Industry graduate skills needs

Summary report for the National Centre for Universities and Business

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01. INTRODUCTION

This initial review presents the results of a rapid evidence assessment of literature on the graduate skills needs of UK employers, based primarily on reports from employer bodies and stakeholders in the skills and HE sectors. Commissioned by the National Centre for Universities and Business (NCUB) in 2013, the review took place as a first stage in developing research into industry demand for graduates and will be supplemented with feedback from employers. It is not intended at this stage to be a full review of the issues under consideration, but to provide a high level overview to stimulate discussion and suggest issues for further investigation.

This report is based on a rapid review of relevant literature published by policymakers, quasi- and non-governmental organisations, private companies, and sector skills councils (SSCs). The report focuses on issues with the demand for graduate skills needs as articulated by employers in the UK.

For this initial phase of the research we have adopted the method of a *rapid evidence assessment* (REA).[1] This method begins with an exhaustive search for source material on the subject of demand for graduate skills, focusing on key employer and HE stakeholders across sectors, and particularly those industries that have been identified in the government's plans for economic growth. Over 300 sources were identified through the literature search. These were evaluated in terms of date and relevance, and categorised by industrial sector. This ranking and categorisation allowed us to focus on the most recent and relevant source material only. Our main criterion for ranking the relevance of source material is the degree to which there is clear and reliable evidence of current or likely future demand for graduates and postgraduates from specific business sectors. As we reviewed data at a sector level, we found many common graduate skills challenges across sectors, and we have therefore structured this report as an overall review of demand and challenges. Given the rapid approach taken, we outline findings at a high level only and also identify where there are gaps in our findings on the current state of demand for graduate skills in the UK.

In the first section, we provide a discussion of the supply of and demand for graduate skills, including evidence on graduate destinations and skills levels across industry. This is followed by an exploration of a selection of key skills needs and imbalances in industry, drawing upon both our literature review and supporting data analysis. Throughout this review we have drawn on a broad variety of sources to obtain an industry and sector-focused viewpoint; where possible we use examples from industries and sectors. These include perspectives from within the advanced manufacturing sector, energy, knowledge intensive services, creative and cultural, agri-tech, education and others.

[1] HM Treasury, *The Magenta Book: Guidance for Evaluation* (Crown Copyright, 2011) <http://www.hm-treasury.gov.uk/data_magentabook_index.htm>.

The present report covers these issues and sectors at a high level only and further secondary or primary research would be necessary to develop the discussion further. The review ends by suggesting some key questions for further investigation. Options for developing this work further include consultations with key employers, and/or taking a sharper focus on particular issues or sectors to produce a more focused discussion on a smaller number of priority issues.

02. SUPPLY OF AND DEMAND FOR GRADUATES AND SKILLS

Access to appropriate skills, and in particular higher level skills, is of great importance to UK industries. A recent report by the LSE Growth Commission emphasises the importance of higher level skills in building flexible and adaptable economies, and notes that proper investment in skills forms an important part of the infrastructure required to ensure recovery and growth to the UK economy.[2] While higher level skills and qualifications are not synonymous, demand for qualifications such as undergraduate and postgraduate degrees serve as a useful proxy for higher level skills demand. As this paper is primarily concerned with demand for graduates (in other words, people with degrees) we make use of qualifications as a measure of higher level and graduate level skills.

It is clear that the supply of individuals gaining higher education qualifications each year is rising. Student record data produced by the Higher Education Statistics Agency (HESA) shows that the number of people gaining higher education qualifications of all types in the UK has steadily risen from around 500,000 annually in 2000/01, to nearly 790,000 in 2011/12.[3] Similarly, first degree graduate numbers have also increased significantly over this period.

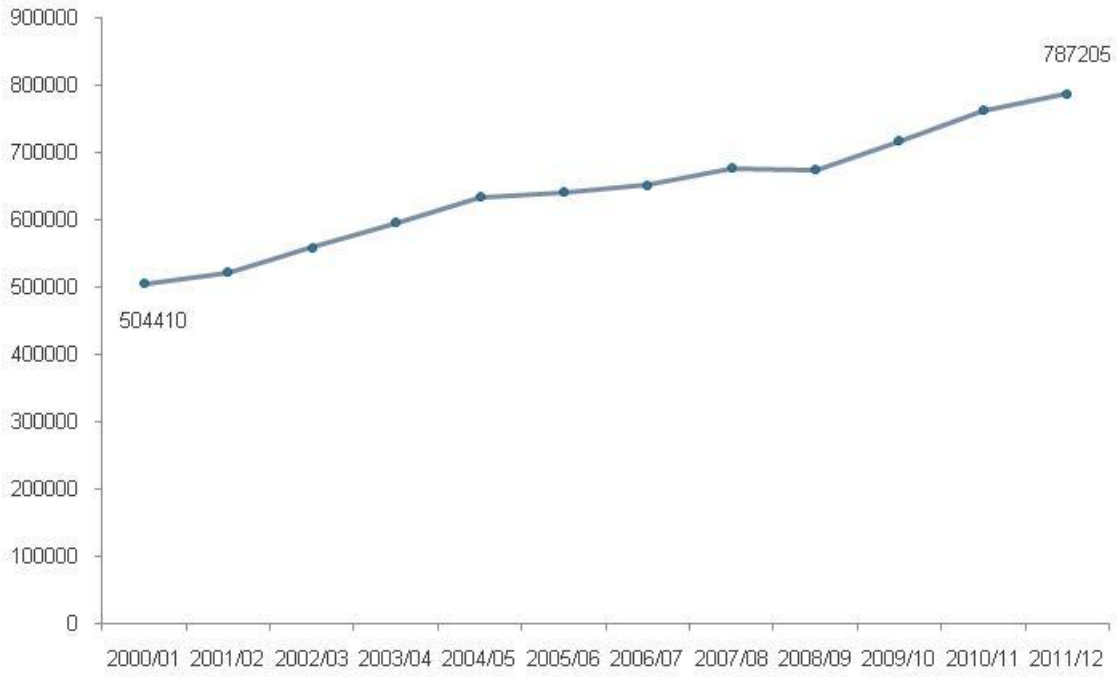

Figure 1: Higher education qualifiers annually, 2000/01 to 2011/12, HESA

The majority of these increasing numbers of graduates are entering the workforce, potentially implying a continuing demand for higher level qualifications from employers. Table 1 summarises

[2] LSE Growth Commission, Investing for Prosperity: Skills Infrastructure and Innovation, (2013), p. 19.

[3] Higher Education Statistics Agency, 'Students and Qualifiers at UK HE Institutions' <http://www.hesa.ac.uk/content/view/1897/239/>.

destinations and employment trends for full time first degree graduates leaving higher education between 2006/07 and 2011/12, based on Destinations of Leavers from Higher Education (DLHE) survey of graduates. The proportion of all first graduates who entered employment or further study within six months fell from 89% in 2006/07 to a low of 85% 2008/09, and has since increased to 87% in 2011/12. However, the total number of graduates has risen steadily, from around 190,385 in 2006/07, to around 224,045 in 2010/11, meaning that the total number of first degree graduates entering employment has also risen. Although the survey only represents a sample of the total population of graduates each year and depicts a very early stage of graduate careers, its high response rate means that the survey offers useful information about the employment circumstances of new graduates. [4]

	2007/08	2008/09	2009/10	2010/11	2011/12
Total number of first degree graduates	262,440	260,750	271,530	284,980	**301,370**
Total number of first degree graduates responding to the DLHE survey (with known destination)	**200,090**	**205,340**	**213,390**	**224,045**	**232,110**
UK employment only	59%	57%	60%	60%	63%
Overseas employment only	3%	2%	3%	3%	3%
Combination of employment and study	8%	8%	7%	8%	6%
Further study only	17%	18%	16%	16%	15%
Not available for employment[5]	4%	4%	3%	3%	-
Assumed to be unemployed	8%	10%	9%	9%	9%
Other	1%	1%	1%	1%	5%

Table 1: Destinations of full time first degree graduates by activity (Source: DLHE survey).

These increasing numbers of graduates entering the workforce each year enter a range of industries across the economy. Table 2 below provides a breakdown of UK graduate employment by broad industry sector. The table presents a complex picture, with a relatively small number of industry sectors dominating recent graduate employment, and a larger number of sectors with lower proportions of graduates each year. Trends in graduate employment vary between sector, and are likely influenced by changes in overall levels of graduate employment (particularly recession), and mobility between sectors.

For example, recent graduate employment in the property development, renting and business and research activities sector reduced sharply from 20.2% to 14.4% between 2006/07 and 2008/09, an effect that might be attributed to recession, given its gradual recovery to 16.7% in 2011/12. During this time period, the proportion of graduates entering employment in public administration, manufacturing, and financial activities has also fallen. However, the share of graduate employment

[4] The DLHE survey covers a range of graduate populations, including first degree and postgraduates, full-time and part-time and those domiciled in the UK, EU or further afield. The response rate of the survey varies across these groups but is generally between 70 and 80 per cent. For first degree graduates, the average response rate between 2005/06 and 2011/12 is 78%.

[5] Category omitted from 2011/12 onwards

has grown in some sectors, most notably in wholesale and retail trade, hotels and restaurants. These sectors are typically seen as requiring fewer higher level skills, so this pattern may be indicative of more graduates entering non-graduate level job roles.

Industry sector[6]	2007/08	2008/09	2009/10	2010/11	2011/12
Total	**133,565**	**132,290**	**143,205**	**151,245**	**159,960**
Agriculture, forestry and fishing	0.3%	0.3%	0.3%	0.3%	0.3%
Mining and quarrying	0.4%	0.2%	0.3%	0.4%	0.5%
Manufacturing	4.2%	3.9%	4.3%	4.6%	4.4%
Electricity, gas and water supply	0.8%	0.7%	0.7%	0.7%	0.7%
Construction	1.7%	1.3%	1.4%	1.5%	1.4%
Wholesale and retail trade/repair	13.6%	16.9%	16.9%	17.2%	16.7%
Hotels and restaurants	4.9%	6.3%	6.3%	6.8%	6.2%
Transport, storage and communication	7.1%	6.1%	6.8%	6.9%	7.8%
Financial activities	6.0%	4.6%	5.8%	5.4%	4.9%
Property development, renting, business and research activities	15.8%	14.4%	15.8%	16.5%	16.7%
Public administration and defence/social security	6.9%	6.1%	3.9%	3.7%	4.3%
Education	12.4%	12.6%	11.5%	11.2%	11.8%
Health and social work	19.3%	19.8%	19.2%	17.7%	17.8%
Other community, social and personal service activities	6.3%	6.6%	6.3%	6.6%	5.8%
Private households with employed persons	0.1%	0.1%	0.1%	0.1%	0.1%
International organisations and bodies	0.0%	0.1%	0.1%	0.2%	0.0%
Not known	0.2%	0.2%	0.3%	0.2%	0.5%

Table 2: Industry of first degree leavers entering employment in the UK (Source: DLHE)

The DLHE also provides analysis of occupational level, giving some insight into the types of role that recent graduates enter. Analysis of this by HECSU suggests that high proportions of employed graduates move into what might be termed "graduate roles", relating to professional, associate professional or management roles. However 22% of recent graduates were employed in retail, catering, waiting and bar staff, or clerical, secretarial and numerical clerk occupations at this stage of their career.

[6] Note that the DLHE survey uses an adjusted version of the Standard Industrial Classification 2007, due to earlier data using different categories.

Occupational area	Percentage
Health professionals	13.8%
Retail, catering, waiting and bar staff	13.7%
Business, HR and finance professionals	8.8%
Clerical, secretarial and numerical clerk occupations	8.5%
Other occupations	6.9%
Marketing, PR and sales professionals	6.8%
Education professionals	6.6%
Childcare, health and education occupations	5.9%
Arts, design and media professionals	5.5%
Legal, social and welfare professionals	4.9%
Other professionals, associate professionals and technicians	4.8%
Managers	4.5%
Engineering and building professionals	4.2%
Information technology (IT) professionals	4.0%
Science professionals	1.0%
Unknown occupations	0.2%

Table 3: Type of work for those in employment. Graduates who were in employment either full-time, part-time or working and studying in the UK. Base=173,480 (What do Graduates Do? 2013)

Looking beyond recent graduates, over time, this increasing supply of individuals with higher level qualifications has led to a more highly qualified labour force in the UK. Recent statistics from the Labour Force Survey show that people holding degree-level or other higher education qualifications now make up a significant proportion of the economically active population. Of the economically active population in the UK, almost a quarter hold at least a degree or equivalent (24.7%), and a further 9.1% are qualified to Higher Education level (sub-degree level). Evidence suggests that the proportion of graduates in the population has more than doubled since the early 1990s.[7]

[7] Office for National Statistics, Full Report – Graduates in the UK labour market 2013, (November 2013), p.4. <www.ons.gov.uk/ons/dcp171776_337841.pdf> Note that 2013 LFS statistics on qualifications apply to individuals of working age (16-69) and those in employment with qualifications (including individuals over age 70). Due to working age adjustments and seasonal variation, proportions will slightly differ to ONS published statistics covering a longer time period.

Qualification	Number in workforce	Percentage in workforce
Degree or equivalent	10,809,409	24.7%
Other higher education	3,974,169	9.1%
GCE, A-level or equivalent	9,927,970	22.7%
GCSE grades A*-C or equivalent	9,573,766	21.9%
Other qualifications	4,275,959	9.8%
No qualification	4,733,089	10.8%
Don't know	419,964	1.0%
Total	43,714,326	100.0%

Table 4: Breakdown of economically active population of the UK by qualification (source: Quarterly Labour Force Survey, Spring 2013).

The proportion of people with higher level qualifications in each industry varies considerably across the whole workforce. Recent statistics gathered through the quarterly Labour Force Survey (see Table 5) show that higher level qualifications are concentrated in some broad industry sectors more than others. For example, information and communication, education, and health and social work all have high proportions of the workforce at Level 4[8] or above, in comparison to construction, manufacturing and accommodation and food services. This is similarly reflected in the proportion of each sector holding a degree level qualification.

[8] This refers to Level 4 on the Qualification s and Credit Framework, which is below degree level, but equivalent to certificates of higher education, see <http://ofqual.gov.uk/qualifications-and-assessments/qualification-frameworks/levels-of-qualifications>

Industry sector	% with any qualification above Level 4	% of total employees in industry sector qualified to Degree level	% of total employees in industry sector qualified with a Higher Degree	Total number employed in industry
M Prof, scientific, technical activities	67.60%	41.20%	16.90%	1,992,525
P Education	65.20%	25.00%	29.70%	3,090,965
J Information and communication	65.10%	41.40%	14.70%	1,152,955
U Extraterritorial organisations	62.80%	35.90%	19.90%	38,930
Q Health and social work	53.80%	25.00%	10.70%	3,958,918
K Financial and insurance activities	48.90%	33.80%	8.10%	1,149,752
O Public admin and defence	47.70%	25.60%	10.20%	1,841,733
B Mining and quarrying	44.10%	19.40%	11.70%	133,080
D Electricity, gas, air conditioning supply	43.30%	18.70%	7.90%	181,069
L Real estate activities	38.80%	23.50%	3.70%	341,573
R Arts, entertainment and recreation	37.70%	22.20%	7.60%	721,763
S Other service activities	33.40%	17.40%	7.40%	795,048
T Households as employers	30.90%	16.80%	1.10%	58,627
C Manufacturing	30.00%	15.00%	4.10%	2,911,815
N Admin and support services	28.80%	15.90%	4.00%	1,346,352
E Water supply, sewerage, waste	23.10%	11.70%	5.70%	220,988
G Wholesale, retail, repair of vehicles	22.30%	13.30%	2.30%	4,011,980
I Accommodation and food services	22.30%	12.90%	1.90%	1,492,423
F Construction	21.70%	11.10%	2.50%	2,100,132
A Agriculture, forestry and fishing	21.30%	8.20%	2.60%	302,785
H Transport and storage	19.30%	9.90%	2.20%	1,478,678
Total	40.50%	21.10%	9.20%	29,322,091

Table 5: Sector breakdown of individuals qualified to Higher Degree level, Degree level, and Level 4+ (Source: Quarterly Labour Force Survey, Spring 2013)

Table 5 also shows that people with higher, postgraduate degrees are similarly unevenly spread across sectors. Our literature review found little emphasis on differences between demand for graduate and postgraduate skills. Whilst many sources articulate a need for high-level skills, it is rare for such demand to make a clear distinction between the skills required from postgraduates as opposed to undergraduates. The lack of available data suggests that this is another area that would benefit from further research. As one example, in the agri-tech sector, the sources we reviewed

showed a particular issue with a shortage of very high-level skills (Masters and PhD) to support research in both academia and industry.[9] This is likely to be mirrored in other sectors with a strong reliance on research and development, but this was not widely represented in the literature reviewed.

Research with employers conducted by CFE for Universities UK suggested that employer demand for Masters graduates varies greatly across industries. Based on qualitative evidence, industries that recruit for specific subject expertise, for example statistical research or engineering, appear more likely to target individuals with Masters degrees, given that they are seeking individuals with the best skills in their area of expertise, and a Masters degree may even be a requirement for professional accreditation. Conversely, many employers that recruit graduates for non-subject specific roles, including many of the large-scale graduate recruitment programmes, do not particularly differentiate between first degree and Masters graduates, preferring instead to look at skills and competencies at the individual level. Adding or removing a requirement for a Masters degree can be one way in which large employers can filter the number of applications they receive.[10]

When considering the distribution of qualifications in the workforce, it is important to note that simply because someone with a higher level qualification is working in a particular industry does not necessarily mean they are working in what might be termed a graduate-level occupation (as seen in Table 3 above for recent graduates). The Labour Force Survey can also be analysed to gain an understanding of how job roles relate to qualification levels across sectors. Looking at individuals holding qualifications at Level 4 or above only, we see that there are substantial proportions working in occupations outside of managers, directors and senior officials, professional and associate professional and technical occupations. These occupational groups are only an indicative proxy for graduate-level roles, but they give a good sense of the variation across sectors.

[9] Food Research Partnership Skills Sub-Group, *High-Level Skills for Food* (FRP, 2010).

[10] CFE & HECSU, *Employability of Masters Graduates* (Universities UK, unpublished).

Industry sector	Number qualified to Level 4+	% Managers, Directors and Senior Officials	% Professional Occupations	% Associate Professional and Technical Occupations	% Senior level occupations
Q Health and social work	2,130,608	7.6%	57.1%	11.9%	76.6%
P Education	2,015,976	2.0%	72.0%	9.5%	83.5%
M Prof, scientific, technical activities	1,346,823	12.9%	48.3%	26.0%	87.2%
G Wholesale, retail, repair of vehicles	893,276	21.8%	10.0%	13.1%	44.9%
O Public admin and defence	878,072	12.4%	32.4%	32.6%	77.4%
C Manufacturing	872,395	20.6%	28.1%	22.5%	71.2%
J Information and communication	750,431	11.7%	52.4%	25.6%	89.7%
K Financial and insurance activities	562,338	20.6%	25.6%	31.5%	77.7%
F Construction	455,313	23.4%	32.4%	11.2%	67.0%
N Admin and support services	387,626	18.2%	11.2%	20.8%	50.2%
I Accommodation and food services	332,094	23.3%	1.5%	6.2%	31.0%
H Transport and storage	285,633	16.3%	11.1%	14.8%	42.2%
R Arts, entertainment and recreation	272,043	12.2%	18.3%	43.7%	74.2%
S Other service activities	265,291	9.0%	33.0%	21.3%	63.3%
L Real estate activities	132,431	37.8%	10.5%	29.5%	77.8%
D Electricity, gas, air conditioning supply	78,376	21.6%	26.7%	22.2%	70.5%
A Agriculture, forestry and fishing	64,498	16.2%	9.8%	3.5%	29.5%
B Mining and quarrying	58,713	20.2%	47.6%	15.7%	83.5%
E Water supply, sewerage, waste	50,982	20.3%	25.4%	27.0%	72.7%
U Extraterritorial organisations	24,461	28.5%	33.6%	16.9%	79.0%
T Households as employers	18,103	3.0%	0.0%	0.0%	3.0%
Total	11,875,483	12.9%	41.5%	18.7%	73.1%

Table 6: Sector breakdown of individuals in senior occupational roles that are qualified to Level 4 (Source: Quarterly Labour Force Survey, Spring 2013).[11]

Despite some variation in the type of roles graduates enter across sectors, analysis by the University of Warwick's Institute for Employment Research predicts that the proportion of jobs requiring higher level skills will increase from 30% in 2004, to 42% in 2020.[12] Other analysis suggests that generally, the supply of higher qualified people in the workforce has risen in tandem with the proportion of jobs requiring or making use of higher level skills.[13] Higher employment rates for people with higher education qualifications suggest that industry's appetite for higher level skills, and higher level qualifications as a proxy for these, has continued.

This increase in the amount of higher level skills being used by industry is evidenced by the Labour Force Survey, which shows that many industrial sectors are increasing their share of high-skilled workers. Professions commonly described as skilled include teachers, engineers, scientists, technical workers, managerial and sales, legal, financial and economists, social scientist and health workers and welfare workers. These high-skill professions demonstrate generally increasing employment shares over time, while the relatively lower-skilled professions (such as clerical and related, selling and catering, and manual roles) demonstrate generally declining employment shares.[14] The UK is not alone in this situation. A Europe-wide analysis by CEDEFOP of supply and demand for skills suggests that recent economic conditions mean that there is only a modest increase in job openings, including a shift to more skill-intensive jobs and a demand for people to be better qualified that will continue throughout the EU.[15] The trend towards more skill-intensive jobs at all levels will be sustained and many traditional manual or routine jobs will decline.

Higher skills act as one of several key drivers of productivity and output. Independent reviews, (such as Dearing, Browne and Wilson), ministers, and industry groups repeatedly have identified higher education as a source of strength in the knowledge-based economy of the 21st century.[16] However, a lack of skills in the workforce is not always the first concern of individual businesses. In a survey conducted by the CBI, the top priority for 61% of firms in the survey was improving productivity. In comparison, only 24% of respondents highlighted raising workforce skills as a key business priority, while 57% lacked confidence that they had enough skilled staff.[17] Of course, raising skills may support improved productivity, but it is only one of several factors at play. In

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[11] For more information on the major Standard Occupational Classification Categories used, see: <www.ons.gov.uk/ons/guide-method/classifications/current-standard-classifications/soc2010/soc2010-volume-1-structure-and-descriptions-of-unit-groups/index.html>

[12] Rachel Beaven and others, *Alternative Skills Scenarios to 2020 for the UK Economy: a Report for the Sector Skills Development Agency, as a Contribution to the Leitch Review of Skills* (HM Treasury, 2005).

[13] R.A. Wilson and K. Homenidou, *Working Futures 2010-2020* (UKCES, 2012), p. 123.

[14] Robert J. R. Elliott and Joanne Lindley, 'Skill Specificity and Labour Mobility: Occupation and Sectoral Dimensions', *Manchester School*, 73 (2006), 389–413 (p. 396).

[15] European Centre for the Development of Vocational Training, *Future Skills Supply and Demand in Europe: Forecast 2012* (CEDEFOP, 2012), p. 7.

[16] For example, Professor Sir Tim Wilson DL, *A Review of Business-University Collaboration* (Crown Copyright, 2012), p. 2.

[17] Confederation of British Industry, *Emerging Stronger: The Value of Education and Skills in Turbulent Times - Education and Skills Survey 2009* (CBI, 2009), pp. 12–16.

2006, for example, the Government published a paper on the five drivers of productivity, namely: Investment, Innovation, Skills, Enterprise, and Competition. Raising skill levels alone is unlikely to produce maximum productivity gains and innovation: the other drivers noted will play an important role. Equally, the type of skills required to support productivity gains may not be precisely the same as those gained through typical higher education study.

03. SKILLS NEEDS AND IMBALANCES ACROSS SECTORS

This section highlights five key skills issues or imbalances that arose from our initial literature review. For each issue we give a brief overview of how the need can affect industry, based on evidence collected in the review.

Core and employability skills

A consistent theme running through employer feedback on graduate skills is the desire for graduates to possess a set of core or platform skills, including employability skills, which will allow them to contribute fully in the workplace. Employability skills include, for example, fluent communication, teamwork, self management, mathematical and ICT proficiency, analytical skills and commercial awareness. A recent survey of 542 organisations by the CBI found that while employers were increasingly satisfied with the employability skills of graduates compared to non-graduates, weaknesses were noted, for example in team working, problem-solving and work experience. Employability skills are the most important factor taken into account when businesses recruit graduates. Four in five employers (81%) value these skills over degree subject (70%) and class (46%).[18] While the survey is only based on employers covering around 1.6 million people (representing around 6% of all employees in the UK), it gives useful evidence about the importance of employability skills to employers. Increasingly though, and related in part to the English government's reform of higher education funding, both students and universities are also emphasising the importance of employability skills as an outcome of higher education.

Our review of sector specific literature produced many examples of calls for better employability skills. This included calls for skills relating to ICT and digital technology from graduates of all subjects. Employers that provide knowledge-based, professional and business services have emphasised the importance of strong generic IT skills, which are increasingly likely to be valuable, combined with the ability to relate quickly to business processes and business applications.[19] Mathematics and problem-solving skills are also seen as highly desirable across many sectors, and are often in shortage. Often this is in the form of basic mathematical capability, which underpins specific knowledge and assists roles in engineering and life sciences jobs, for example.

Project management skills, including team leadership and the ability to manage project budgets, are also often cited as desirable across many sectors, including engineering, ICT, professional services and construction. Good stakeholder relationship management and the ability to negotiate are emphasised in several key sectors. This is crucial, for example, in the oil and gas industry,

[18] Confederation of British Industry, *Learning to Grow: What Employers Need from Education and Skills - Education and Skills Survey 2012* (CBI, 2012), p. 45.

[19] Department for Business, Innovation & Skills, *Professional and Business Services: A 2020 Vision for Growth* (Crown Copyright, 2010), p. 10.

where the ability of graduate entrants to be able to engage with national stakeholders, government and officials from multinational energy companies was highly desirable.[20]

Sector insight provided by UKCES also noted the value of general entrepreneurial skills, and a good level of commercial knowledge. Similarly it has been noted that a successful creative and cultural sector, particularly in the music, film and video games industries requires commercially savvy, graduates with openness to change and the ability to adapt to new business models and have the ability to change.[21] In the digital industries, multi-skilling is becoming increasingly important, to enable workflow from creation via delivery to storage management, with the ability to work across different media platforms forming a prevalent skills gap in the digital creative industries.[22] Professionals in the video games industry for example, require a fundamental grounding in maths, physics and art, as well as software and computer science.

In recent times the graduate recruitment market for some companies and sectors has become more global in character and professionals working in global companies may be expected to be able to operate effectively across national borders and to manage complex international and intercultural relationships. A report by CFE, CIHE and the Association of Graduate Recruiters (AGR) aimed to define how employers and universities understand global competency and how these can be developed.[23] The report argued that a global mindset, cultural agility and relationship management were core parts of global competency. The concept of a global mindset therefore goes beyond just skill or knowledge development, and into the attributes of outlook, values and character traits. Betty Leask supports this view of a global mindset identifying that globally-oriented individuals will "consider issues from a variety of perspectives; and demonstrate an awareness of their own culture and its perspectives and other cultures and their perspectives".[24]

THE IMPORTANCE OF RELEVANT WORK EXPERIENCE

A key enabler of employability skills is relevant work experience, and this is also repeatedly emphasised by employers across sectors as an important component of their graduate skills needs. For example, a CBI report finds that a quarter of employers are concerned about graduates' limited awareness of careers, and that 37% think graduates should have more work experience.[25] This issue relates to skills that may take time to acquire. This may be difficult to quantify and can often only be passed on through face-to-face interaction, usually through demonstration by a skilled and experienced colleague, followed by a supervised process of trial and error. These kinds of skills can be characterised by the concept of *tacit knowledge*, which in contrast to formal or 'explicit'

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[20] A. Diamond and others, *Global Graduates: Global Graduates into Global Leaders* (CIHE, 2011), p. 10.

[21] T. Fleming and A Erskine, *Supporting Growth in the Arts Economy*, 2011, p. 76..

[22] Creative and Cultural Skills, *Strategic Skills Assessment for the Creative Industries*, 2010, p. 8.

[23] Diamond and others, p. 9.

[24] B. Leask, 'Internationalisation of the Curriculum and Intercultural Engagement - A Variety of Perspectives and Possibilities', 1999. Cited in: J. Fielden, *Global Horizons for UK Universities* (CIHE, 2007), p. 36.

[25] Confederation of British Industry, *Education and Skills Survey 2012*, p. 34.

knowledge cannot easily be written down and transmitted.[26] To a great extent, formal qualifications such as undergraduate and postgraduate degrees are an expression of acquired explicit knowledge. As such, the importance of tacit knowledge (in the form of practical experience relevant to working practices) may be overlooked in some courses. Hence greater integration of work experience programmes and closer links to professional activity within each academic discipline would generally be welcomed by employers – something that already exists for many HE programmes. One study suggests that successful work placements also improve students' degree performance, and ultimately their employability, but also that stronger students are more likely to choose a placement, making the impact of placements challenging to disaggregate.[27]

Demand for Science, Technology, Engineering and Mathematics (STEM) subjects

Calls for graduates with science, technology, engineering and mathematics (STEM) skills have been commonplace across several key sectors of the economy and were evident in the sources reviewed for this paper. Since well before the publication of *SET for Success*[28] in 2002 there has been consensus between Government and business leaders that the promotion of STEM skills is vital to the flourishing of the high-tech, high-value added sectors. In 2011 the CBI proposed that over 640,000 STEM-related jobs must be filled by 2017 for the UK to become a true leader in areas such as advanced manufacturing and low carbon technologies. With new industries recruiting and an ageing workforce retiring, it is widely argued that the country is facing a deficit of qualified, educated professionals in STEM-related jobs.[29]

Much research into STEM skills continues to show that these are in high demand. As an example, the CBI's most recent employer survey suggests that around two in five (42%) respondent employers who need employees with STEM skills and knowledge had difficulties recruiting staff. Half of responding employers also prefered applicants with STEM degrees for non-discipline-specific roles.[30]

The preference for STEM skills is reflected in an earnings premium for many STEM graduates. Many qualifications have higher labour market value if they are in a STEM subject, especially mathematics and engineering qualifications. Individuals earn a particularly high premium if they hold STEM qualifications and work in a STEM-related role. Those working in technology,

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[26] Michael Polanyi and Amartya Sen, *The Tacit Dimension* (Chicago; London: University of Chicago Press, 2009). See also, Patrick Werquin, *Recognising non-formal and informal learning; outcomes, policies and practices*, Organisation for Economic Co-operation and Development (2010). < www.cicic.ca/docs/oecd/rnfil.en.pdf>

[27] N.L. Driffield, C.S. Foster and H.E. Higson, 'Placements and Degree Performance: Do Placements Lead to Better Marks, or Do Better Students Choose Placements' (presented at the ASET Annual Conference, ASET, 2011), p. 9.

[28] Gareth Roberts, *SET for Success: The Supply of People with Science, Technology, Engineering and Mathematics Skills* (HM Treasury, 2002).

[29] CBI, *Building for Growth: Business Priorities for Education and Skills* (CBI, 2011), p. 7.

[30] Confederation of British Industry, *Education and Skills Survey 2012*, p. 7. See also Learning and Skills Improvement Service, *Skills for Economic Growth - An Overview of Priority Sectors* (LSIS, 2010).

engineering and different combinations of these subjects earn significantly more (between 14 and 34 per cent) than those in non-STEM occupations.[31]

This premium is not, however, simply caused by a shortage in STEM graduates. According to research by UKCES, the slow decline in the numbers of students taking STEM subjects at A-level and degree level was reversed in the mid 2000s. The numbers of students enrolled on STEM-related higher education courses has increased from 660,000 to 840,000 between the academic years 2002/03 and 2009/10. This represents a 27 per cent increase, compared to 14 per cent in non-STEM subjects.[32] There are now over 2.4 million people with STEM degrees in employment in the UK, up from 1.7 million in 2004 (an increase of 42 per cent).[33] Indeed, while the number of jobs classified as STEM graduate occupations previously exceeded the numbers of STEM degree holders in the workforce, over time the situation has been reversed: there are now more STEM-related degree holders in the workforce than STEM graduate occupations.[34]

Significant proportions of STEM-qualified graduates are found in employment not related to their degree. This is widely recognised, with analysis indicating that for every two STEM graduates in the labour market, only one is in a STEM-related role.[35] Although not necessarily a problem in itself, the main reason cited for this is a lack of clear ambition to move into a STEM-related career among STEM graduates[36], and higher earning potential in other sectors may also play a role. The quality of STEM graduates is, though, also thought to play a role. Research for BIS found that some 'STEM specialist' employers perceive deficiencies in some STEM graduates' technical ability and subject knowledge. A more common complaint, however, is that STEM graduates lack more general business skills and commercial awareness. CBI's survey suggests the two biggest barriers to filling STEM vacancies are a lack of workplace experience (42%) and, closely related, a lack of employability skills (39%).[37] HEFCE's report on SIVS identified that employer demand for STEM graduates comprises "a broad requirement for numeracy aligned with specific technical skills".[38]

Amongst the cross-cutting skills identified by employers as being in greatest demand, competency in mathematics frequently appears high up the lists of desirable characteristics of graduates. Besides basic numerical competency, the mathematical skills in greatest demand are analytical skills. Demand for mathematics skills in graduates may be categorised in two types: lower level

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[31] C. Greenwood, M. Harrison and A. Vignoles, *The Labour Market Value of STEM Qualifications and Occupations* (Institute of Education, 2011), p. 10. See also Department for Innovation, Universities and Skills, *The Demand for Science, Technology, Engineering and Mathematics (STEM) Skills* (DIUS, 2009)., and R. Mellors-Bourne, H. Connor and C. Jackson, *STEM Graduates in Non STEM Jobs* (Cambridge, 2010).

[32] UKCES, *The Supply of and Demand for High-level STEM Skills* (UKCES, 2011), p. 12.

[33] UKCES, *The Supply of and Demand for High-level STEM Skills*, p. 13.

[34] UKCES, *The Supply of and Demand for High-level STEM Skills*, p. 14.

[35] C. Levy and L. Hopkins, *Shaping Up For Innovation: Are We Delivering the Right Skills for the 2020 Knowledge Economy?*, 2010, p. 11. See also Department for Innovation, Universities and Skills. and, Mellors-Bourne, Connor and Jackson.

[36] Mellors-Bourne, Connor and Jackson, p. 160.

[37] Confederation of British Industry, *Education and Skills Survey 2012*, p. 17.

[38] Higher Education Funding Council, *Strategically Important and Vulnerable Subjects: The HEFCE Advisory Group's 2010-11 Report* (HEFCE, 2011), p. 19.

maths skills that are lacking in otherwise high-skilled graduates, and high-level skills in demand as part of a high-skilled role. The high-level mathematics skills required by STEM industries include the ability to perform mathematical modelling, use of technical software packages, costing exercises, and performance indicators. A report on demand within the finance sector, which consulted over 400 finance and HR managers, revealed that one third (34%) of respondents feel that the maths skills of recent hirings had become worse over the past five years. Of those employed in the respondents' workforce, 29% had studied mathematics to A-level, 17% to undergraduate level, and 15% to postgraduate level.[39] Basic mathematical capability and application of mathematical knowledge was also identified in research in 2008 concerning skills supply in pharmaceutical and biomedical sciences.[40]

Demand for STEM skills, and consequently STEM graduates, should remain strong for the foreseeable future. At present, there does not appear to be a problem with the supply of STEM graduates so much as their career directions and work-readiness. While recent efforts to increase interest in STEM among A-level and first degree students do appear to be bearing fruit, there may be further scope for advice on STEM careers pre- and post-graduation, as well as for business-university collaboration to improve work-readiness. More fundamentally, the concept of STEM is based on *subjects*, which do not easily map across either to sectors or occupations. For this reason, thinking in terms of STEM subjects is arguably not as valuable as more specific consideration of the skills and occupations that are actually in demand in the economy.

Sector specific skills needs

Our review of literature also noted a wide range of industry or occupation specific skills and competencies that were either in demand, or considered highly desirable in graduates. In many cases, skills needs mentioned in the literature were unique to the sector and were often required for specific applications, or new and evolving technology. Examples of this include skills shortages in the life sciences industries in specific technical areas, including clinical pharmacology, drug metabolism and ADME, pharmacological modelling, chemical and process engineering, statistics and computational chemistry. For employers in this sector, a major concern highlighted is the lack of practical experience held by graduates leaving life science degrees, which may not pick up these specific skills and competencies.[41] Research by the BBSRC Bioscience Skills and Careers Strategy Panel identified similar concerns in niche subject areas of bioscience that were strategically important for the sector, but where future demand for graduates would likely outstrip supply. These included whole animal physiology, industrial biotechnologies, plant and agricultural sciences, systematic microbiology and zoological taxonomy. A recent report by Cogent suggests that skills demand in the life sciences sectors will become increasingly diverse, dependent upon

[39] Robert Half, *City Managers Suffering from Maths Skills Shortages*, 2009, p. 3.

[40] ABPI, *Skills Needs For Biomedical Research: Creating the Pools of Talent to Win the Innovation Race* (ABPI, 2008), p. 5.

[41] ABPI, p. 6.

specialist capability, and reliant on highly developed skills in research methodologies.[42] As another example, the aerospace industry is facing similar concerns, with employers seeking graduates with specific knowledge in subjects such as fatigue, damage, tolerance, stress and composite materials.[43]

There is also indication in the energy sector that employers struggle to identify graduates with relevant knowledge, skills and competencies, and with appropriate degree specialisation towards requirements of the industry.[44] For senior occupations in the oil and gas sector, analytical skills, such as statistical analysis, numerical reasoning and information modelling techniques are increasingly sought after. A report published by Accenture in 2012 highlights the increased need for predictive analytics to support upstream and downstream operations, and warns of a future shortage of analytical scientists as growth and demand in the industry gathers pace. The sector will depend increasingly on strategic management skills, to effectively plan and deliver the future capacity and infrastructure of the energy network, and also on professional and technical skills to help design and develop new energy production and distribution techniques. Technological development will evidently hold implications for the types of skills required in the sector, for example in research and development and the development of onshore and offshore wind, solar and marine energy, carbon capture and storage.

Sector specific skills needs change over time and other sources from the literature reviewed show a concern for graduates who are up to date with the latest developments in an industry or in technology. For example, the construction sector, which is continually evolving and adapting its approach to buildings and infrastructure, increasingly needs managers with up-to-date knowledge and skills. These include planning, logistics and commissioning skills, and awareness of Modern Methods of Construction (MMC) and the low carbon agenda.[45] New approaches such as Building Information Modelling and Management (BIMM), and increased growth in offsite manufacturing are also set to play a pivotal role as the industry moves from recession to recovery.[46] As technology changes over time, it is therefore arguably important that graduates are equipped with the platform skills and adaptability to respond to changing requirements over time.

Re-skilling and up-skilling the workforce is a priority for employers across most sectors, particularly for individuals in professional occupations. For example, standards and business practices in the accountancy sector, a continually changing, and must be adhered to by chartered professionals. Accountancy standards are normally regulated by one of five professional bodies in total,[47] all of which uphold requirements for continuing professional development (CPD). This

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[42] Cogent, *Life Sciences & Pharmaceuticals: A Future Skills Review with Recommendations to Sustain Growth in Emerging Technologies*, 2010, p. 12.

[43] Department for Business, Innovation & Skills, *Lifting Off: Implementing the Strategic Vision for UK Aerospace* (BIS, 2013), p. 56.

[44] See: A. Harris, 'Power Skills in Short Supply', *Engineering and Technology Magazine*, 2011.

[45] UK Commission for Employment and Skills and Institute for Employment Research, *Sector Skills Insights: Construction* (UKCES, 2012), p. 22.

[46] Construction Skills, *Construction, Building Services Engineering and Planning: Sector Skills Assessment 2012* (UKCES, 2012), p. xiv.

[47] UK Commission for Employment and Skills, *Building Future Skills in Accountancy* (UKCES, 2011), p. 4.

creates an ongoing demand from employers to maintain and update technical skills and knowledge in chartered members, the vast majority of whom are graduates. Similarly, CPD and re-skilling are commonplace in the ICT sector and in many professions. The rapidly changing nature of systems and software necessitates continual workplace training to augment and adapt workers' skills.[48]

Ageing workforce and replacement demand

Across the economy, most of the future demand for individuals of all skills levels comes not from growth, known as 'expansion demand', but from the need to replace workers who leave the workforce due to retirement, career change, or other reasons. This is referred to as replacement demand. Replacement demand far outweighs the extent of expansion demand; recent analysis predicts that the net requirement, or total number of job openings taking replacement demand into account will reach 13 million in the years up to 2020, compared with a predicted overall increase in employment of around 1.5 million.[49] Replacement demand will affect all sectors and industries of the economy, and all occupational levels, to some extent, but will be more pronounced in some areas than others. For example, certain groups, such as lower level, administrative posts and skilled trades will experience a contraction in employment in the years up to 2020, which will somewhat offset the need to recruit individuals to replace those that retire or leave their posts. Other occupations, such as managerial, professional and associate professional posts are expected to rise, and as such replacement demand will reinforce this trend.[50] Some industries, such as engineering, manufacturing, and energy generation, face particularly significant replacement demands, particularly for senior-level, managerial and professional posts, which would need to be met through a combination of existing staff progressing to senior levels, as well as new sector entrants.

The UK workforce as a whole is ageing. Labour market participation for the 50-64 age group has increased in recent years and the percentage of workers aged 65 or over has doubled over the last decade. This is due to a range of factors, including increasing life expectancy, and increased financial necessity.[51] Recent data from the Labour Force Survey shows that of those aged 16 to 64, the proportion classified as economically inactive is 22.2%, the lowest since 1991.[52] At the same time, the unemployment rate for 18-24 year olds has steadily increased in the last decade, from 10.4% in 2003, to 18.9% in 2013.[53]. These details support the overall picture of an ageing workforce amidst an ageing population, to some extent also affecting job openings for younger people.

Labour Force Survey statistics indicate that the age profile of industry sectors is varied, with a number showing relatively high proportions of employees aged over 50, such as Agriculture,

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[48] Organisation for Economic Cooperation and Development, *ICT Skills and Employment: New Competencies and Jobs for a Greener and Smarter Economy* (OECD, 2012), p. 6.

[49] Wilson and K. Homenidou, p. XVI.

[50] Wilson and K. Homenidou, p. XVII.

[51] Parliamentary Office of Science and Technology, *An Ageing Workforce*, 2011, p. 1.

[52] See: Office for National Statistics, *Labour Market Statistics* (ONS, 2013).

[53] See: Office for National Statistics, Labour Market Trends (ONS, 2003), S.31.

Mining and Quarrying, Health and Social Work, and Real Estate activities (Table 7). However, not all of these sectors will have significant implications for higher level skills demand; some sectors will be steadily declining in employment, and replacement demand may not be focused upon individuals in occupations that require education to degree-level or equivalent.

Taking a closer look at the composition of the labour force in each sector offers some additional insight into possible impacts that replacement demand may have. Table 7 below shows the proportion of employment in each industry sector aged 50 and above, who are qualified to a higher level (Level 4+), and who are in an occupation equivalent to the highest three Standard Occupational Classification Groupings.[54] The data suggests that some sectors may have more significant concerns over future replacement demands than others, depending on the proportion and overall number of individuals that may leave the workforce. There is some variation in the proportion of individuals aged 50 or above when occupational level or the presence of higher level qualifications is considered. Generally, the proportion aged above 50 with higher level skills is lower than the proportion aged 50 who are employed in senior occupational roles, although there is considerable overlap between these two groups. For example, nearly a third (34.6%) of the manufacturing workforce are aged over 50 and in a senior role, but just over a quarter (26.8%) are both aged above 50 and hold a qualification at Level 4 or above. Some sectors, such as Agriculture forestry and fishing, Construction, and Transport and Storage, have a relatively high proportion of individuals aged over 50 with higher level qualifications, in comparison their respective workforces as a whole (see Table 5).

[54] These are either a) Directors, Manager and Senior Officials, Professional Occupations, and Associate Professional and technical occupations

Industry sector	% aged above 50	% aged above 50 in senior roles	% aged above 50 with higher level skills
T Households as employers	44.2%	29.3%	54.4%
A Agriculture, forestry and fishing	44.1%	42.9%	42.4%
B Mining and quarrying	38.7%	34.6%	33.2%
L Real estate activities	35.8%	35.7%	31.3%
H Transport and storage	33.9%	32.3%	29.2%
P Education	33.7%	32.1%	31.1%
Q Health and social work	32.6%	31.8%	28.7%
C Manufacturing	31.6%	32.1%	26.8%
F Construction	30.8%	34.9%	27.5%
O Public admin and defence	30.8%	26.5%	25.4%
S Other service activities	29.9%	34.8%	33.0%
E Water supply, sewerage, waste	29.6%	37.2%	26.8%
N Admin and support services	29.5%	26.1%	21.3%
R Arts, entertainment and recreation	29.5%	31.3%	27.5%
D Electricity, gas, air conditioning supply	27.8%	26.1%	24.5%
M Prof, scientific, technical activities	27.6%	26.9%	23.6%
G Wholesale, retail, repair of vehicles	26.4%	30.7%	19.4%
U Extraterritorial organisations	26.3%	22.5%	26.9%
J Information and communication	20.1%	19.6%	17.3%
K Financial and insurance activities	18.9%	18.4%	13.2%
I Accommodation and food services	16.6%	26.7%	13.6%

Table 7: Breakdown of aged over 50 in each sector, by those holding a higher level qualification and by those employed in a senior-level, professional, or associate-professional occupation (Source: Quarterly Labour Force Survey, Spring 2013)

Describing the current proportions of qualifications and age profiles in this way may indicate where possible future replacement demands will be focused. However, it should be noted that this information should be analysed further in the context of differing levels of supply and demand in each sector, and in light of the overall evolution of the economy. Understanding replacement demand in the context of differing levels of skills supply is likely to be highly complex, especially because degree-level provision may be relevant to a number of sectors, and because the demand for skills is influenced by a number of interrelated issues. Moving on from estimations based upon the Labour Force Survey, our rapid evidence assessment found replacement demand to be a significant concern for a number of key industries and sectors in the UK. A significant number of sector and industry-centric publications touch upon the issue of an ageing workforce and highlight concerns about future issues with skills supply and demand.

In the engineering industries specifically, it is estimated that demand for graduate engineers is heavily shaped by the pressures of an ageing workforce and the need to meet replacement demand, despite an overall reduction in employment levels in some parts of the sector. Research by SEMTA highlights a need for about 232,000 additional employees to replace those retiring during 2010-16. The greatest proportion of this demand will be for managerial and professional roles, with medium-low skilled jobs projected to decrease.[55] The Royal Academy of Engineering also provides similar estimates, and notes that surveys of STEM graduates indicate that this demand will not be fully met through fresh graduates from UK universities alone. Recognising this potential shortage, the Institute for Mechanical Engineers has called for a step change in the number of graduate engineers, to address economic, transport, energy and environmental challenges over the coming decades.[56]

The picture is similar for advanced manufacturing industries, such as the aerospace industry, pharmaceuticals, optics and the nuclear workforce. Cogent (the Sector Skills Council for Nuclear), has noted that the age profile of the civil nuclear workforce is older than, and retires earlier than the UK workforce in general, and estimate that in one scenario, up to 70% of current employees will retire by 2025.[57] The report points to a possible skills gap of 14,000 highly skilled nuclear employees by 2025, in a scenario where significant attrition of the current workforce through retirement is combined by an economic demand to design, build and operate a new fleet of nuclear power stations. While the broader manufacturing, energy and construction sectors all show fairly high proportions of employees aged above 50 in Table 7 above, it is only when focusing on specific workforces, such as nuclear, that the possible impact of replacement demand becomes clearer. It has also been noted that a significant proportion of the aerospace workforce will retire in the next 10 years, highlighting a crucial need to attract engineers and technicians to the sector.[58] SEMTA estimates that 32% of the aerospace workforce are aged above 45, and that the workforce has a higher proportion of individuals qualified to Level 4 or above than the rest of the workforce as a whole.[59]

Similarly in the energy sector future skills demand may be driven by many interrelated issues, such as government regulation, technology and societal pressures, as well as replacement demand. Available literature suggests that the sector is facing significant challenges in future skills demand, owing to an ageing workforce, an ageing energy infrastructure, and the increasing imperative to reduce carbon emissions.[60] To meet this potentially additional demand, and replace retirees, the industry needs to recruit, develop and up-skill around 45,000 people by 2014, including 5,000 graduate entrants. The literature identifies an acute shortage of suitably qualified energy

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[55] SEMTA, *UK Summary Report: Sector Skills Assessment for Science, Engineering and Manufacturing Technologies*, 2010, p. 4.

[56] Institution of Mechanical Engineers, *Meeting the Challenge: Demand and Supply of Engineers in the UK*, 2011, p. 2.

[57] Cogent, *Power People: The Civil Nuclear Workforce 2009-2025*, 2010, p. 9.

[58] The Aerospace Growth Partnership, *Reach for the Skies: A Strategic Vision for UK Aerospace* (BIS, 2013), p. 20.

[59] SEMTA, *Aerospace: Labour Market Intelligence Factsheet*, 2010, p. 1.

[60] See: Engineering Construction Industry Training Board, 'Meeting the Challenges of the Future', 2013 <http://www.ecitb.org.uk/AboutECITB/MeetingTheChallengesOfTheFuture/>.

professionals in the UK workforce, worsened by the rate of people retiring or otherwise leaving the industry.[61] The issue is further complicated by the fact that some roles, such as engineering graduates, are in high demand across several sectors of the economy.[62]

Qualitatively there is a perception in several industries that replacement demand may exacerbate skills shortages in future. Other sectors such as construction, and specialised industries such as agri-tech have both also raised replacement demand as a key concern.[63] However, it is not possible to determine from the literature what the precise impact that the retirement of senior-level, higher skilled individuals will have. Partly this is a problem of definition, since many that retire will possess higher level skills, but may not have these accredited through a formal qualification, such as a degree or equivalent.[64]

The impact of the ageing workforce needs to be considered against the backdrop of new talent entering the sector.. Our evidence review suggested that the attractiveness of careers and employment in the sector plays a role in determining skills supply, and thus may alleviate or exacerbate demand as older workers leave the sector. In the oil and gas industry for instance, it has been recognised that more can be done to improve the image of the sector for young people and graduates, and communicate the benefits that careers in the industry can bring. The perception that oil and gas are 'sunset industries' with an unsustainable future may impact upon the attractiveness of the sector to new graduate talent. The Journal of Pipeline Engineering notes a number of specific barriers that may deter graduates from entering the industry, including issues with diversity, an older than average workforce demographic, the possibility of redundancy, and the requirement to gather experience for a long time before being considered for a mid-level role.[65] All of these issues may be impede upon the industry's ability to offset replacement demand. The Energy Institute goes further to draw attention to a perceived 'disconnect' between skills supply and demand, whereby the industry faces a shortage of competent individuals to support it, despite there being a plentiful pool of young engineering and technical graduates available. The cyclical nature of employment in the industry (caused by the ebb and flow of demand for drilling and upstream activities, for example) means that many qualified individuals will opt for more stable careers elsewhere. Concerns about employment prospects are mentioned widely as a constraint upon skills supply, particularly in high-value, high-tech industries. For instance, in biosciences, it has been noted that current skills shortages from employers relates to a general lack of employment opportunities discouraging students from choosing to specialise in these areas.[66] In common with other sectors mentioned, the age profile of the workforce suggests a significant workforce replacement demand due to retirement in the years leading to 2020.

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[61] See: Engineering Construction Industry Training Board, *Securing Engineering Construction Skills for the Future* (ECITB, 2008).

[62] UKCES, *Energy Production and Utilities: Sector Skills Assessment 2012*, 2012, p. 67.

[63] See: Construction Skills, p. 151. & Food Research Partnership Skills Sub-Group, p. 29.

[64] SEMTA, *UK Summary Report: Sector Skills Assessment for Science, Engineering and Manufacturing Technologies*, p. 88.

[65] P. Hopkins, *The Skills Crisis in the Pipeline Sector of the Oil and Gas Business* (Penspen, 2008), p. 10.

[66] BBSRC Bioscience Skills and Careers Strategy Panel, *Strategically Important and Vulnerable Capabilities in UK Bioscience* (BBSRC, 2009), p. 4.

Expansion demand in emerging industries may further constrain the pool of young graduate talent available. For example, in a scenario where the offshore wind industry grows to a much higher capacity, it may need to compete directly with the oil and gas industry for engineers and energy professionals with the same or similar skillsets.[67] Engineers' skills are highly versatile and often transferable across several industries, and employers are known to pay sizable wage premiums to ensure an adequate intake of graduate engineers.[68] This becomes a problem for emerging industries such as offshore wind, because they are unlikely to be able to compete with wages and benefits offered by employers in the oil and gas industry.[69]

Gender and diversity issues

Imbalances in workforce diversity were also raised in material covered by our literature review. These issues extend beyond straightforward skills needs but are often covered in literature about graduate skills demand, and may be highly relevant for employers in some sectors, particularly where there are also skills shortages.

Research by CIPD argues that effective management of workforce diversity makes an important contribution to sustaining economic competitiveness. Employers are often keen to attract and retain the skills needed to develop a sustainable and competitive advantage; ensuring diversity at the recruitment stage ensures that there are no unnecessary barriers to any appropriately qualified applicant gaining a position.[70] Therefore ensuring diversity is good practice from the perspective of raising access for the best and brightest candidates, in addition to upholding equal and fair opportunities, and corporate and social responsibilities. Thus, limiting access for any reason other than quality of candidate is a lost opportunity for employers. However, evidence suggests that many sectors have issues with diversity, and that the supply of graduates entering industry is not always diverse in terms of gender and ethnicity across different subjects. In this section we discuss gender and ethnicity, but other issues could include socio-economic background, location of study and employment.

GENDER

Gender imbalance is an issue for some sectors, reflected in both the current composition of the workforce, and also in the supply of qualified male and female higher education graduates. This is in part related to established gender imbalances across undergraduate subject areas. A number of subject areas are dominated by male students, including engineering and technology (86.4%) and computer science (83.3%). Other subjects have much higher female participation, including

[67] I. Edwards, *Overcoming Challenges for the Offshore Wind Industry and Learning from the Oil and Gas Industry*, 2011, p. 159.

[68] Royal Academy of Engineering, *Jobs and Growth: The Importance of Engineering Skills to the UK Economy* (RAENG, 2012), p. 20.

[69] UKCES, *Maximising Employment and Skills in the Offshore Wind Supply Chain*, 2011, p. 46.

[70] Chartered Institute for Professional Development, *Managing Diversity: People Make the Difference at Work - but Everyone Is Different* (CIPD, 2005), p. 14.

subjects allied to medicine (81.2%), education (80.7%) and languages (68.1%).[71] Whether these imbalances are seen as a problem for employers in the sector is variable, and employers may or may not seek to address them. If employers or sectors are able to meet skills needs by recruiting more males than females, or vice versa, then they do, and there is not necessarily a problem. Equally though, some sectors see addressing gender imbalance as an important strategic issue, particularly to encourage workforce diversity, and extend the pool of potential applicants and employees.

Table 8 gives a high level indication of gender breakdown by sector in the UK workforce. The data suggests that gender imbalances are common and vary across sectors. Sectors with high majorities of male workers include construction, mining and quarrying, agriculture, forestry and fishing. Men are also slightly in the majority across the workforce as a whole, at 53%. Sectors with majorities of women include health and social work, households as employers and education.

The table also shows the breakdown of employees working in higher occupational roles (classified as either Managers, Directors, Senior Officials, professional occupations and associate professional occupations), broken down by gender. Here we can see that the gender balance in each sector is broadly similar amongst senior-level employees in comparison to the entire workforce. In some sectors, gender disparities become more pronounced at the higher occupational levels (e.g., manufacturing), while in others they become less pronounced (agriculture, forestry and fishing). In other service activities, the gender picture reverses at higher occupational levels, with men taking six in ten higher occupational roles, compared with four in ten across all levels.

[71] For a full breakdown of gender by degree subject see: HESA, *Students and Qualifiers*, accessible at www.hesa.ac.uk/index.php/content/view/1897/239/.

Industry sector	Total employees in sector	% Male	% Female	Total employed in Senior occupations	% Male	% Female
Q Health and social work	3,958,918	20.9%	79.1%	1,972,309	25.2%	74.8%
P Education	3,090,965	28.0%	72.0%	1,904,059	36.4%	63.6%
M Prof, scientific, technical activities.	1,992,525	59.2%	40.8%	1,491,607	65.5%	34.5%
O Public admin and defence	1,841,733	51.9%	48.1%	1,148,415	60.1%	39.9%
C Manufacturing	2,911,815	76.4%	23.6%	1,121,797	79.7%	20.3%
G Wholesale, retail, repair of vehicles	4,011,980	51.9%	48.1%	1,057,658	63.0%	37.0%
J Information and communication	1,152,955	71.7%	28.3%	938,877	76.4%	23.6%
K Financial and insurance activities	1,149,752	55.8%	44.2%	730,560	67.4%	32.6%
F Construction	2,100,132	88.5%	11.5%	553,785	86.1%	13.9%
N Admin and support services	1,346,352	55.3%	44.7%	386,977	58.9%	41.1%
R Arts, entertainment and recreation	721,763	53.2%	46.8%	384,064	58.5%	41.5%
S Other service activities	795,048	38.4%	61.6%	263,922	57.6%	42.4%
I Accommodation and food services	1,492,423	46.4%	53.6%	262,879	55.8%	44.2%
H Transport and storage	1,478,678	80.9%	19.1%	260,719	83.1%	16.9%
L Real estate activities	341,573	49.4%	50.6%	218,561	53.7%	46.3%
D Electricity, gas, air conditioning supply	181,069	75.7%	24.3%	86,643	82.0%	18.0%
E Water supply, sewerage, waste	220,988	77.0%	23.0%	73,007	71.7%	28.3%
B Mining and quarrying	133,080	82.7%	17.3%	67,925	83.8%	16.2%
A Agriculture, forestry and fishing	302,785	72.3%	27.7%	44,959	67.5%	32.5%
U Extraterritorial organisations	38,930	64.2%	35.8%	25,927	69.5%	30.5%
T Households as employers	58,627	26.3%	73.7%	1,833	35.1%	64.9%
Total	29,322,091	53.3%	46.7%	12,996,483	57.1%	42.9%

Table 8: Workforce by sector, with gender breakdown (Source: Quarterly Labour Force Survey, Spring 2013)

Gender imbalance in the workforce therefore varies greatly by sector and discipline. We found numerous examples of gender imbalances through our literature review. For instance, within the education sector female teachers outnumber men at primary school level, but in later stages of education the balance tips the other way. Primary teaching faces a relative shortage of male applicants, compared to female, meaning that the Teaching Agency monitors this proportion. In

2012/13 a record number and proportion of men are due to enter primary teacher training: 20% (up from 18% in 2010).[72] However, the gender imbalance across primary teachers clearly remains an issue, to encourage healthy numbers of new entrants, workforce diversity, but also to ensure sufficient male role models for children. Conversely, in some sectors (such as in Agriculture, forestry and fishing, and Water supply, sewerage and waste), the proportion of women increases when focusing on senior occupations only.

From our literature review, we found considerable discussion of gender imbalance as a particular issue in the manufacturing and engineering industries, including at higher skill levels.[73] The challenge in these sectors starts well before graduates reach the labour market, with the subject choices young people make at university and before. The predominantly male image of the sector, combined with a lack of female role models, affects supply from STEM education and other sectors. Initiatives such as the SEMTA Career Advancement and Progression training programme, and the WISE campaign are specifically designed to redress this balance and may ease tensions on employer demand in future years.[74] A study by Engineering UK found that applications to engineering degrees by women are the lowest for any STEM subject, and are significantly lower than the average for Europe and the rest of the world.[75] Similar issues apply across different STEM disciplines, for example the Institute of Physics has produced several studies exploring the gender imbalance in physics A-level and undergraduate degrees.[76] It is suggested that ways to address the STEM gender imbalance include the proven method of using role models to raise awareness of career opportunities amongst women. Improvements in careers guidance is identified as another area that could address this issue, together with greater awareness of the ecological ('green') credentials of manufacturing and engineering roles, and greater awareness of the potentially high salaries attached to these jobs. A report by the Council for Industry and Higher Education (CIHE) in 2011 emphasised the importance of setting targets for girls achieving good A-level results in physics or its equivalent subjects to act as a pipeline for a range of STEM related careers, particularly those in manufacturing and engineering.[77]

Gender imbalances also persist and often become more pronounced at higher leadership levels across many sectors. In 2010 a review commissioned by government found that in the corporate boards of FTSE 100 companies, only 12.5 % of positions are occupied by women, and in the executive directorships of those companies, women make up only 5.5%.[78] The main barriers for

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[72] Teaching Agency, *Initial Teacher Training Census 2012 Summary* (Department for Education, 2012), p. 7.

[73] See: WISE, *Putting Gender on the Agenda for Advanced Manufacturing and Engineering*, 2012 <http://www.wisecampaign.org.uk/blogs/getset-women/2012/12/putting-gender-on-the-agenda-for-advanced-manufacturing-and-engineering>.

[74] See WISE, *About us*, <www.wisecampaign.org.uk/about-us/>.

[75] Engineering UK, *Women in Engineering and Technology* (Engineering UK, 2010), p. 1.

[76] For example, see: Institute of Physics, *It's Different for Girls*, (2012). See also wider gender analysis in HEFCE data at <www.hefce.ac.uk/whatwedo/crosscutting/sivs/data/>.

[77] Council for Industry and Higher Education, *Great Expectations; Top Manufacturing and Engineering Talent 2030, Creating the Pipeline* (CIHE, 2011), pp. 6–7.

[78] Department for Business, Innovation & Skills, *Women on Boards* (BIS, 2011), p. 15.

women within this area are a lack of flexibility around work/life balance (particularly maternity leave) and perceptions of a traditionally male culture relating to an 'old boys' network which offers few opportunities for women. The *Women on Boards* report recognised that at the current rate of change, it would take 70 years to achieve gender balance in UK boardrooms. It recommended that all FTSE 350 chairs should set targets for the percentages of women they aim to have in 2013 and 2015, and it set a target of 25 % female representation within FTSE 100 boards by 2015. The latest data shows that the rate of change has increased since the first report in 2011, and is on course to achieve the target of 25% by 2015, provided that women are appointed to one third of all new appointments. As of 1st March 2013, there were 192 out of 1,100 women directors on FTSE 100 boards (17.3%).[79]

ETHNICITY

Ethnic diversity is also an issue in some sectors, and particularly in leadership positions. Analysis of the Labour Force Survey suggests that in 2013 10% of the workforce is from an ethnic minority background (see table below). This proportion varies substantially across sectors, from 1.2% in agriculture, forestry and fishing, to 15.9% in accommodation and food services. There is also evidence of imbalance in the creative industries, with the percentage of BAME employees in some sectors being lower now than prior to the recession.[80] Employment levels are also disproportionate: while over 70% of white people are employed, this compares to only 59% for Black, Asian and Minority Ethnic (BAME) people. Although varying levels of ethnic diversity across sectors may not necessarily be a cause for concern, there is increasing awareness not only of the value of diverse workforces, but also of the importance of equality of opportunity, particularly for higher level roles. Currently of FTSE 100 directors, 5.7% are from an ethnic minority, with only a minority of these British nationals.[81]

Industry sector	Number employed	% from BME groups
U Extraterritorial organisations	38,930	23.4%
I Accommodation and food services	1,492,423	15.9%
J Information and communication	1,152,955	13.9%
Q Health and social work	3,956,219	13.9%
H Transport and storage	1,478,678	13.6%
T Households as employers	58,077	12.8%
K Financial and insurance activities	1,149,246	12.7%
G Wholesale, retail, repair of vehicles	4,010,357	11.0%
N Admin and support services	1,344,944	11.0%
M Prof, scientific, technical activities	1,991,181	9.4%
S Other service activities	794,423	8.9%

[79] Department for Business, Innovation & Skills, *Women on Boards: Second Annual Review* (BIS, 2013), p. 2.

[80] Creative and Cultural Skills, p. 23.

[81] See: Race for Opportunity, *Campaign Aims*, <http://raceforopportunity.bitc.org.uk/about-race-opportunity/campaign-aims>.

P Education	3,089,412	8.1%
L Real estate activities	341,075	7.5%
O Public admin and defence	1,840,352	7.3%
D Electricity, gas, air conditioning supply	181,069	7.0%
C Manufacturing	2,911,815	6.8%
R Arts, entertainment and recreation	721,198	6.5%
B Mining and quarrying	133,080	6.1%
F Construction	2,099,134	4.7%
E Water supply, sewerage, waste	220,988	1.6%
A Agriculture, forestry and fishing	302,785	1.2%
Total	29,308,341	10.0%

Table 9: Breakdown of ethnicity in each sector (Source: Quarterly Labour Force Survey, Spring 2013)

These trends are reflected similarly when focusing only on individuals with in senior occupational roles. However, the proportion of the workforce belonging to a BME group is slightly lower for all sectors among individuals who are Managers, Directors and Senior Officials, Professionals, or Associate Professionals.

At the university level, varying degrees of ethnic imbalance exists within undergraduate courses. The highest proportion of white applicants (94.5%) is seen in veterinary science and agriculture. Subjects with the largest proportions of non-white applicants include medicine and dentistry (42.3%). Other subject areas with large proportions from ethnic minorities include law, business and subjects related to medicine (30.1%).[82] For industries that rely on graduates of specific subject areas, the ethnic make-up of the student and then graduate population affects the pool of available recruits, and can perpetuate imbalances. Therefore for some employers, it would be necessary to influence the choices young people make at school and university in order to address ethnic (and other) imbalances effectively.

[82] Engineering UK, *The State of Engineering* (Engineering UK, 2013), p. 76.

04. QUESTIONS FOR FURTHER DISCUSSION

This short review of literature on graduate demand from industry has identified some key areas for further investigation. Here we present some high level question areas that would be interesting to investigate further with employers and universities.

Overall supply of graduates and skills

- *Do employers agree that there is not an overall shortage of graduates in the labour market?*
- *Are there felt to be shortages in particular sectors or subject areas?*
- *How far do employers see the supply of postgraduate level skills as a particular issue for their sector?*
- *How far does the supply of graduates with appropriate skills affect or enable productivity gains? How does this compare to other key drivers of productivity: investment, innovation, enterprise, and competition?*

Skills needs and imbalances across sectors

- *Are graduates leaving university with the right combination of subject expertise and core, platform skills? How can employers give feedback on their perceptions of graduate employability to support universities?*
- *Universities are becoming increasingly focused on developing employability and work experience opportunities for students. How can these be extended and quality maintained? How can employers best support these developments (for example by providing high quality work placement opportunities to students)?*
- *Are there sufficient applicants from STEM backgrounds in key industries? How can industry, universities and schools work together to promote STEM related careers to students and graduates and to promote diversity in this cohort?*
- *In technical disciplines are university courses covering the right topics to meet industry needs? How can businesses articulate their subject specific needs to universities and maintain regular feedback as needs change?*
- *Are there sufficient numbers of new graduate or high skilled entrants to support industries that will lose high skilled staff due to retirement? Are the staff development structures in place to up-skill the existing workforce, should this be necessary, and what role should higher education play in this?*
- *How far do gender or ethnicity imbalances affect employers' businesses? How far do they relate to higher level and other skills needs? How can employers support universities and schools to encourage students of all types to apply for STEM and other subjects? How can industry do more to ensure equality of access to progression opportunities for under-represented groups?*
- *More fundamentally, how valid are individual or collective employers' views in shaping higher education? What weight should universities and government give employer concerns, against other factors shaping HE or policy development? Should employers develop their own responses to skills gaps or shortages and when should universities or governments become involved?*

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