3 Global Drivers of Change

**Societal**

A rising global population will drive creative healthcare solutions across the developed and developing world economies. Demographics and affordability will lead to increased healthcare demand but at reduced costs in both the developed and developing worlds.

In the developed economies the ageing population will lead to increased demand for healthcare, especially for the diseases of old age – diabetes, dementia, cancer, arthritis. At the same time, the decline in the proportion of the population at work will reduce tax revenues and reduce national healthcare budgets. This conundrum is also likely to be compounded for many years by national debt from the recession of the current decade.

In the developing world, rising educational attainment and lower costs will facilitate inward investment of high-tech industries. The large populations will be an important health market in the medium term as wealth rises in these countries, but the sheer burden of the population in some countries will limit the general affordability of high-tech medicines.

**Commercial**

As with the societal drivers, there are severe cost-reduction drivers at a time when investment in new products is required. This is compounded in the short-to-medium term by reduced access to financial products for investment in business development, such as the venture capital activities of the past decade.

The most important drivers are profitability, competitiveness and control of costs. This is best illustrated by the Pharmaceuticals industry where multinational corporates have dominated across the globe. The era of the blockbuster drug is closing; patent lifetimes are running out; and, the generics market is providing opportunities for more nimble pharmaceutical manufacturers to fragment market share. This creates: lower revenue per drug; threatens new drug development; highlights the extremely high overhead cost in research and development (skills, equipment, regulatory costs); and, exerts pressure for cost reduction overall.

At a time when potential new global markets are opening up, the industry is facing lower profit margins for existing inventory, fragmented demand, and niche demand, but in an increasing cost-sensitive and competitive market. But all global markets are experiencing this trend.
2.4 A New Industry Scenario

The scenario considered here is not dissimilar from the approach the software industry has adopted for survival in the global Information Technology sector: a highly lucrative but fragmented market, with many highly competitive enterprises, each differentiating by niche innovation and working with the customer-client to provide not just a product but a project-management service that ensures efficacy and customer satisfaction. The consequences for skills are far-reaching.

The existing business model (in Pharmaceuticals at least) is not sustainable. Without innovation driven by biotechnologies it will remain incapable of the alacrity required to produce the stratified treatments demanded by global markets and to make the most of future growth opportunities. But costs will remain high because of investment in skills, capital equipment for research and plant that are essential to sustain a value-added product. But the yield through the end product itself will reduce as the market will no longer bear current margins. The industry will change the way it operates in both R&D and manufacturing.

Biotechnology offers the innovation required for targeted markets with reduced risk and accelerated product pipelines. Diversity and differentiation underpinned by a shift to health care management service/technical service. Risk will be reduced for the manufacturer and consumer through biotechnology. Diagnostics will identify suitable treatments; biologics will produce the product candidates with high molecular specificity; bioinformatics will filter the most propitious candidates; and therapeutics will be modeled using dynamic virtual biosystems powered by a highly advanced systems biology capability so that only the most efficacious candidates are offered for clinical trials. Overall, the increased efficacy reduces risk and development costs. The more focused approach on the client means a greater degree of technical service support and engagement with the healthcare provider will be required.

There is already evidence of the commercial restructuring at the ‘front end’ of this scenario. Increasing mergers and acquisitions mark the end of the vertically integrated company and a shift to sourcing new expertise, innovative processes and intellectual property. Patent activity suggests that biologics is already taking hold. The longer term developments will probably bring further cost savings in return for greater market penetration through patent-pooling consortia, and collaborative and developmental engagements with national healthcare bodies that would have massive purchasing power and world-leading research expertise (such as the NHS in the UK). This will shift emphasis from payment by product to payment by outcome. This can only be achieved by a greater integration and marketing of the healthcare management service to underpin the product.

The regulatory process will also have to change to keep pace with innovation. There may be a move towards global regulation or, at least, a federal regulatory structure. Without this, rogue regulators may disrupt the market. There may be a shift away from the all-or-nothing regulation of today to a live-licensing system predicated on continuous monitoring of the efficacy of lower risk but experimental treatments supported by a technical service and rewarded by payment linked to outcome.

The Factory of the Future

Cogent recently hosted a scenario workshop with the industry and the ABPI to explore the concept of the ‘factory of the future’. The scenario considered the proposition that pharmaceuticals manufacturing as it currently exists in the UK is not sustainable. Even the record balance of trade for the industry in 2008 has not weakened this view, with most other indicators being pessimistic such as costs, pipeline of new drugs, patent expiries, investment decisions, intra-company competition for manufacturing investment.

In the current sector, primary manufacturing sites - those making the actual active pharmaceutical ingredient (API) – are predicted as most as vulnerable, followed by secondary sites, where formulation, tabletting, filling and packaging takes place.

The ‘factory of the future’ will mostly involve discovery (R&D), experimental scale-up, and the process-intensive manufacture of biological APIs (therapeutic proteins, monoclonal antibodies, recombinant DNA etc).

Discovery will be the business of small, science-driven biotech companies. The UK’s research base for biologics is second only to that of the USAIs and should assure a future for the discovery end of bio-pharma. Their products will be of low volume, e.g. 1-2 litres of fermentation liquor.

Scale-up and process-intensive manufacturing will be out-sourced to contractor manufacturers who will receive such products from a broad array of small discovery companies. The contract manufacturer volume per product will be low by current manufacturing measures - typically 1,000 litres of API. A key question will be: to what extent will such contract manufacturers, handling multiple, small-volume, very high-value API products, be based in the UK? An advantage is the proximity of the infrastructure of discovery companies and Universities, and the availability of specialist scientific and processing skills.

The contract formulation and manufacturing part of the supply chain will be supported by traditional filling and packaging companies whose output is the final medicines. In this way, the API is brought together with non-active ingredients and processed to make batches of medicines.

Regulatory trends, “personalized” therapy for the individual patient, and cheaper medicines will drive much leaner, real-time product release, and flexible manufacturing as the medicines are made and packed to order.
2.4 A New Industry Scenario

A Future for Life Sciences and Pharmaceuticals in the UK?

In terms of skills, the sector will become: increasingly high-tech; more diverse; more interdisciplinary in the shape of the workforce (especially between life sciences and physical sciences); dependent on highly skilled specialist capability; reliant on highly developed skills in research methodologies; more dependent on legal, ethical and regulatory methodologies; less dependent on sales and marketing and more dependent on supporting services that manage the process and outcomes of treatments.

Manufacturing will become more diverse, more flexible and more tailored. This brings considerable workforce development to the manufacturing sector, where autonomous teams of skilled people with an all-round understanding of the process support the supply of an ever-increasing range of drugs.

Overall there remains a profitable proposition for innovative biotechnology solutions and integrated services. For example, the current business model of the pharmaceutical industry rests on targeting the 10% of budgets that national healthcare providers typically allocate to drugs. The shift to a tailored healthcare service approach opens up access to compete for the much greater remainder of that budget and to offer value for money to the customer.

Such a period of change could be viewed as a key opportunity not to be missed by both the industry and the public sector to maintain the UK position as a leader in Healthcare, Bio-technology and Pharmaceuticals.

3.0 Strength in Depth - The UK Position

The UK is a global centre of excellence in the life sciences. What keeps global life science businesses investing in the UK is the access to top quality research, not only in life sciences and especially the chemical sciences, but the supply of premium graduates from the HE system, and access to research and teaching hospitals. However, competition from the US, Europe and Asia, will intensify.

This section reviews the UK policy framework in health skills and fiscal policy that will maintain the attractiveness of the UK for inward investment. Many of the policy positions have been published during 2009 and are in early stages of development.

New Industry, New Jobs

Published in April 2009, outlines a strategic approach to a number of emerging technology sectors that promise to reshape industries but demand high levels of innovation, skills and investment. Life Sciences and Pharmaceuticals is identified as one such sector. Through New Industry, New Jobs, the Government has marked a clear intent for a policy framework that will allow industry to lead. This entails: competitive policies; influencing markets strategically; and, targeted interventions to retain and develop strengths in high-value areas of global growth or rapid and fundamental technological change.

Jobs of the Future

Published in September 2009 (Jobs of the Future), underlines the value UK pharmaceuticals sector and the potential for transformation through bioscience. It raises: the potential of the NHS as an innovation champion; the work of the newly constituted Office for Life Science (below); and, the Life Science Blueprint. It has also announced a joint Higher Education-Industry forum that will help maintain and bolster the supply of high-calibre skilled employees into UK life science industries.

The Office of Life Science

The Office for Life Science is the embodiment of an integrated approach to industrial policy bringing together Government departments (Business Innovation and Skills; Health; and the Treasury) and industry, through four industry-chaired working groups: the NHS as an innovation champion; building a more integrated life sciences industry; access to finance and stimulating investment; marketing the UK life sciences industry overseas. The Life Sciences Strategy was published in July 2009, and sets out the following actions to stimulate investment and innovation in the UK Life Science sector:

- a Skills Forum to address skills gaps
- accreditation of bioscience degrees to ensure that graduates leave with the core mathematical and practical skills and competencies required by employers
- an “Innovation Pass” for innovative medicines on the NHS (£25m pilot)
- a Strategic Health Authority Delivery Group to improve uptake of innovative medicines and technologies, and engagement between industry and the NHS
- incentives such as payment-by-results for uptake of medical technologies in the NHS
- emphasis on research and clinical trials in the NHS Operating Framework
- a UK Life Sciences Super Cluster across industry, HE and the NHS
- £150m to leverage private investment to a £1bn and a 10-year venture capital fund
- a tax system that encourages innovative activity
- £18m ‘RegenMed’ programme for R&D partnerships
- £1m to promote the UK and NHS brand
3.0 Strength in Depth - The UK Position

The Skills Forum for life sciences brings academia, industry and the healthcare sector together to address the skills needs in the same way that the STEM High Level Strategy Group addresses concerns over science, technology, engineering and mathematics. The Forum will consist of two groups: a Skills Advisory Group and a Skills Board. The Advisory Group will have strategic and operational representatives from industry, academia and the life sciences sector. The Skills Board will have senior representatives from government, public sector funders, academia, industry and healthcare. The Forum will build on the skills gap analysis conducted by the Sector Skills Councils (Cogent, Semta, Skills for Health) and the Life Sciences industry.

Higher Ambitions

The Higher Education Framework was released under the Higher Ambitions banner in November 2009. The framework makes important reference to close engagement with business. Elements include:

- Developing with employers, Sector Skills Councils and the UKCES, the practical and analytical capability to collect, process and deploy intelligence on skills needs in key sectors and markets quickly and effectively
- Creating a Skills Funding Agency to ensure the skills system has capacity and funding available rapidly to support developments in areas of strategic importance to the economy
- Developing a rapid and more responsive approach to development of new qualifications and apprenticeship frameworks so that employers in strategic sectors can access accredited learning which meets their current and future skills needs
- Strengthening the employer voice on employment and skills, including through local and multi-area agreements and employment and skills boards, giving them leverage over provision in their areas to make it responsive to local needs while taking into account national and regional priorities
- Further integrating employment and skills policy so that those seeking jobs have the opportunity to move into those sectors that will drive future growth
- Ensuring universities have clear incentives to respond quickly to changes in demand
- Ensuring that public procurement, regulators and regulatory frameworks all make a full contribution to raising skills levels.

Innovation Nation

The government established the Technology Strategy Board (TSB) in 2005 to channel public funds into driving business forward in innovation areas and where there is future growth. This led to the 2008 White Paper Innovation Nation which aims to encourage closer ties between scientific and engineering researchers and industry/private investors to ensure economic benefit from ground breaking science. SMEs are able to access Innovation Vouchers through the Solutions to Business portfolio (Universities, RDA and TSB). Grant applications to research funding bodies from April 2009 will have to outline the economic impact of their research, which will be incorporated into the Research Excellence Framework (REF).

Higher Education

The HE system in the UK is a national asset. A world-class research base is the foundation of any high-tech industry. The HE system is recognised worldwide for its excellence in teaching and research, and many life sciences companies are built on the exploitation of this cutting-edge research.

The UK spends 0.6% of GDP on HE. There are 169 universities of which 133 are in England and 12 in Wales. They employ about 170,000 academic staff and have an income of over £21bn. The student population is approximately 2.3m – an increase of over 50% since 1994 - and a participation rate of 40% of young people. Almost 2m of the population is based in England with 130,000 based in Wales. Approximately 2m of the students are indigenous to the UK, leaving the balance as a large international influx of 300,000.

Biological sciences has by far the largest undergraduate population at 105,000. This is more than twice the size of the physical sciences undergraduate population at 50,000, and 50% larger than the engineering and technology undergraduate population at 71,000. When postgraduates are included the gap between these fields narrows: biological science (164,000), physical sciences (84,000), engineering and technology (140,000), subjects allied to medicine (301,000). In total 650,000 qualifications are awarded annually.

In the supply to HE, the number of students studying chemistry, biology and mathematics at ‘A’ level or equivalent has risen by 11.6%, 8.6% and 20.1% (respectively) over the last five years. Applications to study science technology engineering and mathematics (STEM) subjects at HE level are also increasing.

Higher Education Academy Subject Centres

The Higher Education funding councils maintain 24 subject centres devoted to developing graduate skills in HE (and HE in FE), working with employers, and networking. A number of these are of relevance to Life Sciences and Pharmaceuticals.

- UK Centre for Bioscience (University of Leeds)
- The Physical Sciences Subject Centre (University of Hull)
- Health Science and Practice Centre (King’s College, London)

Sector Skills Councils

The UK Commission for Employment and Skills funds Sector Skills Councils to champion workforce development, to undertake labour market research on employment and skills, and to develop national occupational standards. With regard to Life Science and Pharmaceuticals the key SSCs are:

- Cogent (Pharmaceuticals Industry)
- Semta (Bioscience sector)
- Skills for Health

4.1 The UK Pharmaceutical Industry

This section covers Standard Industry Classifications 24.41 and 24.42 (SIC 2003).

4.1.1 Insight - the Industry

• £52.5bn R&D spend by Pharmaceuticals & Biotechnology companies globally (2007)
• 98 of the 178 Pharmaceuticals & Biotechnology companies are US-based (2008)
• UK largest share (15 of 60) in European Pharmaceuticals & Biotechnology (2008)
• UK sales in 2007 for Pharmaceuticals increased by 4.7%
• Global sales in 2007 for Pharmaceuticals increased by 9.4%
• R&D accounted for 15.9% of UK sales in 2007
• Eight of the 25 top global R&D investors are pharmaceutical companies (2008)
• Two of the top eight Pharmaceutical R&D companies are UK firms (2008)
• Two UK companies spent 89% of the sector total, and 37% of the UK850 (2008)
• 30 Pharmaceuticals & Biotechnology companies in the R&D UK850 (2008)
• £7.9 billion invested in Pharmaceutical & Biotechnology R&D by 130 UK firms (2008)
• Pharmaceuticals & Biotechnology accounts for 37% of total R&D spend in UK (2008)
• Five companies account for 77% of investment in R&D by firms from the UK850 (2008)
• 56 Foreign-owned Pharmaceuticals & Biotechnology companies in the UK850 (2008)

The picture of the industry today supports the preceding scenarios: a large, skills-intensive workforce contributing significant added value per employee. But R&D costs are rising faster than sales, reflecting stringency in regulation leading to greater attrition rates of new products. This suggests that investment in R&D alone will not produce the innovative products required to sustain the industry at today’s levels.

The Industry in 2006 had an annual turnover of £15.68bn, with a Gross Value Added (GVA) of £7.45bn. This equates to an average GVA per employee of £109,000 compared to the UK average of £31,419. The turnover has increased by £6.4bn since 1998. GVA in the industry has also increased significantly in the same period (Figure 4.1).

Pharmaceutical companies in the UK spent £7.9bn on R&D in 2007 – an investment of around £20m every day. Well over a third of all UK industry-supported R&D comes from the pharmaceutical industry. The Association of British Pharmaceutical Industries note that of the major medicines sold in the UK, around half were developed in British laboratories.

Figure 4.1
Turnover for the Pharmaceuticals Industry from Econometrics 1997-2006

17 Cogent Pharmaceuticals Industry Factsheet, 2007 - http://www.cogent-ssc.com/research/Publications/factsheets/Pharmaceuticals_Factsheet.pdf  (Also, Appendix 2)
21 The R&D Scoreboard 2008, Pharmaceuticals and Biotechnology, Sector Summaries, HM Government
Analysis of the UK top 850 R&D companies in the UK illustrates that Pharmaceuticals is the number-one investor (Figure 4.2).23

The Workforce and the Geography
The Pharmaceutical Industry in the UK currently employs approximately 70,000 people in 600 companies (Figure 4.3). Approximately 28,000 of these are employed in R&D related activities. Total employment has remained stable since 1998.

Both Labour Force Survey and Annual Business Enquiry national data sources indicate that the workforce is characterized by a dominant proportion of senior management/professional skills (almost 50% at Level 4 and above) and a significant proportion of supporting technical skills (up to 35% at Level 3).17,22 In comparison to most manufacturing sectors, the industry has a large proportion of female staff - 44%. This is not untypical, though, for employment in Healthcare sectors.17,22

Regions of high concentration in the industry are the South East, the North West, and the East of England. These regions employ, respectively, 24%, 21% and 12% of the total workforce (Appendices 4-6). Data for each UK region and nation are published by Cogent.19

Figure 4.2
R&D Growth

Figure 4.3
Employment in the Pharmaceutical Industry 1995-200518,22

4.1 The UK Pharmaceutical Industry

Skills
In 2006/07 Cogent carried out its Sector Skills Agreement research into the Chemicals and Pharmaceuticals industry. The research found that, inter alia, technical skills were at a premium. Skills gaps were reported for Management and Leadership, Business Improvement Techniques and upskilling according to the Cogent ‘Gold Standard’. A need for large numbers of Apprentices was also identified. Standards and qualifications have since been developed and the formation of the National Skills Academy for the Process Industries was announced in 2008 to raise demand and deliver training through accredited providers.

In the Bioscience SSA of 2006, which also included the Pharmaceuticals sector, Semta reported skills gaps at management, scientific and technical levels. (Consistency noted between the two independent Sector Skills Agreement studies by both Cogent and Semta). In the case of ‘hard-to-fill’ vacancies, the most commonly cited scientific and technical skills in short supply were chemical, biological and medical sciences. These findings correspond very closely to those reported by Association of British Pharmaceutical Industry (see below). Further analysis of the Bioscience SSA is given in section 4.2 under Medical Technologies and Biotechnologies.

In terms of the supply of skills from HE, the Association of British Pharmaceutical Industry, the Biosciences Industry Association, and the Biosciences Federation have conducted surveys. Key Findings are skills shortages amongst potential recruits.

Figure 4.4
Hard-to-Fill Vacancies

Discipline groupings for which there have been hard-to-fill vacancies

<table>
<thead>
<tr>
<th>Discipline</th>
<th>No. sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological and Medical Sciences</td>
<td>19</td>
</tr>
<tr>
<td>Chemical Sciences</td>
<td>11</td>
</tr>
<tr>
<td>Engineering</td>
<td>11</td>
</tr>
<tr>
<td>Statistics/Mathematics</td>
<td>8</td>
</tr>
<tr>
<td>Biotechnology</td>
<td>5</td>
</tr>
<tr>
<td>Emerging disciplines</td>
<td>5</td>
</tr>
<tr>
<td>In Vivo Sciences</td>
<td>4</td>
</tr>
<tr>
<td>All Generic disciplines</td>
<td>22</td>
</tr>
<tr>
<td>Other</td>
<td>14</td>
</tr>
</tbody>
</table>

References:
24 http://www.process.nsaacademy.co.uk/
26 Sustaining the Supply of Skills in the 21st Century; the Association of British Pharmaceutical Industry, the Biosciences Federation, 2007; Skills needs for Biomedical Research, the Association of British Pharmaceutical Industry, 2008.
4.1.2 Foresight - the Industry by 2020

The scenarios of section 2.4 give a clear indication of change in all spheres of the industry from R&D to manufacturing. The complexion of higher level skills will change with increasing interdisciplinarity and the change in manufacturing processes will stimulate a requirement for significant workforce development. This is significant as, historically, the industry has shown stable employment for decades. This section assesses the effect of change on the size of the workforce and the skills of that workforce.

Working Futures27

The Working Futures report predicts demand for pharmaceuticals to continue to rise with an ageing and wealthy population but it does recognize strain on healthcare budgets with the prescription system increasingly using generic drugs and encouraging self-medication (over-the-counter-drugs). In the longer term, positive replacement demands are reported – of the order of one-third of the workforce in the decade 2007-2017.

‘The Factory of the Future’

A recent scenario workshop convened by Cogent and which included Semta and the ABPI, considered the skills development that will be needed for the workforce of the future in UK Pharmaceuticals manufacturing using the ‘factory-of-the-future’ scenario of section 2.4. The following requirement are predicted.

• All Manufacturing Sectors
  ◦ Employee Skills Passports recommended to record training and development. This will facilitate change and skills retention of skills during a transition period for the sector.

• Discovery Companies
  ◦ BIT/PAC (Business Improvement Techniques/ Performance and Competitiveness) have a role for the small business as the discovery businesses matures. They are predominantly staffed by PhD-level scientists and owner/entrepreneurs, many with limited overall business experience.
  ◦ Laboratory Technicians: The discovery companies recruit mostly from academia (PhD scientists), and these scientists do all the experimental work. Much more of the routine work could be done by suitably qualified lab technicians supervised by the scientists.

• Contract Manufacturers
  Manufacturings disciplines are highly relevant to this part of the supply chain envisaged for the future. A site will have 150-180 employees. As in current big pharma, the majority of the employees will be Operators, but will be very highly skilled and educated.
   ◦ Operators: Very highly skilled, some graduates (Level 3, 4 or even 5). Will need to be in-depth problem solvers, able to set up, and start up a production batch run, interrogate process information in real time, understand the underlying science (chemistry, biochemistry, chemical engineering). Products will frequently change as experimental materials are sent in from the labs of the discovery companies. The operators will also need to do some maintenance work. They will also be adept in IT (interrogation and maintenance).

   ◦ Fitters: Traditional fitters will be required but only a minimum. Currently they are a substantial part of the workforce.
   ◦ Electricians: Minimum number.
   ◦ Process Expert (Level 4 or 5): Chemical engineer, able to reconfigure processes for different products.
   ◦ Quality Control Assurance and Quality Control (Level 3): Finished products require analysis. To what extent QA and QC will be integrated into the Operators’ job is not clear.
   ◦ Stockroom and Warehouse Control: Minimum inventory and product made to order, real time release. Biological raw materials and products may require special conditions (cold store) and may have short shelf life.

   ◦ Filling and Packing: This will be machine-driven environment requiring traditional skill sets (Level 2 operators). But packing to order in a more automated, high-speed process will demand better technical skills (including routine maintenance) to minimise over- and under-fill and cost control. Lean manufacturing will be essential because of cost and time pressures. However, compared to the new contract manufacturing environment (above), the jobs will be repetitive in nature. Business Improvement Techniques/ 6 Sigma/Lean skills and training will be the norm. Qualified persons (Level 4 or 5) will be needed, as at present.

27 Working Futures 2007-2017, the UK Commission for Employment and Skills
**Workforce Stock and the Flow Predictions**

In 2008 Cogent published its first estimates of ‘stock and flow’ of employment in its sector. With ‘stock’ corresponding to current and projected levels of employment in the sector, the main outflow was taken as retirement and the main inflow was taken as new blood to the sector from university graduates, apprentices etc (taking other flows as static and small in proportion to these two). While the analysis covered all industries, the process is re-worked in this study taking account of the latest scenarios for the Pharmaceuticals sector.

Figure 4.5 portrays the workforce stock of 70,000 with 73% of employment in technical or higher occupations – outstripping all other sectors in the proportion of higher level skills employed.

Stock projections for the industry are dependent on the future scenario. While inflows and outflows in retirement and recruitment can be measured and predicted from historical trends, drivers of change in the industry requires scenario validation. For this report, a judgement of future stock requirement has been derived from the evidence available but has not been more widely validated.

This analysis uses a scenario in line with Working Futures. This projects sustained employment to 2020 and a significant net replacement demand of up to one-third of the 2007 workforce per decade due to age and market change.

Two dominant factors are considered to affect stock demand in this study:
1. emerging technologies and their effect on R&D (Skills Shortages)
2. a shift in manufacturing to the more nimble ‘factory of the future’ (Skills Gaps)

**Figure 4.5**

Stock by Occupation

The first, emerging technologies, will potentially re-focus research and will sustain higher level skills demand overall. However, the composition of higher level skills will change in a manner beyond the scope of this preliminary research. Mergers and acquisitions, alliances and collaborations will bring a new workforce, new expertise and new dimensions on skills, especially in biotechnology into the sector. This will be the area of skills shortages in recruitment for a new type of workforce.

The second, the factory of the future, will raise workforce development demand. Employees will be required to know and be experienced in more of the business value chain than just a single drug product. This too will be the area of skills gaps in the workforce.

In general, skills inflation is predicted for the dynamic decade ahead. The postgraduate proportion of professional occupations will increase; the technical occupations will require more graduate skills (e.g. Foundation Degree level) and other occupations will shift to Higher Apprentice level.

A replacement demand of one-third per decade is estimated to correspond to approximately 27,000 by 2020. The higher level occupational requirement is estimated to be 60% of this range (16,000); the technical occupations 25% (7,000); and, the process occupations 10% (2,700).
### 4.1 The UK Pharmaceutical Industry

#### Table 4.1
Pharmaceuticals Industry Graduate Supply (SIC03 24.41, 24.42)

<table>
<thead>
<tr>
<th>Scientific Employment</th>
<th>Scientists % intake 2008</th>
<th>Graduates % intake 2008</th>
<th>Supply by 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Sciences¹</td>
<td>28</td>
<td>13</td>
<td>2,000</td>
</tr>
<tr>
<td>Biological Sciences²</td>
<td>23</td>
<td>11</td>
<td>1,700</td>
</tr>
<tr>
<td>Pharmacology &amp; Toxicology³</td>
<td>15</td>
<td>7</td>
<td>1,000</td>
</tr>
<tr>
<td>Molecular Science⁴</td>
<td>6</td>
<td>3</td>
<td>500</td>
</tr>
<tr>
<td>Engineering⁵</td>
<td>5</td>
<td>2</td>
<td>300</td>
</tr>
<tr>
<td>Mathematical Sciences⁶</td>
<td>4</td>
<td>2</td>
<td>300</td>
</tr>
<tr>
<td>Subjects allied to Medicine⁷</td>
<td>3</td>
<td>1.5</td>
<td>230</td>
</tr>
<tr>
<td>Physical Sciences⁸</td>
<td>2</td>
<td>1</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>86%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>41%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6,180</td>
</tr>
</tbody>
</table>

Source: HESA 2008

Notes

An estimate of the current flow of graduates into the Cogent sector can be found through HESA destination analysis. Figure 4.6 illustrates. Cogent trend analysis has consistently shown that the total intake across the sector is 4,000 p.a. Of this, 45% is from the science and engineering subject areas, with the balance coming predominantly from the business, finance, management and information technology fields. As a whole, 75% is employed (at least initially) in the technical/associated professional levels or higher.

Appendix 3 provides the latest HESA data for the Pharmaceuticals industry. The data is in line with this consistent trend tracked previously by Cogent. The graduate intake in total is 1,300 (weighted relative to return rate). It is also noted that the science and engineering intake by the industry is a very small fraction of the total produced annually by HE, thereby indicating that simply increasing the numbers of students in these subjects, when there is distinct vocational demand, is a weak lever to direct supply to the industry. It is also noted that the regions of domicile of graduates do not precisely match the regional clusters although the South East and North West are prominent. This is more a reflection of the location of the provision than the employment.

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28 Higher Education in the Cogent Sector at a Glance, Cogent SSC, 2007
Table 4.1 illustrates the scientific graduate intake by the industry. Chemical and biological sciences dominate with a combined 51% of the scientific cohort. Pharmacology, toxicology and molecular sciences are closely related to these two disciplines and make up a further 21%. When disaggregated from the subject categories, the degree titles show the breadth of science and engineering required by the industry. The projected graduate supply at today’s rate would supply 15,600 of the predicted 16,000 replacement demand. However, the overall statistics may well disguise a shortage within the science disciplines that are reported as hard-to-fill.

The data suggests that the industry generally sources what it needs in graduates skill with a caution on the hard-to-fill scientific disciplines that are the foundation of future growth. It is noted that 25% of the overall graduate intake goes, at least initially, into lower occupational levels. The focal point of graduate skills is therefore one of graduate workforce development and CPD in a fast-changing industry.

There is a paucity of comparable data for vocational routes to the industry making analysis less precise for the technical and process occupations. A general analysis by Cogent SSC in 2008 explored the age profile of these levels and the inflow via apprenticeships and vocational qualifications.22 Large skills gaps were measured, with supply predicted to be insufficient to meet replacement demand. Apportioning the data to the Pharmaceuticals sector gives a shortage of 4,000-5,000 or up to 50% of the predicted replacement demand for technicians and process operators. It was further predicted that this deficit would increase significantly in the next decade. This coincides with the known lowest point in 16-18 year-olds in the general population.

Regardless of shortages there will certainly be significant levels of skills gaps. This is to be expected for a fast changing sector. The influx of large volumes of newly skilled people will bring with it demand for workforce development in a strategic sector where the UK has a prime position and one that should be protected through skills investment.

Taking account of the biotechnology scenarios of section 2, it is emphasized that roles will change gradually within 5 years and significantly within 10 years.

Future Labour Market Research

Labour Market Research in progress with the industry includes the Skills Oracle23 (Cogent - Dec 2009), the Bioscience Skills Balance Sheet (Cogent, Semta – Dec 2009) and Scenarios for Industrial Biotechnology (Cogent 2010). The Skills Oracle involves an established expert panel for the sector returning trend data on employment, skills and training, and future directions. It is planned to be the barometer for skills in the sector. These surveys, expert panels and scenario planning events will further enhance the voice of industry and underpin it with evidence on skills.

Figure 4.6

STEM Graduate Flow (HESA 2007), Cogent SIC (2005/06)22, 28, 30
4.1
The UK Pharmaceutical Industry

The UK has a world-leading Pharmaceuticals industry which, by most econometric measures, has an impressive impact for the UK economy. The industry is sustained by access to a supply of highly skilled graduates and postgraduates, quality research from Higher Education, a large ‘client’ National Health Service, and the proximity of a significant supply-chain Chemical industry.

The Pharmaceuticals industry employs 70,000 people in the development and manufacture of drugs. Over 70% of the employment is at the technical and professional levels. Regional concentrations are in the North West and the South East of England which together make up 45% of employment. The East of England is a further cluster region comprising 12% of the industry’s employment.

The industry will be entering a phase of prolonged change. Anticipating skills demand and developing robust data to underpin the preliminary analysis of this paper is a priority. An employer-validated scenario planning study should be undertaken and reported within a year. The study should use the model developed by Cogent Research with the Nuclear industry and the Office for Nuclear Development (DECC) but be overseen by the Office for Life Science (OLS) and report to the OLS Skills Forum. For a timeline to 2020 the objective should be to research what new skills are required, by when and to develop a stakeholder action plan.

The industry creates 1,000 new jobs per year for UK graduates, 45% of which are in sciences – mostly chemical and biological. Up to 30% of the science intake comprises small numbers (1-2% each) of highly specialized subject areas across life sciences and engineering, so that overall the profile of skills sourced each year by the industry is highly interdisciplinary, 60% graduate, and 40% postgraduate. While some posts are recorded as hard-to-fill, and surveys indicate skills gaps with the intake, in general the graduate level of recruitment may be just sufficient to meet the projected need but should be monitored. Also, vacancies may be increasingly hard to fill (and should be monitored). If there is a general step to increasing postgraduate intake, competition for these critical skills will be more intense. Industry and career awareness programmes have a role to play here.

Replacement demand in the technical and process occupations may be acute and routes to sourcing new supply will have to be addressed, perhaps through targeted and supported Apprenticeships. An industry reliant on higher level skills requires a significant and competent technical workforce to support both research and manufacturing. Recruitment data in this area is less robust, but from the age profile, shortages up to 50% of replacement demand are predicted for the technical and process occupations if the industry is to retain today’s employment levels. Robust vocational destination schemes should be developed to monitor a critical part of the workforce.

4.1.3 Summary and Recommendations - Pharmaceuticals

The UK has a world-leading Pharmaceuticals industry which, by most econometric measures, has an impressive impact for the UK economy. The industry is sustained by access to a supply of highly skilled graduates and postgraduates, quality research from Higher Education, a large ‘client’ National Health Service, and the proximity of a significant supply-chain Chemical industry.

Table 4.2
Typical Destinations for Science and Engineering Graduates within the Cogent Sector*

<table>
<thead>
<tr>
<th>Typical Job Titles:</th>
<th>2005-06 Cogent research shows</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Production Managers</td>
<td>• 8% of graduates from Cogent-relevant science and engineering subjects entered Management and Senior Official Occupations in 2005-2006</td>
</tr>
<tr>
<td>• Site Managers</td>
<td>• Manager and Senior Official occupations are typically level 5 positions</td>
</tr>
<tr>
<td>• Maintenance Managers</td>
<td></td>
</tr>
<tr>
<td>• Chemists, Physicists,</td>
<td>• 46% of graduates from Cogent-relevant science and engineering subjects entered Professional Occupations in 2005-06</td>
</tr>
<tr>
<td>Biochemists, Biologists</td>
<td>• Professional Occupations are typically Level 4 positions</td>
</tr>
<tr>
<td>• Mechanical Engineers</td>
<td></td>
</tr>
<tr>
<td>• Production &amp; Process Engineers</td>
<td></td>
</tr>
<tr>
<td>• Chemical Engineers</td>
<td></td>
</tr>
<tr>
<td>• Laboratory Technicians</td>
<td>• 21% of graduates from Cogent-relevant science and engineering subjects entered Associate Professional and Technical Occupations in 2005-06</td>
</tr>
<tr>
<td>• Engineering Technicians</td>
<td>• Associate Professional and Technical occupations are typically Level 3/4 positions</td>
</tr>
<tr>
<td>• Quality Assurance Technicians</td>
<td></td>
</tr>
</tbody>
</table>

* Defined by standard occupational classification (SOC)

The industry creates 1,000 new jobs per year for UK graduates, 45% of which are in sciences – mostly chemical and biological. Up to 30% of the science intake comprises small numbers (1-2% each) of highly specialized subject areas across life sciences and engineering, so that overall the profile of skills sourced each year by the industry is highly interdisciplinary, 60% graduate, and 40% postgraduate. While some posts are recorded as hard-to-fill, and surveys indicate skills gaps with the intake, in general the graduate level of recruitment may be just sufficient to meet the projected need but should be monitored. Also, vacancies may be increasingly hard to fill (and should be monitored). If there is a general step to increasing postgraduate intake, competition for these critical skills will be more intense. Industry and career awareness programmes have a role to play here.

Replacement demand in the technical and process occupations may be acute and routes to sourcing new supply will have to be addressed, perhaps through targeted and supported Apprenticeships. An industry reliant on higher level skills requires a significant and competent technical workforce to support both research and manufacturing. Recruitment data in this area is less robust, but from the age profile, shortages up to 50% of replacement demand are predicted for the technical and process occupations if the industry is to retain today’s employment levels. Robust vocational destination schemes should be developed to monitor a critical part of the workforce.

(c.f. Section 5 RECOMMENDATIONS 1 & 2)
The large turnover in people and the pace of technological change will drive a massive need for workforce development, especially in the biotechnologies that the Pharmaceutical industries are engaging with. Targeted Technical Foundation Degrees (such as Working Higher, see Case Study below), Higher Apprentices and Technical Masters in the fields of biotechnology and bioscience should be supported, developed and delivered. This could provide a continuous higher upskilling ‘seam’.

(c.f. Section 5 RECOMMENDATION 3)

With so much technology-driven change in the system there will be massive demand for workforce development - both reskilling, upskilling. The education system in science and engineering is well geared for supply, but vocational provision that caters for employer demand is comparatively weak. At the technical and higher levels, part-time provision for employers has shrunk drastically since the demise of the polytechnic system in the early 1990’s. Establishing a new network of Technical Foundation Degree providers in the priority regions could address this (see case study on Working Higher). With provision limited, the industry itself has developed a good training record but the scope of training required in future may become unsustainable. Accordingly, the industry would require reliable and accredited sources of training and education, a more mixed curriculum across the technical, the commercial and the regulatory, and a skills funding mechanism that recognizes the shared value of skills to the individual and the business. Also, the local and regional economy, and the strategic position of the industry should be factors for consideration of support.

(c.f. Section 5 RECOMMENDATION 3)

Given the pace of change, overcoming inertia to reskill is a key consideration. A ‘Bio Primer’ series in Industrial Biotechnology and Industrial Bioscience should be developed with industry and for industry. Specialist learning modules could be built around this series. The Sector Skills Councils and professional bodies should commission these, industry should inform/resource the development, the National Skills Academies should drive demand and deliver the modules through accredited training providers.

(c.f. Section 5 RECOMMENDATION 3)

The period to 2015 will be one of gradual change; that to 2020 may have significant change. The old economic model based on high R&D investment, patent protection, and high-margin manufacturing will be challenged. The high-cost high-value equation will no longer sustain the business model for either the industry or its health sector clients.

The skills mix in the future is likely to be higher, wider and more interdisciplinary. Research will be more niche, innovative, project-driven and reliant on new technology platforms. In manufacturing, the ‘factory of the future’ will be more flexible and responsive to technological innovation and a new client relationship. On the whole, for sustainability, there needs to be significant ‘ventures’ with Higher Education and with the Health sector so that timelines and costs for discovery, approval and efficacy are reduced. Reform in the NHS is required to facilitate this. The strategic role of the Office for Life Sciences is an excellent start. In general, this scenario portends a shift towards a value-added technical service for the industry. There will be significant skills inflation in the sector – technical occupations will require a higher proportion of graduate skills, while the professional occupations will become increasingly postgraduate relative to today.

Exploiting interdisciplinarity has been a feature of the Pharmaceutical industry. But this trend will intensify in the future as all discernable advances are at the interfaces of the sciences - and particularly at the interface between chemistry and molecular biology. Acquiring these skills will generate new challenges for employers, especially in those skill areas that are already recognized as hard-to-fill. The market for postgraduate skills will be more competitive as the pool is smaller and more sought after. Employers will have to offer attractive and fulfilling career opportunities. There may be scope for Masters preparation / conversion for those graduates considering a career in the Pharmaceuticals industry.

(c.f. Section 5 RECOMMENDATION 4)

Life Science and Pharmaceuticals is a strategic sector. The Sectors Skills Councils and the National Skills Academies should consider if the proposals above could be furthered by wider partnerships and funding under the Joint Investment Scheme announced in the Skills for Growth White Paper.

(c.f. Section 5 RECOMMENDATION 5)

The future for Pharmaceuticals is predicted as stable but dynamic: stable in employment but, within that employment, a shift in skills is required to support new biotechnology-driven products and services. The changes and skills developments must be embraced by the industry and facilitated by Government for the sector to be well-placed to retain its global premier status.

(c.f. Section 5 RECOMMENDATION 5)

Case Study – Technical Foundation Degrees

Direct action has been taken through Cogent’s Foundation Degree Framework, Working Higher.

Working Higher is designed to be a solution to workforce development needs by creating a flexible, work-based Foundation Degree Framework of which Bioscience is a key sectoral strand. Led by the University of Kent, the Bioscience Foundation Degree is aimed at the upskilling of existing staff in technical roles. Key to the success of the project will be the appointment of an Industry Champion for the bioscience sector who will work with the academic lead to ensure that the provision is fit for purpose and remains close to the needs of industry and their employees. This project is an important test of employer demand for HE provision in workforce development and the co-funding model for learning through work.

The flexible provision for learning through work, provided by Working Higher, will allow employers to better manage workforce development, will widen access for those in employment without prior HE experience and enhance employability for the future workforce.

Working Higher is a £3m Higher Education Funding Council for England (HEFCE) funded collaboration between Cogent, the University of Hull and the Higher Education Academy Physical Science Centre.
This section addresses two key life sciences areas beyond pharmaceuticals: medical technologies and biotechnology. While the Standard Industrial Classification (SIC) is challenged to adequately represent these areas, the relevant categories are:

- SIC 03 33.1: Manufacture of medical and surgical equipment and orthopaedic appliances, and
- SIC 03 73.1 (part of): Research and experimental development on natural sciences and engineering.

The most relevant of the different areas of science and technology R&D formally classified to SIC 73.1 are: biology research and experimental development and biotechnology (research).

It is impossible to reliably estimate the fraction of enterprises allocated to SIC 73.1 that work in biotechnology, but it is notable that, in terms of Higher Education leavers entering the science and engineering R&D sector, those from biological sciences are generally among the largest numbers, whether at first degree, taught Masters or PhD levels, as compared with other science and engineering subjects (see Bioscience Sector Skills Agreement (SSA) Stage 2 report). It is possible that between 25% and 50% of the overall science and engineering R&D (SIC 73.1) consists of biotechnology, whether in terms of number of enterprises, turnover or employment levels.

The medical equipment sector covers manufacturers of a broad range of medical devices and diagnostics - from bandages to computed tomography (CT) scanners; from laboratory (in vitro) diagnostics to implanted (in vivo) pacemakers. The industry also supplies (profitably) lower technology items such as mobility aids.

The R&D in science and engineering in the sector includes biotechnology companies whose products are intended for medical use and those designed for other applications and markets.

4.2.1 Insight - the Industry Today Econometrics - Medical Technologies

- £5.6bn sales (2007)
- £300m R&D spend
- £5.4bn exports (2008)
- £300m Trade surplus (2008)
- 2,100 manufacturing enterprises (2007)
- 47,000 employees (2007)

The Department for Business, Innovation and Skills (BIS) (and its predecessors, including the Department for Business, Enterprise and Regulatory Reform – BERR) have developed a wide range of metrics for the Medical Technology sector. These show, inter alia, a high level of international UK trade in the sector, a net balance of trade to the UK, and significant venture company activity (up to 2007). Measured by turnover for production of medical devices, the UK is a major force in Europe, although the profile shows less year-on-year growth than other major nations. As can be seen, Germany is by far the dominant country in Medical Technologies. (Figure 4.7)

The Medical Technology field is one of much start-up activity indicating that there is scope for many new products through translational innovation from other sectors such as automotive.

Figure 4.7
Production of Medical Devices 1999-2006

![Graph showing production of medical devices from 1999 to 2006 for France, Germany, and the UK]

Source: http://www.berr.gov.uk/files/file46588.xls

31Sources: ONS; BIS (BERR) R&D Scoreboard
4.2 Medical Technology and Biotechnology

Biotechnology

Science and engineering R&D (within which biotechnology activity is tracked) has shown strong growth of turnover and GVA over recent years, with employment growing more erratically up to nearly 100,000 in 2005. Productivity (in terms of GVA per employee) has also grown strongly, although, given its early stage in the commercialisation process, has generally run a little below unit employment cost. It ‘overtook’ unit employment cost in 2005, with a value of some £47,000. The area as a whole contributed a turnover over of some £12bn, and a GVA of £5bn, in 2007.

The UK hosts some of the largest specialised investment funds and has particular expertise, in relation to medical biotechnology, in neurosciences, oncology, infectious diseases, vaccines, monoclonal antibodies, tissue engineering and stem cell technology. Strategic leadership in this area has been taken up by the newly formed Office for Life Sciences (OLS) within the Department for Business, Innovation and Skills (BIS). For this reason, the review of biotechnology in this report signposts the action plan for life sciences published in the Office for Life Sciences report ‘Life Sciences Blueprint’.

A Skills Forum which includes Cogent, Semta and Skills for Health has been established by the OLS to drive the supply of skills and make it more responsive to employer demand.

In May 2009, the Government published its response to the ‘Review and Refresh’ update of the Bioscience Industry Association’s (‘BIGT’) report, Bioscience 2015. In relation to skills, key Government priorities refer to the wide circulation and implementation of the Semta Bioscience SSA.

The Workforce and the Geography

The most significant cluster is the ‘golden triangle’, around Cambridge, Oxford and London, but also the East of England, the Midlands and the North West of England. There is often a strong link in cluster regions to other science industries such as Pharmaceuticals.

Table 4.3 Medical Equipment and Biotechnology Enterprises (ABI 2007)

<table>
<thead>
<tr>
<th>England:</th>
<th>Enterprises (SIC 33.1)</th>
<th>Enterprises (SIC 73.1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North West</td>
<td>200</td>
<td>250</td>
</tr>
<tr>
<td>Yorkshire &amp; Humber</td>
<td>190</td>
<td>200</td>
</tr>
<tr>
<td>North East</td>
<td>50</td>
<td>100</td>
</tr>
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<td>170</td>
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<tr>
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<td>490</td>
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<td>720</td>
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<tr>
<td>London</td>
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<tr>
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<td>290</td>
</tr>
<tr>
<td>Wales:</td>
<td>80</td>
<td>120</td>
</tr>
</tbody>
</table>

32 Life Sciences Blueprint, HM Government, Office for Life Science, July 2009
4.2 Medical Technology and Biotechnology

Given the problems with SIC classification in relation to life sciences, evidence from official data can vary in comparison to other surveys. This is demonstrated by some variance between national data for SIC 33.1 and evidence produced from narrower, more focused, industry surveys. For example, data on the distribution of employment would suggest (ABI 2007) that employment is dominated (75%) by small enterprises of 10 employees or less, whereas the BERR Medical Technology Metrics indicates a much more significant skew towards medium and larger companies. Employment estimates are 98,000 in SIC 73.10 and 35,000 in SIC 33.10 (ABI 2007).

4.2.2 Foresight - the Industry by 2020

When medical biotechnology is taken into account, this is a significant market. However, as many countries in the world have the biomedical sector as an economic and social priority, the growth of competitiveness in the relevant international markets is of prime concern. The UK, with public sector strengths in health care, and sciences through Higher Education, and a globally recognized Pharmaceuticals sector, has a strong base for future development.

A general trend in the literature is for the employment in Medical Technologies but not Medical Biotechnology to be in decline but with net positive replacement demands due to the age profile from 2017 onwards, particularly in the higher skilled and more experienced occupations. Employment prospects in the sector will therefore depend on the rate of diffusion of innovation, a major factor of which can be the availability, and effective deployment, of relevant skills and skill sets within an organisation. In medical innovations facing a major public sector ‘client’ such as the NHS, interdisciplinarity in the workforce and awareness of and fluency in the underpinning science and engineering can be a key business factor.

Nevertheless, established subsectors are predicted with large growth: orthopaedics (20% p.a.) and dental implants (15 -20% p.a.). At the high end of the skills spectrum diagnostics are forecast overall to grow at around 6.7% p.a.

Skills

The Bioscience SSA, which included Pharmaceutical employers, identified opportunities for action by employers, working together with stakeholders and government in addressing these themes.

On the demand side, issues raised include:
- Greater scientific literacy in the population as a whole;
- Strengthened use of external directors, managers, advisers and mentors;
- Improved efficiency of clinical trials;
- Taking advantage of advanced genetic research techniques;
- Bioinformatics;
- Bio-processing;
- In-Vivo research skills;
- Practical skills;
- Strengthening of Good Laboratory and Manufacturing Practice;
- Postgraduate and graduate level skills;
- Chemistry skills;
- Skilled Technicians;
- Strengthening science education in schools;
- Strengthening vocational routes into Bioscience;
- Depth of degrees, progression and succession;
- Scientific research skills
- Cross sectoral skill needs and structural issues.

On the supply side it was noted that many of the courses of relevance to bioscience have suffered since the 1990s from a fall in the numbers of young people wanting to study highly technical subjects, not least since they are often perceived to be (too) difficult. There are some indications of corrections to this trend, particularly within schools, but the ‘appetite’ of the fast-growing sector for an increasing flow of good science graduates and post-graduates requires not just a reversal of falls, but healthy increases.

Employers within the Bioscience sector appear to recruit comparatively very low fractions of the First Degree graduates in relevant HE subjects – many good graduates go to work in other sectors. This suggests that effort to improve the attractiveness of employment in the sector is needed.

The main subjects of relevance to Bioscience companies are in the (official) categories of biological sciences, subjects allied to medicine, and chemistry, although not all fields within biological sciences and subjects allied to medicine are relevant.

36 Source: http://www.berr.gov.uk/files/file46588.xls
4.2
Medical Technology and Biotechnology

Within the relevant subjects, the specific courses of interest to Bioscience employers are those involving some time in industry, and, for joint Honours degrees, those whose second subject is appropriately complementary (rather than 'less mainstream').

In addition to the main science subjects, there is interest from some employers in new areas like bio-informatics and more engineering-oriented degrees in Chemical and Process Engineering. This depends on the particular product/market niche of the company.

In principle, it would be desirable to try to increase the comparatively small numbers of young people who choose science subjects at school and then science, technology engineering and mathematics courses at university. It is likely that the greatest influence Bioscience employers would have in contributing to tackling this problem is as part of the existing national programmes.

Within the Vocational Education and Training provision system, there are a number of relevant courses. While not all newer provision has yet found strong take-up by employers, the SSCs will work with employers to examine how those achieving on these courses might be able to provide good candidates in certain occupational areas. First steps will be to strengthen support and commitment for the emerging National Occupational Standards (NOS).

Considerable refinement and improvements have been made over recent years to science learning provision in schools. Cohorts of those choosing relevant GCSE, A Level and equivalent courses have recently been growing, but the challenge of encouraging more good young people to take such subjects continues.

The supply of requisite skills from the formal education system - not just for current demand, but for the required innovations for the industry of tomorrow - are expected to be available. Figure 4.8 demonstrates the supply from Higher Education of the order of 300,000 p.a. across all relevant and critical science and engineering areas. Those arriving in the sector are but a fraction of the workforce population. The issue then becomes one of sourcing the appropriate skills and attracting the best applicants in competition with other sectors.

In response to the demand and supply priorities the Bioscience Sector Skills Agreement grouped the Action Plan for Bioscience Skills around Four Themes:

**Figure 4.8**
First degrees relevant to medical devices industry

![Graph showing number of graduates in various fields from 2004/5 to 2006/7](http://www.berr.gov.uk/files/file46588.xls)
4.2 Medical Technology and Biotechnology

1 Leadership and Entrepreneurship: Viewed as a significant area of opportunity and improvement for the sector, not only in the large companies, but also in the smaller biological laboratories where often technically competent and academically strong young entrepreneurs require improved support and business acumen/skills to grow and develop the business. There is a need to encourage leadership at a regional/local level in partnership and through existing clusters and networks in order to develop a critical mass of influence.

2 Networks and Clusters: Networks and Clusters are viewed as a critical enabler and cluster development is central to the growth of bioscience and has been supported by the government since the 1999 Sainsbury report. Skills are an important component of successful clusters, along with proximity to suppliers and markets. Delivery of provision will be more successful if pursued through the clusters and networks already developed.

3 Image and Attractiveness: To help the public at large have a better informed understanding of science generally (science literacy) and bioscience as a consequence of improved general education and a more balanced representation of information in the public domain i.e. industry take a more participative role in this area. Encourage young people aspire to a career in science and engineering. Increase the number of adults employed in other sectors to consider bioscience as an attractive and rewarding sector when retraining and up-skilling as a consequence of redeployment and/or career advancement.

4 A Top Quality Workforce: Closing the skills gap by increasing the supply of quality people. Identify ‘core’ subjects and activities within the curriculum, i.e. the STEM subjects and a focus on practical skills. Within these themes, key priority areas of focus are as follows:

1. Apprenticeships: Apprenticeships are under utilised by the Bioscience sector and these could be used more in the future. This could free up graduate resources for work that draws more on their broader, deeper knowledge.

2. Practical Skills: Improve practical skills as an integrated component of the education system at all levels (School through to HE).

3. Short Courses: Promote and develop a responsive system – to design short courses to address emerging specialist areas and upskilling requirements for the existing workforce.

4. Career Pathways: Enable young people to aspire to a career in science by establishing a clear set of career pathways .

5. Use of National Occupational Standards: Qualification developers should utilise a number of existing and emerging Competence Standards that could be of value to Bioscience employers and these should be explored.

4.2.3 Summary

The Medical Technologies and Biotechnology sectors will continue to depend, for their ability to innovate and remain globally competitive, on recruitment and effective deployment of advanced technical skills. This will continue in most cases to mean graduate recruitment, but recent reviews, including in the context of the implementation of the Bioscience Sector Skills Agreement, have resulted in growing recognition of the potential value of technician skills in this work to provide effective support for the professional scientists and senior researchers.

The recommendation of the Bioscience SSA concerning Networks and Clusters, Image and Attractiveness, and the Top Quality Workforce are particularly pertinent to the recommendations suggested by this report. (c.f. Section 5 RECOMMENDATIONS 2-4)

The Skills Forum of Office of Life Sciences will continue to support employer responses to the changing nature of global markets, through improved procurement and utilisation of strategic skill-sets. (c.f. Section 5 RECOMMENDATIONS 1 and 5)

4.3 The UK Health Sector

The Office for Life Science recently published its “Blueprint for Life Sciences” and recommendations for the sector. These are endorsed by this report. Accordingly, the following section is more of a commentary on the current skills trends and opportunities in the sector.

Historically, the fates of the Health, Life Science and Pharmaceutical sectors have been interdependent. Today, they are arriving at a critical point in their development. The breadth of activity engaged in by the National Health Service (NHS) could be a powerful constituency in which to accelerate innovation and translational research, especially in the emerging biotechnologies.

The UK occupies a strong position of a large public Health sector and a highly regarded public Higher Education sector. Both provide the skills, the knowledge, and the demand for life sciences.
4.3 The UK Health Sector

4.3.1 Insight - the Health Sector Today
The NHS is the world’s largest centralised healthcare system and accounts for about 8% of the UK medical technology market. Clearly, access to the NHS is seen as vital to companies’ success.

In 2009, there were 2.1 million people working in the sector - around 7% of the UK workforce. It is estimated that just over two thirds of these (72%) work in the public sector, i.e. the NHS, and just under one third (28%) work in the independent sector. A small but not insignificant proportion of just over 1% are estimated to work in the voluntary sector.

The workforce grew significantly from 1998 to 2008 in tandem with an increase in public funding from around £40bn to £100bn. The NHS has been responsible for much of the growth, but there has been significant stimulation of growth in the private sector as well.

During this period of growth the Health sector can be seen to have performed well on a number of broad measures of skills and skills utilization. However, the much-vaunted NHS University did not materialise.

The Health sector boasts a highly qualified workforce. This is undoubtedly due to the number of professions. Nevertheless, it is believed the sector could perform better in the development of intermediate and junior roles, many of which would be located within ‘Agenda for Change’ bands 1-4. There are low levels of skills shortages and gaps compared to the rest of the economy. It also has a high ‘stock’ of quality and management initiatives and one of the highest levels of High Performance Working Practices (1) in the UK.

Drivers for change

Costs Drivers
In the short term, the affordability of publicly funded healthcare will be tested to an extent that the increases in spending witnessed in the past ten years are unlikely prevail for the foreseeable future.

People Drivers
In the longer term, drivers include: an ageing population, a rising incidence and prevalence of people with long-term conditions (diabetes, dementia, cancer, arthritis, obesity, alcohol-related conditions); and, growing expectations of patients.

As a mass employer itself, the sector will be impacted by the ageing workforce, with almost a third of the workforce being lost to retirement between 2007 and 2017.

Science and Technology Drivers
Historically, the Health sector has maintained a close relationship with the Life Science and Pharmaceutical sectors. And it is evident that innovations from these sectors can arise rapidly and with far-reaching consequences for health provision and the skills of its workforce.

4.3.2 Foresight - the Sector towards 2020
Reform of the Health Sector
As the workforce accounts for over 70% of spending in the Health sector, attempts to reform the service will need to have workforce development and planning at its heart.

Overcoming inertia to change will be a major task for such a large organisation.

“In workforce policy between 1997 and 2006 was dominated by doing more of the same rather than doing things differently. This approach is not sustainable in the much more challenging financial times that lie ahead and it may well be that issues such as productivity and skill mix at last receive the attention they deserve.”

Innovating and Diffusing New Knowledge and Practice
It is commonly assumed that large centralised organisations struggle to embrace innovative practice. In light of this, Government has sought to encourage innovation:

“The Healthcare Industries Task Force (HITF) and Strategic Implementation Group (SIG) focused on ways of encouraging the NHS to introduce beneficial new medical technologies more quickly and spread their use more widely through patient services.”

Healthcare Costs
With the drugs bill for the NHS having more than quadrupled from £2.5bn in 1991 to £11bn today, the NHS will look to achieve better deals with its suppliers. In 2009, the King’s Fund applied Institute of Fiscal Studies data to create a series of possible scenarios to 2017 on NHS finance. The stark conclusion was that to deliver the same degree of service, productivity gains of at least £21.6bn would be required. Even in the independent sector, the effect of the economy has been direct and the first fall (in real terms) in spending witnessed in the last 30 years has occurred in 2009. It is therefore reasonable to assume that the drive for employers across the whole sector – public, independent and third – will be on achieving sustainable efficiency savings over the coming years to maintain financial balance and high quality patient care.

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See references for further details.

25 National Employer Skills Survey 2007
26 Skills for Health: UK Employer Perspectives Survey 2008
27 Working Futures 2007 - 2017, the UK Commission for Employment and Skills
28 The Healthcare We Want: A Debate on the Future of Employment and Skills in the Health Sector, Skills for Health, 2009
4.3 The UK Health Sector

Skills Developments to Facilitate Innovation

Tasking the NHS as an ‘innovation champion’ is a prime thrust of the Office of Life Science (reviewed in section 3.0 of this report). Those occupational areas which could have greatest impact on innovation are now highlighted.

Strategic Management

The Health sector operates a planned workforce economy. As a result workforce planners will need to have reform central to their strategy. In this regard, they will also need to work closely with those who commission services and, in line with the Darzi recommendations, link the design of the workforce to the new patient pathways.

Healthcare Scientists

Healthcare scientists are likely to be a major part of the interface with the Pharmaceutical and Medical Devices sectors in the future. This will be a particularly valuable resource for the continuation of translational research in the commercialisation of new technologies in the biomedical area.

The healthcare scientists in the NHS, including the Health Protection Agency and the National Blood and Tissue Authority, represent the largest group of scientists in a single employment sector in the UK. According to ‘Our NHS; Our Future’, healthcare scientists in the NHS cover up to 50 scientific disciplines including biology, genetics, physiology, physics and engineering. The professions have a crucial role in:

- providing complex and specialist diagnostic services, analysis and clinical interpretation
- offering direct therapeutic service and support
- introducing technological advances
- undertaking research, development and innovation
- providing performance, quality assurance, risk management and clinical safety design in complex environments with sophisticated equipment
- teaching, training and specialist consultancy
- clinical advice services to other clinicians

Notable precedents for such interaction involve developments in MRI and CT scans.

It may be advantageous to innovation if healthcare scientists developed management and leadership skills.

Health Informatics

A wide variety of roles are likely to be affected by information technology, including knowledge and information management, health records, patient administration and clinical informatics. In the future, a much broader range of personnel will be involved in the management and understanding of healthcare information in order to improve health and healthcare delivery.

4.3.3 Summary – the Health Sector

The Life Science industry has the potential to be a major driver of growth.

The public sector is the largest single user of life sciences and pharmaceuticals through the NHS. It is also the priority supplier of skills, through Further and Higher Education. And it is a significant sponsor of knowledge creation through research in Higher Education Institutions. The UK bio-economy thus offers businesses in the Life Science and Pharmaceutical sectors a fertile environment in which to establish their innovative biotechnology credentials and grow new global markets with new UK jobs for the future.

The Government has embraced this potential and created the Office for Life Science to take facilitative actions and to ensure the NHS becomes an innovation champion, and with it secure the UK lead international position in Life Sciences and Pharmaceuticals.

Key drivers are costs, technology and skills. Technological change and cost pressures will create a new paradigm for the health industries. This will drive new skills and new working across disciplines. Greater numbers of health professionals will be involved in projects with the Pharmaceuticals and Medical Devices sector. Opportunities to apply research methodologies will be more widespread. Increasing use of large databases will raise demand for data management skills and training in ethical and regulatory matters. Interdisciplinary awareness and capability will be at a premium, although scientists in the Health sector have traditionally been exposed to the interfaces between the sciences.

Although the Health sector, the Pharmaceuticals sector and the Medical Technology sector may have a greater level of integration or collaboration they will be competing for similar skills on the job market. (c.f. Section 5 RECOMMENDATIONS 1-2 and 5)

41 Our NHS Our Future, HM Government, Department for Health, 2007
42 Health informatics career framework - Informing Healthcare and Connecting for Health, Skills for Health, 2009 Health informatics career framework (HICF) Informing healthcare and connecting for health
43 Functional Map for Health Informatics Skills for Health, 2004
5.0 Skills Recommendations

Life Sciences and Pharmaceuticals are amongst the most high-tech, value-adding sectors of the modern global economy. They secure employment in the UK for a large, highly skilled workforce. And they make a major contribution to exports and wealth generation for the UK.

Biotecnologies will strategically affect innovation and growth in Life Sciences and Pharmaceuticals globally. The UK skills system in this field is world-class and is a major factor in retaining inward investment in R&D. The sector is already R&D and skills intensive, and will remain so in the future but will become more diverse with a growing emphasis on treatments compared to prescription, and payment by results. This will drive greater engagement across research, manufacture and healthcare. The ‘factory of the future’ will focus on a more diverse portfolio of treatments; the workforce will need greater awareness of the value chain; the research companies, institutions and hospitals will need greater supply of specialists with increasing interdisciplinary diversity. The NHS will have a premium role as an innovation champion across the piece.

To secure the future of Pharmaceuticals and Biotechnologies in the UK, a policy framework that facilitates skills supply, workforce development, and investment in innovation is critical. The formation of the Office of Life Science followed by the publication the Life Science Blueprint communicates a strong UK policy position and options for intervention focused on research, investment in innovation, and collaboration with the public sector, especially equipping the NHS with the skills and culture to cope with the new environment around biotechnology. All skills actions in the Life Science Blueprint are endorsed. But little attention has been given to workforce development. The following recommendations address this.

Recommendation 1 - Future Skills Scenario Planning

1.1 Anticipating skills demand and developing robust data to underpin the preliminary analysis of this paper is a priority. An employer-validated scenario planning study should be undertaken and reported within a year. The study should use the model developed by Cogent Research with the Nuclear industry and the Office for Nuclear Development (DECC) but be overseen by the Office for Life Sciences (BiS) and report to the Skills Forum. For a timeline to develop, the National Skills Foundation, the Office of Life Science followed by the publication the Life Science Blueprint communicates a strong UK policy position and options for intervention focused on research, investment in innovation, and collaboration with the public sector, especially equipping the NHS with the skills and culture to cope with the new environment around biotechnology. All skills actions in the Life Science Blueprint are endorsed. But little attention has been given to workforce development. The following recommendations address this.

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1.1 Anticipating skills demand and developing robust data to underpin the preliminary analysis of this paper is a priority. An employer-validated scenario planning study should be undertaken and reported within a year. The study should use the model developed by Cogent Research with the Nuclear industry and the Office for Nuclear Development (DECC) but be overseen by the Office for Life Sciences (BiS) and report to the Skills Forum. For a timeline to 2020, the research should indicate what new skills are required by then, and should develop a stakeholder action plan.

(Action: Cogent, Semta, Skills for Health, NSA for the Process Industries, NSA for Manufacturing, the HEA Subject Centres for Physical Science and Bioscience).

1.2 The graduate level of recruitment may be just sufficient to meet the projected needs but should be monitored. Also, vacancies may be increasingly hard to fill (and should be monitored). In addition, destination data for Technical and Process roles is less robust than for graduate roles. Robust schemes should be devised.

(Action: Cogent, Semta, Skills for Health)

Recommendation 2 - Information Advice and Employment Opportunity

2.1 The level of recruitment in sciences may be just sufficient to meet the projected needs and shortages may be increasingly hard to fill. Industry and career awareness programmes have a role to play here and should be activated. Action should be taken to improve information, advice and guidance on career pathways and work experience opportunities for young people considering employment in the sector or courses of study should be facilitated. Employer-recognized Graduate Employability Benchmarks should be developed by the Sector Skills Councils.

(Action: Cogent, Semta, Industry, the Office for Life Science, the National HE STEM Programme).

2.2 Replacement demand in the Technical and Process occupations may be acute. Resourcing new supply must be addressed, perhaps through targeted and supported Technical Apprenticeships and Higher Apprentices.

(Action: Cogent, Semta, NSA for the Process Industries, NSA for Manufacturing, Regional Development Agencies, BIS)

Recommendation 3 - Technical Skills Gaps and Workforce Development

3.1 The large turnover in people and the pace of technological change will drive a massive need for workforce development. Workforce-targeted Technical Foundation Degrees (such as Working Higher), Higher Apprentices and Technical Masters in the fields of Biotechnology and Bioscience should be continued/developed, expanded, supported, funded/co-funded, delivered and taken up by employers. The Sector Skills Councils should build these into a continuous upskilling ‘seam’ for the workplace.

(Action: Cogent, Semta, Industry, the Office for Life Science, HEFCE/HEFCW, the NSA Process Industries, the National HE STEM Programme, the HEA Subject Centres for Physical Science and Bioscience).

3.2 With so much technology-driven change in the system, there will be massive demand for workforce development - both reskilling, upskilling. The education system in science and engineering is well geared for supply, but vocational provision that caters for employer demand is comparatively weak. At the technical and higher levels, part-time provision for employers has shrunk drastically since the demise of the Polytechnic system in the early 1990’s. Establishing a new network of Technical Foundation Degree providers in the priority regions could address this. From Sector Skills Agreement work with the Sector Skills Councils, industry has articulated a preference for accredited sources of training and education, a more mixed curriculum across the technical, the commercial and the regulatory, and a skills funding mechanism that recognizes the shared value of skills to the individual and the business. Where possible, the local economy and the strategic position of the industry should also be taken into account.

(Action: Cogent, Semta, industry, the NSA Process Industries, the HEA Subject Centres for Physical Science and Bioscience, Professional Bodies, Regional Development Agencies).

3.3 Given the pace of change, overcoming inertia to reskill is a key consideration. A ‘Bio Primers’ series in Industrial Biotechnology and Industrial Bioscience should be developed with industry and for industry. Specialist learning modules should be built around this series. The Sector Skills Councils should commission these, industry should inform/resource the development, the National Skills Academies should drive demand and deliver the modules through accredited training providers.

(Action Cogent, Semta, Skills for Health, industry, the NSA for Process Industries, NSA for Manufacturing, the National HE STEM Programme, the HEA Subject Centres for Physical Science and Bioscience, the Association of British Pharmaceutical Industry, the Bioscience Industry Association, Professional Bodies).
5.0 Skills Recommendations

**Recommendation 4 - Technical Skills Shortages and Skills Supply**

4.1 All discernable advances are at the interfaces of the sciences - and particularly at the molecular interface between chemical science and biological science. Acquiring these skills will generate new challenges for employers, especially in those areas that are already recognized as hard to fill. The market for postgraduate skills will be more competitive as the pool is smaller and more sought after. Employers will have to offer attractive and fulfilling career opportunities. There may be scope for Masters preparation/conversion for those considering a career in the Life Sciences and Pharmaceuticals industry.

*(Action: Cogent, Semta, the Office for Life Science, HEFCE/HEFCW, the HEA Subject Centres for Physical Science and Bioscience, the Association of British Pharmaceutical Industry, the Bioscience Industry Association, Professional Bodies).*

**Recommendation 5 - Strategic Skills Investment**

Life Science and Pharmaceuticals is a strategic sector. The Sectors Skills Councils and the National Skills Academies should consider if the proposals above could be furthered by wider partnerships and funding under the Joint Investment Scheme announced in the Skills for Growth White Paper.

*(Action: Cogent, Semta, NSA for the Process Industries, NSA for Manufacturing, Regional Development Agencies, BIS, others)*
Appendices

1. Life Science and Pharmaceuticals SIC Codes

2. Pharmaceutical Industry Factsheet

3. Pharmaceuticals Destinations, HESA

4. Cogent Regional Factsheets
   4.1 North West of England
   4.2 South East of England
   4.3 East of England
## Appendix 1
### Life Science and Pharmaceuticals – Licensed SIC03 Codes by SSC

<table>
<thead>
<tr>
<th>SIC03</th>
<th>Pharmaceuticals</th>
<th>Life Sciences</th>
<th>Medical Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Drug development, testing, approval, manufacture and administration</td>
<td>Life sciences not elsewhere specified</td>
<td>Bioinformatics, diagnostics, therapeutics, medical biotechnology, devices</td>
</tr>
</tbody>
</table>

**Cogent**

- **SIC Codes**
  - 24.41 Manufacture of basic pharmaceutical products
  - 24.42 Manufacture of pharmaceutical preparations
  - 24.66 Manufacture of other chemicals products not elsewhere specified

**Notes:**
- R&D in Pharmaceuticals industry generally integrated within industry SICs

**Semta**

- **SIC Codes:**
  - 73.1 Science & Engineering Research and Development

**Skills for Health**

- **SIC Codes:**
  - 86.101 Hospital activities
  - 86.210 General medical practice activities
  - 86.220 Specialists medical practice activities
  - 86.230 Dental practice activities
  - 86.900 Other human health activities

**Notes:**
- NHS as a catalyst for innovation and the development of new therapies and drugs for use and development. The SIC that follow tend to cross the three areas of debate.
- Practitioner skills and culture to be continually developed. NHS as an employer of medical scientists.
- Medical practitioners as informatics experts as well as medical experts.
Appendix 2
Cogent Pharmaceutical Industry Factsheet

The Pharmaceuticals Industry includes:
- Basic pharmaceutical manufacture
- Pharmaceutical preparations manufacture

The industry produces everything from antibiotics to the contraceptive pill and develops products that treat many common illnesses and ailments from allergies and infections through to asthma and diabetes. It also continues to pioneer new treatments for many serious and life-threatening diseases including cancer and heart disease. In short, this is an industry that enhances and, in some cases, prolongs, many lives all around the world.

The pharmaceuticals industry is also responsible for the safety and effectiveness of the products it manufactures. Products go through rigorous tests and trials.

In 2005, pharmaceutical companies in the UK spent £3.3 billion on pharmaceutical research and development – that’s an investment of around £9 million every day. Indeed, around a quarter of all UK industry-supported research and development comes from the pharmaceutical industry.

It is also an industry that needs highly skilled people. There are many and varied careers on offer. Career development in the pharmaceutical industry is well respected and the companies which make up the sector are committed to investing in their people, as it is through their employees’ skills and talents that they are able to be innovative and compete internationally.

### Economic picture of the Pharmaceuticals Sector

<table>
<thead>
<tr>
<th>Industry</th>
<th>Turnover</th>
<th>GVA</th>
<th>GVA per employee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Totals</td>
<td>£15.68bn</td>
<td>£7.45bn</td>
<td>£109,530</td>
</tr>
</tbody>
</table>

### Industry details

- The UK Pharmaceuticals industry is 4th globally in world trade balance
- The Pharmaceuticals industry accounts for 1% of UK GVA
- UK pharmaceutical exports (2006): £14.6 billion
- UK spend on medicines as a proportion of GDP: 0.94%
- UK sales share of the world’s top 100 prescription medicines (2003): 20%
- UK market share of new medicines (2003): 17%
- Pharmaceutical R&D expenditure in the UK (2005) = £3,308 million
- R&D accounted for 34.2% of sales in the UK Pharmaceuticals industry (2004)
- UK has 2 corporations in the global top ten with a 10.5% global market share

---

2GVA is the difference between the value of goods and services produced and the cost of raw materials and other inputs which are used up in production.

For further information please email research@cogent-ssc.com or visit www.cogent-ssc.com
Appendix 2
Cogent Pharmaceutical Industry Factsheet

The Pharmaceuticals Industry Workforce

<table>
<thead>
<tr>
<th>Workforce Distribution</th>
<th>Occupation Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Employers ¹</td>
<td>Managers and Senior Officials</td>
</tr>
<tr>
<td>Number of Employees²</td>
<td>Professional Occupations</td>
</tr>
<tr>
<td>Age of workforce</td>
<td>Associate Professional and Technical</td>
</tr>
<tr>
<td>16-24</td>
<td>Administrative and Secretarial</td>
</tr>
<tr>
<td>25-34</td>
<td>Skilled Trades Occupations</td>
</tr>
<tr>
<td>35-44</td>
<td>Sales and Customer Service Occupations</td>
</tr>
<tr>
<td>45-54</td>
<td>Process, Plant and Machine Operatives</td>
</tr>
<tr>
<td>55+</td>
<td>Elementary Occupations</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>* Remaining 1% Personal Service Occupations</td>
</tr>
<tr>
<td>White</td>
<td></td>
</tr>
<tr>
<td>Non-white</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>* Industry estimates can exceed ABI employee data due to contractor workforce and SIC limitations</td>
</tr>
<tr>
<td>Female</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td></td>
</tr>
</tbody>
</table>

The Skills Gap

Skills Gap in the Pharmaceuticals Industry

There is an over supply of people qualified at S/NVQ level 1 and below compared to the number of jobs at that level in the Pharmaceuticals Industry.

Elementary occupations only account for 7% of the overall workforce.

There is a 12% SURPLUS at S/NVQ level 1 and below.

There is an under supply of people qualified to S/NVQ level 2 and 3 compared to the proportion of jobs at those levels in the Pharmaceuticals Industry.

Level 2 and level 3 occupations account for 44% of the Pharmaceuticals Industry.

There is a 21% DEFICIT at S/NVQ levels 2 and 3.

Standard Industrial Classification (SIC) Listing

The Pharmaceuticals Industry by SIC code: 24.41 24.42

¹Labour Force Survey January 2006 - December 2006
²Cogent Industry Estimates
³Office of National Statistics - Standard Industrial Classification (SIC) 2003

Sources: LFS, ABI, NESS, ASHE, Cogent Research
Appendix 3
HESA Destinations to the Pharmaceuticals Industry

- SIC03 24.41 – Basic Pharmaceuticals
- SIC03 24.42 – Pharmaceutical Preparations


Figure 1

STEM Graduates Entering Employment in the Pharmaceutical Industry by Subject Area 2007/2008

<table>
<thead>
<tr>
<th>Subject Area</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular biology, biophysics &amp; biochemistry 5%</td>
<td></td>
</tr>
<tr>
<td>Mathematics 3%</td>
<td></td>
</tr>
<tr>
<td>Analytical chemistry 1%</td>
<td></td>
</tr>
<tr>
<td>General engineering 2%</td>
<td></td>
</tr>
<tr>
<td>Microbiology 2%</td>
<td></td>
</tr>
<tr>
<td>Pharmacy 7%</td>
<td></td>
</tr>
<tr>
<td>Pharmacology 7%</td>
<td></td>
</tr>
<tr>
<td>Biology 14%</td>
<td></td>
</tr>
<tr>
<td>Chemistry 22%</td>
<td></td>
</tr>
<tr>
<td>Other 29%</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2

Graduates Entering Employment in Pharmaceuticals 2007/2008

- Total 956* (Number of Graduates)
- Non STEM 54%
- STEM 46%

*1275 weighted for 75% return

Figure 3

Number of Graduates Entering Employment in the Pharmaceutical Industry in 2007/2008

- Total 956*
- First degree 64%
- Postgraduate 32%
- Other Undergraduate 4%

*1275 weighted for 75% return
Appendix 3
HESA Destinations to the Pharmaceuticals Industry

Figure 4
Graduates Entering Employment in Pharmaceutical Industry by Region 2007/2008

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of Graduates</th>
</tr>
</thead>
<tbody>
<tr>
<td>London</td>
<td>166</td>
</tr>
<tr>
<td>South East</td>
<td>159</td>
</tr>
<tr>
<td>East Midlands</td>
<td>114</td>
</tr>
<tr>
<td>Yorkshire and the Humber</td>
<td>103</td>
</tr>
<tr>
<td>North West</td>
<td>87</td>
</tr>
<tr>
<td>Scotland</td>
<td>67</td>
</tr>
<tr>
<td>West Midlands</td>
<td>58</td>
</tr>
<tr>
<td>East</td>
<td>48</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>42</td>
</tr>
<tr>
<td>North East</td>
<td>41</td>
</tr>
<tr>
<td>Wales</td>
<td>36</td>
</tr>
<tr>
<td>South West</td>
<td>36</td>
</tr>
</tbody>
</table>

Number of Graduates

Figure 5

- Male: 45%
- Female: 55%

Total 956
(Number of Entrants)

*1275 weighted for 75% return

Figure 6

<table>
<thead>
<tr>
<th>Subject Area</th>
<th>Number of Graduates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic pharmaceuticals</td>
<td></td>
</tr>
<tr>
<td>Pharmaceutical preparations</td>
<td></td>
</tr>
<tr>
<td>Chemistry</td>
<td></td>
</tr>
<tr>
<td>Business studies</td>
<td></td>
</tr>
<tr>
<td>Pharmacology, toxicology &amp; pharmacy</td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td></td>
</tr>
<tr>
<td>Management studies</td>
<td></td>
</tr>
<tr>
<td>Molecular biology, biophysics &amp; biochemistry</td>
<td></td>
</tr>
<tr>
<td>Forensic &amp; archaeological science</td>
<td></td>
</tr>
<tr>
<td>Psychology</td>
<td></td>
</tr>
<tr>
<td>Marketing</td>
<td></td>
</tr>
<tr>
<td>Others in subjects allied to medicine</td>
<td></td>
</tr>
<tr>
<td>Human resource management</td>
<td></td>
</tr>
<tr>
<td>Computer science</td>
<td></td>
</tr>
</tbody>
</table>

Number of Graduates

Figure 7

- Full-time paid work (including self-employed): 89.7%
- Work and further study: 8.0%
- Part-time paid work: 2.3%
- Voluntary/volunteer work: 0.4%

1275 weighted for 75% return
Appendix 3
HESA Destinations to the Pharmaceuticals Industry

Figure 8
Comparison of Employment Proportion 2007/2008

- Full-time paid work only
- Part-time paid work only
- Voluntary/unpaid work only
- Work & further study
- Further study only
- Assumed to be unemployed
- Not available for employment

Figure 9
Total STEM Students by Region 2007/2008

- South East: 37939
- London: 35697
- Scotland: 28361
- North West: 23131
- Yorkshire and the Humber: 21505
- West Midlands: 21340
- East Midlands: 17781
- South West: 15982
- North East: 13962
- Wales: 12139
- East: 10306
- Northern Ireland: 4518
Appendix 3
HESA Destinations to the Pharmaceuticals Industry

Figure 10
Top 10 Universities with Highest Employment in Pharmaceutical Industry
2007/2008

- The Open University
- The University of Nottingham
- University of Ulster
- The University of Greenwich
- The Nottingham Trent University
- The Manchester Metropolitan University
- The University of Warwick
- Sheffield Hallam University
- London Metropolitan University
- The University of Portsmouth

Number of Graduates

Figure 11
Comparison of Student Population 2007/2008
4.1 North West of England

England – North West

Cogent in the Region

The Cogent Industries are strategically important to the North West Region:

- Cogent industries account for 8% of the North West total turnover and 7% of the region’s GVA.
- Chemicals, Pharmaceuticals and Nuclear are priority industries for the region as identified in the North West Regional Economic Strategy.*
- 13% of Cogent employers are based in the North West.
- North West regional initiatives are focusing on enhancing Manufacturing and Advanced Engineering skills which are vital to the sustainability of Cogent industries.
- National Skills Academy Nuclear will be based in the region from January 2008.

*www.nwda.co.uk/publications/strategy/regional-economic-strategy-200.aspx

The region has a dominant cluster of Cogent industries:

Sellafield, Springfields, Capenhurst, Windscale and Calder Hall nuclear facilities are all located in the North West as well as the Headquarters of the Nuclear Decommissioning Authority and many supply chain companies. The Shell Stanlow Petrochemical complex is situated in the Wirral with an associated storage and distribution network. The chemical, pharmaceutical and polymer industries are spread across the North West. Hydrocarbons (oil, natural gas and petroleum) are produced and petroleum) are produced in areas of the Irish Sea, including Morecambe and Liverpool Bays.

More information on Regional and Industry Research can be found at: www.cogent-ssc.com/research

Cogent Sector Headlines

- £156bn turnover
- £49bn GVA
- 6.5% of UK GVA
- 12% of UK manufacturing workforce
- 7% of UK manufacturing enterprises

Cogent Headline Figures

Key Economic Indicators

<table>
<thead>
<tr>
<th>2006</th>
<th>Cogent NW</th>
<th>Cogent UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turnover</td>
<td>£18.85bn</td>
<td>£156bn</td>
</tr>
<tr>
<td>Cogent GVA</td>
<td>£5.3bn</td>
<td>£49bn</td>
</tr>
<tr>
<td>Cogent GVA per Employee*</td>
<td>£68,463</td>
<td>£98,394</td>
</tr>
<tr>
<td>Number of employees</td>
<td>77,600</td>
<td>500,000**</td>
</tr>
<tr>
<td>Mean weekly pay***</td>
<td>£459.00</td>
<td>£381.50</td>
</tr>
</tbody>
</table>

**UK GVA average per employee £31,419
*Industry estimate of total Cogent employment 206,300
**Annual Survey of Hours and Earnings 2006
***Annual Business Inquiry 2006

The North West industries account for:

- 12% of Cogent sector total turnover
- 11% of Cogent sector total GVA

Cogent Workforce

Employers by Size Band

<table>
<thead>
<tr>
<th>Size Band</th>
<th>1-10 Employees</th>
<th>11-49 Employees</th>
<th>50-199 Employees</th>
<th>200+ Employees</th>
<th>% of Total Employers</th>
<th>Total Employers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cogent – North West</td>
<td>63%</td>
<td>24%</td>
<td>10%</td>
<td>3%</td>
<td>13%</td>
<td>2,400</td>
</tr>
<tr>
<td>Cogent – Great Britain</td>
<td>68%</td>
<td>23%</td>
<td>7%</td>
<td>2%</td>
<td>100%</td>
<td>18,500</td>
</tr>
<tr>
<td>Regional Economy</td>
<td>82%</td>
<td>14%</td>
<td>3%</td>
<td>1%</td>
<td>100%</td>
<td>242,100</td>
</tr>
</tbody>
</table>

Source: Annual Business Inquiry 2006

For further information please email research@cogent-ssc.com or visit www.cogent-ssc.com
Appendix 4
Cogent Regional and National Factsheets

Cogent Workforce
Regional Employment by Industry

<table>
<thead>
<tr>
<th>Industry Category</th>
<th>NW Employees</th>
<th>GB Total</th>
<th>NW Regional % of GB Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemicals Manufacturing and Processing</td>
<td>23,000</td>
<td>108,300</td>
<td>21%</td>
</tr>
<tr>
<td>Pharmaceuticals Manufacturing</td>
<td>12,400</td>
<td>57,600</td>
<td>21%</td>
</tr>
<tr>
<td>Polymers Manufacturing and Processing</td>
<td>26,500</td>
<td>179,200</td>
<td>15%</td>
</tr>
<tr>
<td>Manufacture of Refined Petroleum Products</td>
<td>1,900</td>
<td>10,100</td>
<td>19%</td>
</tr>
<tr>
<td>Oil and Gas</td>
<td>*</td>
<td>28,000</td>
<td>1%</td>
</tr>
<tr>
<td>Nuclear (inc direct supply chain)</td>
<td>19,500**</td>
<td>49,500</td>
<td>39%</td>
</tr>
</tbody>
</table>

Key issues for the Cogent industries in the North West:

- **10% SURPLUS** of the workforce qualified to Level 1 and below
- **10% DEFICIT** of the workforce qualified to Level 2
- **8% DEFICIT** of the workforce qualified to Level 3

**Cogent Sector Skills Demand**

The proportion of vacancies reported in the Cogent sector is lower than the UK average by 3%. Hard-to-fill and skills shortage vacancies are also lower than the UK average.

**INTERNAL SKILLS GAPS** are 6% higher than the UK average.

**Cogent Sector Training**

The proportion of companies who have trained their staff in the previous 12 months is 8% higher than the UK incidence of training. Nonetheless, there remains an ambition to further increase training.

**Table:**

<table>
<thead>
<tr>
<th></th>
<th>Cogent</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of companies reporting vacancies</td>
<td>15%</td>
<td>18%</td>
</tr>
<tr>
<td>Proportion of companies reporting ‘hard-to-fill’ vacancies</td>
<td>6%</td>
<td>8%</td>
</tr>
<tr>
<td>Proportion of companies reporting a skills shortage vacancy</td>
<td>3%</td>
<td>6%</td>
</tr>
<tr>
<td>Proportion of companies reporting internal skills gaps</td>
<td>22%</td>
<td>16%</td>
</tr>
<tr>
<td>Proportion of firms who have provided funding for staff training within the previous 12 months</td>
<td>72%</td>
<td>64%</td>
</tr>
<tr>
<td>Of those firms which provided training, the proportion of staff trained</td>
<td>62%</td>
<td>68%</td>
</tr>
</tbody>
</table>

Source: Annual Business Inquiry 2005 (regional data rounded and is only Great Britain)

* Data suppressed

**National Skills Academy Nuclear, 2007 estimates

**Current Workforce: The Cogent Skills Gap**

**Graph:**

- **Skill level of Employee**
- **Skill level of Job**

Current Workforce: The Cogent Skills Gap

Source: Labour Force Survey Q2 2006 - Q2 2007

**Business Size of the Cogent Sector in the North West**

<table>
<thead>
<tr>
<th>Business Size</th>
<th>NW</th>
<th>GB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-99 employees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-49 employees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-249 employees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>250 or more employees</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.2 South East of England

England – South East

Cogent in the Region

The Cogent industries are strategically important to the South East Region:
- Cogent industries account for 3% of South East total turnover and 4% of the regions’ GVA.
- 29% of Cogent Employers are based in the region due to the concentration of retail fuels sales.
- The Regional Economic Strategy focuses on the high concentrations of world class companies and high-tech sectors present in the region.
- The South East has a lower proportion of its working age population with no skills than any other UK region.

The region has a dominant cluster of Cogent industries:
The pharmaceutical industry in the region is at the forefront of international R&D. Kent accommodates four of the world’s top ten pharmaceutical companies – Abbott, Glaxo Wellcome, Pfizer and Rhone-Poulenc Rorer. Bio-pharmaceutical is also a major and cutting edge activity in the SE. The South East has the largest European onshore oil field at Wytch Farm along with the largest refinery in the UK at Fawley Southampton. This refinery is linked to a significant petrochemical complex. The UK’s major airports are in the South East requiring significant quantities of jet kerosene fed by refineries or storage farms. The LNG plant at Isle of Grain will become a significant input point for Natural Gas into the national grid. For the polymer industry there is a cluster of companies on the Isle of Wight applying composite materials for producing wind turbine blades and aerospace applications. More information on Regional and Industry Research can be found at: www.cogent-ssc.com/research

Cogent Headline Figures

Key Economic Indicators

<table>
<thead>
<tr>
<th>Year</th>
<th>Cogent SE</th>
<th>Cogent UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turnover</td>
<td>£11.8bn</td>
<td>£156bn</td>
</tr>
<tr>
<td>Cogent GVA</td>
<td>£4.4bn</td>
<td>£49bn</td>
</tr>
<tr>
<td>Cogent GVA per Employee*</td>
<td>£75,680</td>
<td>£98,394</td>
</tr>
<tr>
<td>Number of employees</td>
<td>58,200</td>
<td>500,000**</td>
</tr>
<tr>
<td>Mean weekly pay***</td>
<td>£830.20</td>
<td>£381.50</td>
</tr>
</tbody>
</table>

Source: Annual Business Inquiry 2005
*UK GVA per employee £11.419
**Industry estimate of total Cogent employment 506,000
***Annual Survey of Hours and Earnings 2006

Workforce Distribution

- Female
- Male
- Temporary
- Permanent
- Part time
- Full time

The South East industries account for:
- 8% of Cogent sector total turnover
- 3% of Cogent sector total GVA

Cogent UK Sector Headlines

- £156bn turnover
- £49bn GVA
- 6.5% of UK GVA
- 12% of UK manufacturing workforce
- 7% of UK manufacturing enterprises

Employers by Size Band

<table>
<thead>
<tr>
<th>Size Band</th>
<th>1-10 Employees</th>
<th>11-49 Employees</th>
<th>50-199 Employees</th>
<th>200+ Employees</th>
<th>% of Total Employers</th>
<th>Total Employers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cogent – South East</td>
<td>69%</td>
<td>23%</td>
<td>6%</td>
<td>2%</td>
<td>29%</td>
<td>5,400</td>
</tr>
<tr>
<td>Cogent – Great Britain</td>
<td>68%</td>
<td>23%</td>
<td>7%</td>
<td>2%</td>
<td>100%</td>
<td>18,500</td>
</tr>
<tr>
<td>Regional Economy – All Sectors</td>
<td>85%</td>
<td>11%</td>
<td>3%</td>
<td>1%</td>
<td>100%</td>
<td>374,200</td>
</tr>
</tbody>
</table>

Source: Annual Business Inquiry 2005

For further information please email research@cogent-ssc.com or visit www.cogent-ssc.com
Appendix 4
Cogent Regional and National Factsheets

Cogent Workforce
Regional Employment by Industry

<table>
<thead>
<tr>
<th>Industry Category</th>
<th>SE Employees</th>
<th>GB Total</th>
<th>SE Regional % of GB Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemicals Manufacturing and Processing</td>
<td>15,400</td>
<td>108,300</td>
<td>14%</td>
</tr>
<tr>
<td>Pharmaceuticals Manufacturing</td>
<td>14,000</td>
<td>57,600</td>
<td>24%</td>
</tr>
<tr>
<td>Polymers Manufacturing and Processing</td>
<td>19,200</td>
<td>179,200</td>
<td>11%</td>
</tr>
<tr>
<td>Manufacture of Refined Petroleum Products</td>
<td>1,500</td>
<td>10,100</td>
<td>15%</td>
</tr>
<tr>
<td>Oil and Gas</td>
<td>1,400</td>
<td>28,000</td>
<td>5%</td>
</tr>
<tr>
<td>Nuclear (incl direct supply chain)</td>
<td>8,500*</td>
<td>49,500*</td>
<td>17%</td>
</tr>
</tbody>
</table>

Source: Annual Business Inquiry 2005 (regional data rounded and to only Great Britain)
* National Skills Academy Nuclear, 2007 estimates

Occupational Distribution of the Cogent Sector in the South East

Business Size of the Cogent Sector in the South East

Key issues for the Cogent industries in the South East:
- 14% SURPLUS of the workforce qualified to Level 1 and below
- 4% DEFICIT of the workforce qualified to Level 2
- 15% DEFICIT of the workforce qualified to Level 3

Current Workforce: The Cogent Skills Gap

Cogent Sector Skills Demand
The proportion of vacancies reported in the Cogent sector is the same as the UK average. Hard-to-fill and skills shortage vacancies are also lower than the UK average.

INTERNAL SKILLS GAPS are 8% higher than the UK average.

Cogent Sector Training
The proportion of companies who have trained their staff in the previous 12 months is 12% higher than the UK incidence of training.

National Employer Skills Survey 2005

<table>
<thead>
<tr>
<th></th>
<th>Cogent SE</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of companies reporting vacancies</td>
<td>18%</td>
<td>18%</td>
</tr>
<tr>
<td>Proportion of companies reporting ‘hard-to-fill’ vacancies</td>
<td>7%</td>
<td>8%</td>
</tr>
<tr>
<td>Proportion of companies reporting a skills shortage vacancy</td>
<td>4%</td>
<td>6%</td>
</tr>
<tr>
<td>Proportion of companies reporting internal skills gaps</td>
<td>24%</td>
<td>16%</td>
</tr>
</tbody>
</table>

Proportion of firms that have provided funding for staff training within the previous 12 months | 76%     | 64% |

Of those firms which provided training, the proportion of staff trained | 77%     | 68% |
Appendix 4
Cogent Regional and National Factsheets

4.3 East of England

England – East of England

Cogent in the Region
The Cogent Industries are strategically important to the East of England Region:
- The East of England manufacturing sector is responsible for 600,000 jobs and is the second most important contributor to regional wealth.
- The Cogent workforce accounts for 14% of the region’s manufacturing workforce and 10% of manufacturing employers.
- The East of England Regional Economic Strategy highlights global leadership in developing innovation in science, technology and research.
- The East of England accounts for 10% of Cogent employers and 8% of Cogent employees.
- The East of England is focused on increasing the number of young people studying mathematics, science, engineering and technology.

The region has a dominant cluster of Cogent industries:
There are clusters of pharmaceutical and bioscience companies in the Cambridgeshire area and a significant number of polymer companies across the region including composites. The East is a significant centre for the offshore oil and gas industry with approximately 2,100 jobs directly dependent and 10,000 jobs indirectly dependent upon the industry. Activity is focused around Norfolk – a major landfill site for North Sea Gas production. Lowestoft & Great Yarmouth provide the onshore support base for the Southern North Sea gas fields. There is a refinery and petrochemical facility in the region with numerous marketing operations. Sizewell and Bradwell Power Stations employ people in the nuclear industry. Cogent also plays a strategic role in the East of England Manufacturing Alliance working with other SSCs.

Cogent UK Sector Headlines
- 900,000 employees
- 20,000 employers
- 6.5% of UK GVA
- 12% of UK manufacturing workforce
- 7% of UK manufacturing enterprises

Cogent Headline Figures
Key Economic Indicators

<table>
<thead>
<tr>
<th>2006</th>
<th>Cogent EE</th>
<th>Cogent UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turnover</td>
<td>£9.3bn</td>
<td>£15.6bn</td>
</tr>
<tr>
<td>Cogent GVA</td>
<td>£3.0bn</td>
<td>£4.9bn</td>
</tr>
<tr>
<td>Cogent GVA per Employee*</td>
<td>£76,634</td>
<td>£98,394</td>
</tr>
<tr>
<td>Number of employees</td>
<td>39,200</td>
<td>500,000**</td>
</tr>
<tr>
<td>Mean weekly pay***</td>
<td>£555.58</td>
<td>£381.50</td>
</tr>
</tbody>
</table>

Source: Annual Business Inquiry 2006
*UK GVA average per employee £31,419
**Industry estimate of Total Cogent employment 506,000
***Annual Survey of Hours and Earnings 2006

The East of England Cogent industries account for:
- 6% of Cogent sector total turnover
- 6% of Cogent sector total GVA

Cogent Workforce
Employers by Size Band

<table>
<thead>
<tr>
<th></th>
<th>1-10 Employees</th>
<th>11-49 Employees</th>
<th>50-199 Employees</th>
<th>200+ Employees</th>
<th>% of Total Employers</th>
<th>Total Employers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cogent – East of England</td>
<td>69%</td>
<td>23%</td>
<td>6%</td>
<td>2%</td>
<td>10%</td>
<td>1,800</td>
</tr>
<tr>
<td>Cogent – Great Britain</td>
<td>68%</td>
<td>23%</td>
<td>7%</td>
<td>2%</td>
<td>100%</td>
<td>18,500</td>
</tr>
<tr>
<td>Regional Economy – All sectors</td>
<td>85%</td>
<td>12%</td>
<td>3%</td>
<td>&lt;1%</td>
<td>100%</td>
<td>234,100</td>
</tr>
</tbody>
</table>

Source: Annual Business Inquiry 2005 (Rounded)

For further information please email research@cogent-ssc.com or visit www.cogent-ssc.com
Appendix 4
Cogent Regional and National Factsheets

Cogent Workforce
Regional Employment by Industry

<table>
<thead>
<tr>
<th>Industry Category</th>
<th>EE Employees</th>
<th>GB Total</th>
<th>EE Regional% of GB Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemicals Manufacturing and Processing</td>
<td>7,400</td>
<td>108,300</td>
<td>7%</td>
</tr>
<tr>
<td>Pharmaceuticals Manufacturing</td>
<td>6,700</td>
<td>57,600</td>
<td>12%</td>
</tr>
<tr>
<td>Polymers Manufacturing and Processing</td>
<td>19,200</td>
<td>179,200</td>
<td>11%</td>
</tr>
<tr>
<td>Manufacture of Refined Petroleum Products</td>
<td>*</td>
<td>10,100</td>
<td>*</td>
</tr>
<tr>
<td>Oil and Gas</td>
<td>2,100</td>
<td>28,000</td>
<td>7%</td>
</tr>
<tr>
<td>Nuclear (inc direct supply chain)</td>
<td>*</td>
<td>49,500</td>
<td>*</td>
</tr>
</tbody>
</table>

Source: Annual Business Inquiry 2005 (regional data rounded and is only Great Britain)
* Data suppressed

Occupational Distribution of the Cogent Sector in the East of England

Business Size of the Cogent Sector in the East of England

Key issues for the Cogent industries in the East of England:
- 18% SURPLUS of the workforce qualified to Level 1 and below
- 9% DEFICIT of the workforce qualified to Level 2
- 13% DEFICIT of the workforce qualified to Level 3

Cogent Sector Skills Demand
The proportion of vacancies reported in the Cogent sector is higher than the UK average by 2%. Hard-to-fill and skills shortage vacancies are also lower than the UK average.

INTERNAL SKILLS GAPS are 3% lower than the UK average.

Cogent Sector Training
The proportion of companies who have trained their staff in the previous 12 months is 16% higher than the UK incidence of training.

*National Employer Skills Survey 2005
Appendix 4
Cogent Regional and National Factsheets

4.4 Wales

Wales

Cogent in Wales
The Cogent Industries are strategically important to Wales:
- 5% of the Cogent sector are employed in Wales.
- High skill levels can also attract inward investment and indigenous growth to an area.
- Skills are one of the key drivers to raising earnings and reducing economic inactivity.

Wales has a dominant cluster of Cogent industries:
There are over 24,000 employees in the Cogent sector in Wales, accounting for 5% of the entire
Cogent sector workforce (including petroleum forecourt retail). The employee numbers in Wales
account for 6% of chemicals, 4% of pharmaceuticals, 6% of polymers and 9% of petroleum
industries in the UK. Five of the Cogent industries are active in Wales. The presence of the Nuclear
industry is localised to the north west Wales with two nuclear facilities – in Gwynedd, Trawsfynydd
Power Station is a decommissioned reactor; and, in Anglesey, Wylfa Power Station continues to
generate until 2010. There are a number of polymer and chemicals companies clustered around
Cardiff, Swansea and Newport in the South of Wales, and Wrexham in the North. There are two
petroleum refineries at Milford Haven and Pembroke. There is a decommissioned refinery in
Waterson, which currently has an oil storage and jetty facility in operation. Two new Liquefied
Natural Gas (LNG) facilities are under construction at Waterston. More information on Nations,
Regions and Industry Research can be found at: www.cogent-ssc.com/research (A Welsh
language edition of this factsheet is also available)

Cogent Headline Figures
Key Economic Indicators

<table>
<thead>
<tr>
<th></th>
<th>Cogent Wales</th>
<th>Cogent UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turnover</td>
<td>£3.4bn</td>
<td>£156bn</td>
</tr>
<tr>
<td>Cogent GVA</td>
<td>£11bn</td>
<td>£49bn</td>
</tr>
<tr>
<td>Cogent GVA per Employee*</td>
<td>£38,887</td>
<td>£98,394</td>
</tr>
<tr>
<td>Number of employees</td>
<td>26,700</td>
<td>500,000**</td>
</tr>
<tr>
<td>Mean weekly pay**</td>
<td>£519.20</td>
<td>£381.50</td>
</tr>
</tbody>
</table>

Source: Annual Business Inquiry 2007
*UK GVA average per employee £31,419
**Industry estimate of total Cogent employment 600,000
***Annual Survey of Hours and Earnings 2007

Workforce Distribution

The Welsh industries account for:
- 2% of Cogent sector total turnover
- 2% of Cogent sector total GVA

Cogent Workforce
Employers by Size Band

|                      | 1-10 Employees | 11-49 Employees | 50-199 Employees | 200+ Employees % of Total Employers Total Employers |
|----------------------|---------------|----------------|-----------------|---------------------|---------------------|
| Cogent – Wales       | 70%           | 19%            | 8%              | 3%                  | 6%                  | 1,100               |
| Cogent – Great Britain | 67%           | 23%            | 7%              | 2%                  | 100%                | 18,100              |
| Wales Economy        | 85%           | 12%            | 3%              | 1%                  | 100%                | 215,100             |

Source: Annual Business Inquiry 2006

For further information please email research@cogent-ssc.com or visit www.cogent-ssc.com
Appendix 4
Cogent Regional and National Factsheets

Cogent Workforce

National Employment by Industry

<table>
<thead>
<tr>
<th>Industry Category</th>
<th>Wales Employees</th>
<th>GB Total</th>
<th>Wales % of GB Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemicals Manufacturing and Processing</td>
<td>7,400</td>
<td>107,600</td>
<td>7%</td>
</tr>
<tr>
<td>Pharmaceuticals Manufacturing</td>
<td>3,400</td>
<td>59,300</td>
<td>6%</td>
</tr>
<tr>
<td>Polymers Manufacturing and Processing</td>
<td>12,100</td>
<td>183,200</td>
<td>7%</td>
</tr>
<tr>
<td>Manufacture of Refined Petroleum Products</td>
<td>*</td>
<td>9,200</td>
<td>*</td>
</tr>
<tr>
<td>Oil and Gas</td>
<td>*</td>
<td>30,100</td>
<td>*</td>
</tr>
<tr>
<td>Nuclear (inc direct supply chain)**</td>
<td>2,500</td>
<td>49,500</td>
<td>5%</td>
</tr>
</tbody>
</table>

Source: Annual Business Inquiry 2005 (Regional Data rounded and is only Great Britain)
* Data suppressed
**National Skills Academy: Nuclear, 2007 estimates

Sector Occupational Distribution in Wales

Business Size of the Cogent Sector in Wales

3 key skills issues for the Cogent industries in Wales:
- 33% SURPLUS of the workforce qualified to Level 1 and below
- 25% DEFICIT of the workforce qualified to Level 2
- 5% DEFICIT of the workforce qualified to Level 3

Cogent Sector Skills Demand

The proportion of vacancies reported in the Cogent sector is lower than the UK average by 6%. Hard-to-fill vacancies and skills shortage vacancies are lower than the UK average.

Internal skills gaps are 2% higher than the UK average.

Cogent Sector Training

The proportion of companies who have trained their staff in the previous 12 months is 4% lower than the incidence of training across Wales.

Full range of factsheets by region and nation: http://www.cogent-ssc.com/research/regionsindustry.php

Sources: LFS, ABI, NESS, ASHE, Cogent Research