Current and Future Demand for Skills in the Science Based Industries

cogent

UK Sector Skills Assessment Summary

2011

Chemicals
Pharmaceuticals
Bioscience
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Petroleum
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Nuclear

Delivering Skills for Science Based Industries

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UK Sector Skills Assessment – UK Summary

This UK Sector Skills Assessment Summary should be read in conjunction with the UK Sector Skills Assessment report, especially for the analysis of individual sectors, and references cited therein. The main report is accompanied by four supporting documents and an appendix that reflect the national priorities in England, Scotland, Wales and Northern Ireland.

1. Policy, the Recession, and the Global Economy

The election, the continued recession and globalisation mark three major backdrops to skills development during 2010.

The year marked a change in government and the political drivers of the skills system. With a lower emphasis on intervention and a shift in philosophy to the choices and investments of individuals and employers on skills, comes a strong emphasis on high quality research that translates to employer-led skills solutions and the evidence base for information, advice and guidance required to inform decisions made by employers, employees, and stakeholders (in policy, standards, accreditation, education and training provision, learned societies) in the skills system. The underpinning science base of the industries in the Cogent sector generates a strong and coherent theme through the skills and education system from policy through education to employment and workforce development.

Nationally and globally the recession continues to dominate. Working through, as it has since 2008, from banking to manufacturing, the latest test to the UK economy will be in the contraction of the public sector over the next four years and the extent to which the private sector can grow, absorbing capacity shed by the public sector. In short, enabling skills for growth is high on the agenda. The Cogent footprint, covering mainly the private science-based manufacturing sector and an energy and defence sector which sits across both the public and private domains, give skills for growth an impetus.

The UK position on skills development in an evermore connected global economy remains as prior to both the recession and the election. The large number of global companies, industries and sectors (Nuclear, Pharmaceuticals, Chemicals, Oil & Gas, Bioscience) represented in the Cogent sector bring global themes to the fore.

In all, skills contributions to energy, clean water, food, health, a low carbon economy, sustainable development and advanced manufacturing bring both a social and a technological dimension to skills development. There is also a strategic consideration to retain specific national capability, especially in areas that underpin the supply chain and energy production. There is not a segment of the Cogent footprint that is not driven by some aspect of this complex environment of skills. The strategic positions of the sectors are summarized below.

Sector	Strategic Position
Bioscience	R&D, health, low carbon, sustainable development
Pharmaceuticals	R&D, health, advanced manufacturing
Chemicals	advanced manufacturing, supply chain to manufacturing
Polymers	supply chain to manufacturing, advanced manufacturing (composites)
Petroleum	energy (fuels), transport infrastructure
Oil & Gas	energy (fuels), raw materials, energy security
Nuclear	energy (electricity), low carbon, energy security, defence

This necessitates that high importance be given to the supply and demand for skills in science (both physical and life sciences) and engineering, and the translation of research and innovation into value added. The individual sectors, while diverse in both their markets and their combination of skills, are unified by a common denominator of underpinning science: all exploit molecular or atomic transformations to generate value.

The most critical occupations that define these industries are those that require knowledge and application in science, engineering, and regulatory affairs. These are manifest in the managerial, professional, technical and associated professional and craft occupations mainly.

2. The Economic Contribution of Skills

The UK has the 6th largest economy in the world, and the 4th in the OECD, but its recovery from the recession that began in 2008, will depend *inter alia* on strong growth in the manufacturing sector, not least the Cogent industries.

The sector is responsible for considerable industrial economic activity, spending nearly £7.8 billion a year on new capital investment (excluding the significant Nuclear sector which could double this alone through new build) and research and development, equivalent to 10% of operating profit. Those parts of the sector that are covered by national statistics are shown to generate a turnover of over £200 billion and a gross value added (GVA) of more than £65 billion, a GVA of 6.5% of the UK total. The sector is a net contributor to the UK balance of trade (£3.77 billion contribution in 2009), while its contribution to self-sufficiency in important areas of manufacturing and energy obviates an otherwise significant import liability. The sector is also a strategic supply chain to wider manufacturing, with every worker directly employed supporting three more in allied occupations.

The sector embraces companies from the micro to the global. More than two thirds of employers employ 10 people or less, just over half of the workforce is engaged by companies with in excess of 50 staff, and one third by those with a headcount above 200. More than half the employment is in larger companies (50 or more employees), but this profile is by no means homogeneous at subsector level with Oil & Gas, Nuclear, Pharmaceuticals and Chemicals presenting some of the largest global companies known.

National data does not adequately capture all skills aspects of the sector. There are significant gaps on explicit statistics for the Nuclear sector and Pharmaceuticals R&D (includes manufacturing but not R&D). It is in these areas that research by Cogent

on skills has focused in depth.

Given the significant economic contribution earned by the sector there can be (and there have been) significant downsides for health, safety, cost and the environment when matters go wrong, usually due to non-compliance. In this regard, a common feature of the Cogent sector economy in 2010 is fragmentation of the supply chain so that no single company will have the full panorama on skills across the value-adding process from education to employment. This raises importance in the Cogent sector of skills assurance in what are safety critical and highly regulated science-based sectors, especially where assumptions on quality assurance and compliance are devolved or delegated through the supply chain.

3. The Workforce of Today (2010)

The Leitch Review of 2006 set a goal for the UK to reach the OECD upper quartile for skills attainment by 2020. Targets derived from this recommendation provide the annual assessment of UK skills, jobs and productivity - Ambition 2020 (UK Commission for Employment and Skills, UKCES, 2010). The targets are illustrated below together with the current levels for both the UK and the Cogent sector.

Highest Qualification	Target 2020	UK (current)	Cogent (current)
Level 4	40%	28%	38%
Level 3	28%	17%	24%
Level 2	20%	17%	17%

Cogent and trade bodies estimate that the sector is comprised of over 900,000 people employed (mainly full-time) across 23,000 companies. National statistics identifies a smaller complement of employers and employees (410,000 and 18,000 respectively).

Given the aforementioned preponderance of regulation in the sector, the workforce has historically had a distribution towards the high end of the skills spectrum (as shown above). The Pharmaceuticals sector shows the highest fraction at NVQ level 4 and above at 58%, although this may underestimate the actual level because of the inadequacy of Standard Industry Codes in Pharmaceutical research and development. In contrast, Polymers and Petroleum employ a large number of staff with lower qualifications mostly in occupations of process operations and retail respectively. This pattern is reflected in the weekly earnings which are twice the UK average for the sector with employees in Oil & Gas, Petroleum (Refining only) and Pharmaceuticals earning the most.

The occupational distribution of the workforce reflects the expected demand for Managers, Professionals, Associated Professional and Process Operators (two-thirds of the workforce). In broad terms, this is repeated across the industries with some variation in Professional and Sales depending on the nature of the industry.

Across the sector the existing integrated skills gap is slightly higher than the UK average with most employers placing technical or job-related training as the highest priority. In this context, Skills Oracle data (Cogent 2010) identifies that scientific and technical occupations as the most hard-to-fill vacancies and that Health, Safety and Environment training was the most frequent type of training undertaken. Further, it

was in these areas of 'Professional', 'Technical' and 'Health, Safety and Environment' that companies tended to resource external provision with 94% of using 'Private Training' providers, 80% using 'FE' providers, and 51% using 'HE' providers.

Ambition 2020 cites a link between the proportion of workers trained and the GVA such that a 5 percentage-point increase in the former results in a 4 percentage-point increase in the latter. Although the gearing between training and productivity must be, in part, a function of the character of the industry and the levels at which training is focused, if taken at face value this would imply that raising the proportion of Cogent employees trained from 52% to 60% would generate an additional GVA of at least £4 billion.

4. The Workforce of Tomorrow (2017+)

Working Futures projections (excluding Nuclear, Pharmaceuticals R&D, and Bioscience) have been taken at the highest level of SIC to form an approximation for the sector. While the Working Futures (UKCES, 2008) data preceded the onset of the recession, its projections a decade ahead normally sit outside the variations of general economic fluctuations. In the case of the current global recession the data is yet to be reassessed and is used here as the best data available to inform a conservative analysis.

The combination of expansion demand (positive or negative) and replacement demand in all sectors leads to a positive employment requirement. In summary:

- Polymers has a net requirement for an additional 40,000
- Pharmaceuticals (manufacturing only) for an additional 25,000
- Chemicals an additional 15,000
- Manufactured Fuels an additional 8,000
- Oil and Gas an additional 7,000
- Nuclear – an additional 10,000[1]

In total, an employment requirement of an additional 105,000 personnel is projected. Allowing for uncertainty and conservative estimate of 50% for the direct supply chain, suggests of the order of 100,000 - 150,000 new personnel are required in total by 2017.

When analysed by occupation, it is clear that the greatest net requirement is for occupations related to science or engineering. This is in line with the analysis from Skills Oracle (Cogent 2010) and industry factsheets (Cogent 2010). Accounting for expansion demand, occupational mobility and replacement demand for these occupations, new personnel in science or engineering related occupations are required by 2017. Approximating in the proportions above, the numbers required are:

- managers - 39,000
- professionals - 20,000
- associated professionals - 24,000
- machine operatives - 24,000
- skilled trades - 13,000

[1] Estimate based on existing estate, one new build power station and supply chain by 2018 (Power People and Next Generation, respectively, Cogent 2010).

In total a requirement for 120,000 new personnel is projected in science or engineering-related occupations by 2017.

Of particular note are the following projected populations:

- stable and high - corporate managers (70,000 – 105,000)
- stable - science and technology professional (25,000 – 37,500)
- stable - science/technology associate professionals (15,000 – 22,500)
- decline - process operatives (40,000 – 60,000)
- decline - skilled trades (Mechanical/Electrical) (25,000 – 37,500)

Although the general trend in employment is a decline in the traditional sectors, growth in Nuclear (new build) and Bioscience (across Chemicals, Pharmaceuticals, Oil & Gas and Polymers) will either replace or displace traditional technologies. Attendant to this trend will be a requirement for new employment with new skills opposite new technology and greater interdisciplinarity (across both individuals and companies). This, in turn, will stimulate the requirement for new standards for education and training aimed at workforce development.

5. Education and Vocational Qualifications

Science graduates are critical to the science-based industries and particular to the Pharmaceuticals (R&D) and Medical Biotechnology sector. The Browne review of funding of Higher Education proposes subsidy of science and engineering to ensure that strategic provision is affordable and made attractive to potential students. This may, however, result in consolidation of science and engineering provision.

Of the STEM and Life Science graduates produced by HE, the proportion recruited into the sector is small; too low to support any claim that supply is insufficient for demand. However, these graduates are well sought after in the economy generally, so that the supply may become thinly stretched. Analysis shows that engineering graduates tend to go into vocational employment, and science graduates to a greater diversity of destinations. Coincident with the economic downturn, has been a general decline in recruitment by the sector.

On average 3,000 graduates per year enter the sector, 1,000 bearing STEM and Life Science qualifications.

GCSE and Scottish Standards and Intermediates underpin routes to Higher Education. Entry levels have remained large stable, although in Scotland, there has been a redistribution between a reducing number of Standard grade entries and a similar combined increase in Intermediate 1 and 2. A level and Scottish Highers entry rates have increased in the period 2005 to 2009. As the primary qualification route for higher education, this may be linked to the expansion in the number of university places. Although this is not in itself a sufficient condition to translate into a higher number of STEM and Life Science graduates taking up posts in Cogent industries.

On average 3,000 vocationally related qualifications are registered to learners on Cogent frameworks. Of these approximately 10% (n = 300) are new recruits through Apprenticeships.

6. Skills Shortage and Skills Gap Analysis

Skills Gaps will continue to emerge across all occupations driven in the main by technology, regulation and compliance. Science and technology related occupations are the most critical part of the workforce. These are predominantly found in the occupations of manager, professional, associated professional, process operative and skilled trades.

Projections for priority occupations for 2017, as above, are:

- managers - 39,000
- professionals - 20,000
- associated professionals - 24,000
- machine operatives - 24,000
- skilled trades - 13,000

For managers, the main entry routes are either by internal progression or transfer from the economy generally. These occupations are therefore not limited by the supply from the education system. Shortages are therefore not projected with the main priority for these occupational levels being to address skills gaps.

For professionals the main entry route is either graduate recruitment or transfer from the economy generally. Graduate destinations into the sector in 2009 were of the order of 3,000. This would appear to be in line with the projected need, although a substantial proportion of graduate intake goes into associated professional level initially. Further, a decline of 25% in graduate recruitment since 2007 is noted. Shortages are therefore not projected at the overall sectoral level. Skills shortages may, however, exist at the sub-sectoral level (and there is evidence of this from the Pharmaceutical sector for very high level and specialist skills). In addition, employers report skills gaps in this intake in the areas of practical skills and applying knowledge (problem solving).

From the analysis it would appear that the most at risk occupations are associated professional, process operatives and skilled trades, for which the main entry routes are through apprenticeships or recruits taking vocationally related qualifications. These groups combined make up a requirement for 61,000 by 2017 (projected from 2007).

7. Sector Skills Priorities

The SSA research supports the following SSC-driven developments and include attendant research. These priorities are mainly drawn from the skills shortages and skill gaps.

1. Standards and qualifications focused on science-using occupations – managers, professionals, associated professional, process operatives, skilled trades. (80% of the workforce).

2. Standards and qualifications priority to address skills gaps in the areas of technical and regulatory compliance.

3. Raising awareness of the general requirement for 120,000 new personnel in science-using occupations by 2017.

4. Industry consultation on sector-by-sector analysis of demand for 61,000 new technician, process operative and skilled trade occupations.

5. Products for industry to assure skills standards of its supply chain linked to passport development with the National Skills Academies for Process Industries and Nuclear.

6. Initiatives and interventions to facilitate uptake of technician and skilled trade occupations, including facilitative actions on apprenticeships.

7. Skills Gaps initiatives opposite Higher Education to improve the employability of science and engineering graduates and greater interaction between HE and employers to enhance recruitment opportunities, e.g. placements.

8. Initiatives opposite Further and Higher Education to develop accredited CPD provision for the workforce, e.g. Foundation Degrees and Higher Level Apprenticeships.

8. Sector Summaries

Chemicals

- A strategic infrastructure in manufacturing and raw materials supply supporting most other UK manufacturing.
- Strategic to UK supply of chemicals that are not readily imported due to hazards associated with storage and transport.
- Safety critical sector; highly regulated.
- A major UK industrial sector.
- An energy intensive sector.
- High levels of skills from operator through technical, professional and management.
- Technical and professional occupations are most hard-to-fill.
- Economic downturn has reduced output in short-term.
- Requires supply of science and engineering skills.
- Impact of emerging technologies could drive shift in skills needs higher more interdisciplinary, more bioscience.

Pharmaceuticals & Medical Biotechnology

- Strategically important UK sector.
- A large demand for Professionals, Managers and Operators.
- A concentration of Research Institutions in the south east which may change with rise of biotechnology.

Nuclear

- A politically orientated sector with a future linked to private and public investment.
- A highly regulated, safety critical sector.
- Private sector investment in new build will be a major determinant of future skills demand.
- Long term stable and predictable demand for skills in Decommissioning which will be largest subsector workforce for the foreseeable future.
- The future of Fuel Processing capacity and capability depends on: a) the global demand for fuel manufacture; and b) future policy decisions on the reprocessing of waste.
- The UK is at the forefront of Western European new build ambitions in Civil Nuclear.
- Models of future workforce demand have been developed – potentially equivalent to three London Olympics projects.
- If new build programmes proceed, there will be an immediate need for skills in the manufacturing, engineering construction and construction supply chains.
- New build activity, if significant could induce skills shortages in and the sustainability of the Decommissioning sector.
- Skills shortages are projected for new build projects in western Europe; these are commonly in the areas of nuclear safety and quality assurance in the supply chain, and points to a requirement for standards and training to be developed.
- Critical at-risk skills identified across construction, engineering construction and operation of new power plants.

Pharmaceuticals & Medical Biotechnology (cont.)

- There is demand for technical up-skilling.
- There is competition from low-wage economies.
- Rapid change transfer of new technologies will be a key driver of skills.
- There is demand for science, technology, engineering and mathematics (STEM) graduates, and especially for the highest skills in chemical and biological sciences.

Polymers

- Polymers is a critical UK supply chain to manufacturing.
- The industry is dominated by SMEs.
- A high demand for process operators is evident from the workforce make up.
- Job specific training of highest priority for employers, making training for process operatives a high compounded priority.
- Levels of external spend on training are lower than UK norms and lower than other manufacturing sectors and may be a reflection of the SME dominance of the sector and the lower level of regulation compared to other manufacturing sectors.
- Provision in FE and HE is limited
- Supply of Apprentices and Graduates is articulated by some employers as an important to the sector.
- Employment turnover can be high.
- Demand for technical, leadership and management skills.

Nuclear (cont.)

- General demand for the supply of engineering, science and specialist professionals.

Oil and Gas

- A major revenue earning industry for the UK.
- The industry provides a secure supply of fuels for the UK.
- The industry is crucial source of raw materials for large parts of the manufacturing sector, e.g. Chemicals, Pharmaceuticals, Polymers and Petroleum industries.
- The proximity of the 'downstream' Petroleum and Petrochemicals industry is a major geographical determinant of induced skills demand.
- Production may have peaked but current levels of production continue to obviate significant import requirements.
- A safety critical sector; highly regulated.
- Public perception of the industry critical currently due to recent global incidents.
- Assuring quality and skills in the supply chain is just as important as it is in the asset-holding company.
- Large demand for technical and engineering skills.
- Future demand for skills to support new extraction technologies.
- Large proportion of workforce in professional and managerial levels.
- Many of the high level skills are in demand globally.

Polymers (cont.)

- Training provision tends to be catered for by private providers, with much specialist provision from the HE and FE having shrunk in recent decades.
- High technology role in the area of composites.
- There is a need to attract more young people to the sector.

Petrochemicals

- A strategic infrastructure in manufacturing, satisfying domestic demand and obviating major imports of refined fuels.
- A sector in two parts – Refining and Retail, with very different skills needs.
- A safety critical sector requiring skills in safety awareness in particular in both Retail and Refining contexts.
- Manufacturing sector with high demand for hard-to-fill process operator skills and professional, technical and managerial skills in particular.
- Supply of science and engineering skills is important.

All Sectors

- Almost one million employed in strategic science and engineering industries across energy and manufacturing.
- Strong levels of productivity and contribution to balance of trade.
- Research and development skills a strong feature of the Life science industries.
- Some of the largest private sector employers (by number of employees) in UK.
- Propensity to higher end of skills levels of attainment.
- Mostly full-time employment.
- Widely distributed industries across all UK regions and nations.
- Levels of occupations for categories of Management, Senior Official and Plant Operatives are distinguished from the UK as a whole.
- Greatest skills requirements are in technical competence or job-related roles.
- Safety critical sectors**.**
- Dependence on skilled science and engineering supply.

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cogent Skills for Science Based Industries

The National Skills Academy NUCLEAR

The National Skills Academy PROCESS INDUSTRIES

The strategic skills alliance for the Science-based Industries