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The supply of and demand for high-level STEM skills

Briefing paper

December 2011

UKCES
UK COMMISSION FOR EMPLOYMENT AND SKILLS

Contents

Acknowledgements

Thanks to Richard Holt and Steve Johnson at Consulting Inplace and to Graeme Harrison at Oxford Economics for providing the data analysis, and to Helen Connors for her comments.

We hope you find this paper useful and informative. Please contact Aoife Ni Luanaigh (aoife.niluanaigh@ukces.org.uk) with any queries. Previous briefing papers produced by the UK Commission can be accessed via www.ukces.org.uk

Introduction

This briefing paper considers the supply of and demand for high-level science, technology, engineering and mathematics (STEM) skills in England. It draws on detailed analysis of STEM skills supply, demand and mismatches carried out for the UK Commission for Employment and Skills (UK Commission) by Oxford Economics and Consulting Inplace, as well as key findings from the 2009 National Employer Skills Survey (NESS). It aims to add to the evidence base on high-level STEM skills and identifies a number of areas for further discussion.

STEM skills support research, innovation and high-tech manufacturing, and are seen as critical to the UK's international competitiveness in these areas. Recent media coverage suggests that there is a problem with STEM skills: some employers report that they cannot recruit people of the calibre and with the skills they need, and that this is harming their businesses. However, other sources suggest that the supply of STEM skills is more than sufficient to meet demand, and that the focus needs to be on improving the ways in and extent to which these skills are used in the economy.

This paper sets out and analyses evidence on the supply of and demand for high-level STEM skills, and argues that the picture is much healthier than often suggested.

The paper is structured around the following themes:

- How do we define high-level STEM skills?
- Why are high-level STEM skills important?
- Does England have a STEM skills problem?
- What are the key challenges?

How do we define high-level STEM skills?

STEM disciplines include science, technology, engineering, and maths. STEM skills are those skills which support scientific enquiry and research, and the growth of these disciplines. They include:

- data analysis and interpretation
- research and experimental design
- testing hypotheses
- analysis and problem-solving
- technical skills.

For this paper, we have defined high-level STEM skills as those skills which are held by people with a STEM-related qualification at Level 4 and above. We have adopted a pragmatic approach based on data availability, and used the number of people with a degree-level qualification in science, technology, maths and engineering subjects as a proxy for high-level STEM skills supply.

We acknowledge that high-level STEM skills can also be gained through vocational routes as well as on-the-job learning, but there is a lack of accurate data on the latter, so degree qualifications are used as a proxy measure.

STEM subjects at higher education (HE level) are defined on the basis of HESA's Joint Academic Coding of Subjects (JACS) codes. The underlying analysis for this paper uses a broad definition of STEM subject areas which includes the following subject groups:

- Medicine & Dentistry
- Veterinary Sciences
- Subjects Allied to Medicine (excluding Nursing)
- Agriculture & Related Subjects
- Biological Sciences (including Psychology and Other Biological Sciences)
- Physical Sciences (including Chemistry, Physics, Archaeological and Forensic Sciences, Physical Geography and Other Physical Sciences)
- Technologies
- Engineering
- Mathematical Sciences
- Computer Sciences
- Built Environment (including Architecture and Building subjects but excluding Planning subjects).

The annual supply of STEM skills therefore equates to: the number of graduates from degree-level STEM programmes; and the stock of STEM skills to the number of STEM degree-holders in the workforce.

Demand for STEM skills is more difficult to define and quantify. Employers may seek generic skills often associated with STEM qualifications (such as numeracy, IT skills, and logical thinking) or they may seek specific competencies, such as lab analysis techniques. For this paper, the demand-side analysis was based on STEM occupations. STEM occupations cannot be simply defined by sector, as many people working in STEM sectors will not be in STEM occupations, and vice versa (for example, an HR manager in an engineering firm is not a STEM occupation, whereas an IT specialist in a fashion company is).

This paper focuses on high-level STEM skills (as defined above). The underpinning analysis therefore adopted a definition of high-level STEM occupation based on the following criteria:

- the occupation has a high proportion of graduates
- the occupation has a high proportion of STEM-degree holders
- the occupation has a high proportion of STEM-degree holders among graduate entrants.

The occupations that met these criteria are listed below. They are largely graduate occupations which generally require individuals to possess high-level STEM qualifications for entry (although they may not always have done so in the past).

SOC	Occupation
112	Production Managers
121	Managers in Farming, Horticulture, Forestry and Fishing
211	Science Professionals
212	Engineering Professionals
213	Information and Communication Technology Professionals
221	Health Professionals
232	Research Professionals
242	Business and Statistical Professionals
243	Architects, Town Planners, Surveyors
311	Science and Engineering Technicians
312	Draughtspersons and Building Inspectors
313	IT Service Delivery Occupations
351	Transport Associate Professionals
353	Business and Finance Associate Professionals
355	Conservation Associate Professionals

Why are high-level STEM skills important?

Government and business groups frequently focus on the importance of STEM sectors to the UK economy. STEM sectors are seen as drivers of productivity, innovation, and economic growth, and so particularly important in maintaining global competitiveness.

STEM sectors enjoy higher than average productivity, and 65 per cent of UK exports are from high tech firms. High level STEM skills support advanced research and innovation, so contributing to economic growth. High level STEM skills therefore contribute disproportionately to GVA, and to the UK's international economic competitiveness,

Several key Growth Sectors for the UK are STEM-based, including some of those identified in the Plan for Growth (HM Treasury and BIS, 2010):

- advanced manufacturing
- low carbon industries
- space
- life sciences.

The Learning and Skills Improvement Service (LSIS, 2010) has identified similar priority sectors in England:

- low carbon
- digital industries
- environmental technologies / low carbon
- advanced manufacturing.

These sectors require people with appropriate STEM and management skills, to maximise their economic potential. Advanced manufacturing, for example, is the third largest sector in the UK in terms of GDP (£150bn in 2008, which was 12 per cent of GVA). As a knowledge intensive sector with world leading innovation, it requires a supply of suitably-skilled people.

Ambition 2020 notes that skills have a crucial role to play in increasing 'productivity, employment and international competitiveness and exploiting new opportunities in high value-added activities' (UK Commission, 2010, p28). High level skills, in particular, are important to the UK, as a highly skilled workforce is necessary to ensuring the UK remains globally competitive.

Ambition 2020 (UK Commission, 2010) paints a relatively positive picture of high skills in the UK:

- the UK is 12th in the OECD rank of high skill levels and expected to climb slightly to 11th by 2020
- the proportion of the workforce qualified Level 4+ has increased from 30 per cent in 2007 to 32 per cent in 2009, and is expected to hit 42 per cent by 2020
- the proportion of employers providing training is also increasing.

However, there is no room for complacency: the recession and changes to training entitlements and HE funding may negatively impact on the number of people accessing training and HE. The impact of an increase in the tuition fee rate from Autumn 2012 is still uncertain, but may affect the numbers of students enrolling for STEM degrees. In addition, there are challenges around ensuring high-level STEM skills are used fully. The National Strategic Skills Audit (UK Commission,

2010) notes that the UK has more high skill jobs than high skill people, but also highlights that the rate of high skilled job creation has not kept up with the increase in numbers of high skilled people, and the demand for high level skills is below optimum.

Recent policy approaches to STEM skills supply

Over the last decade, there have been several national-level policy initiatives aimed at increasing the supply of STEM skills. This section identifies some of the many initiatives at both school and HE level, and identifies broad changes in the supply of STEM skills over the same period.

'SET for Success' (the Roberts Review) was published in 2002. It was tasked with identifying 'the supply of science and engineering skills in the UK and the difficulties employers face in recruiting highly skilled scientists and engineers' (p3). It identified 'significant falls in the numbers [of students] taking physics, mathematics, chemistry and engineering qualifications' (p*iii*) as well as a 'number of serious problems in the supply of people with the requisite high quality skills' (p*iii*).

The Review further identified a ''disconnect' between ... strengthening demand for graduates (particularly in highly numerate subjects) ... and the declining numbers of mathematics, engineering and physical science graduates... [which] is starting to result in skills shortages' (p2). Recommendations included 'a more coherent skills dialogue between [R&D) [research and development] businesses and universities' (p201) and increased business involvement in and collaboration with higher education.

A 2004 review of STEM provision, commissioned by the Department for Education and Skills (DfES), identified a number of concerns relating to STEM provision, including:

- decreases in the take up of A level Physics (32 reduction per cent over ten years), Maths (33 per cent) and Chemistry (23 per cent)
- declining numbers of pupils studying science, maths and technology subjects in schools.

The report aimed to identify STEM activity in primary and secondary schools, further education (FE), higher education (HE) and for adults (outside the formal education system). While most activity was focused at primary and secondary school level, the report identified over 460 different STEM initiatives, with significant overlaps as well as gaps in provision. Notable gaps included:

- adult up-skilling and re-skilling in engineering (including women returners)
- developing employers' roles and responsibilities for training, development and career /pay structures
- 'embedding a culture of innovation and enterprise' at all levels of education (DfES, 2004, p40).

The Higher Education Funding Council for England (HEFCE) designated STEM subjects as 'strategically important and vulnerable subjects' (SIVS). The criteria for assessment were:

- 'Does the subject currently provide vital research and/or graduates with recognisably specialist knowledge, skills and competencies to the economy or society?
- Is there a substantiated prediction that vital research and/or graduates with recognisably specialist knowledge, skills and competencies will be required by the economy, society or Government in future?' (HEFCE, 2005, p3).

STEM subjects were recognised as SIVS under both counts. Prior to 2005, there had been a number of high-profile closures of science departments, and there was concern that this trend could negatively impact on the numbers of STEM graduates. The narrative that STEM subjects were at risk and the numbers of STEM graduates insufficient to meet economic needs found salience.

A number of initiatives were set up to promote science subjects in schools and STEM subjects at HE level. These include:

- **National Science Learning Centres**. The ten Science Learning Centres provide CPD opportunities for science educators, including school teachers and technicians. They aim to make science teaching more engaging for pupils, and so raise pupil interest in science subjects[1].
- **STEMNET**. The programme aims to inspire young people by providing enrichment activities in science, engineering, technology and maths. These include after-school clubs and a STEM Ambassadors programme.
- **HE STEM Programme**. The programme provides support to HE institutions in attracting students to STEM subjects, and in delivering STEM-related courses. It is based in six HE institutions across England and Wales. There are four programme partners: Royal Society of Chemistry, Institute of Physics, Institute of Mathematics and its Applications, and the Royal Academy of Engineering.

There are indications that demand for graduates with STEM skills is high. A Department for Education and Skills (2006) research report noted that 'the stock of science and Engineering graduates compares well internationally' with 'the stock of graduate scientists ... increasing at a steady rate' and 'the demand for workers with professional level skills in Science and Engineering ... likely to increase over the next 10 years' (p1). Similarly, research undertaken by the Department for Trade and Industry noted that 'the wage gains associated with holding SET [science, engineering and technology] degrees have remained fairly constant over the last ten years', as have 'employment, unemployment and inactivity rates of SET degree holders ... suggesting no emerging imbalances between demand and supply' (2006, p*vii*). It further stated that 'employment levels in SET occupational groups are expected to grow faster between 2004 and 2014 than the growth rate across all occupations ... [with] considerable requirements for graduates (2006, p*vii*).

A recent report on projections of the demand for STEM graduates (Wilson, 2009) notes that '"demand" for those qualified in most STEM subjects will grow significantly faster than the average for all subject groups' (p8), and that, in addition, there will be a need to replace workers reaching retirement. It also notes that 'demand and supply [for STEM occupations] are currently broadly in balance' (p10), with few such occupations represented on the Migration Advisory Committee (MAC) shortage occupation list.

The HEFCE advisory group's 2009 report on Strategically Important and Vulnerable Subjects noted that 'employers consistently identify a demand for STEM graduates, which arises from a broad requirement for numeracy aligned with specific technical skills' (HEFCE, 2010, p4). It also noted that 'the number of students in Chemistry, Physics and Mathematics programmes in HE has increased at a greater rate than the average' over the previous three years, as have numbers for Civil Engineering and Chemical Engineering (HEFCE, 2010, p3). However, the numbers of Electrical Engineering students, and the numbers of acceptances to Minerals, Metallurgy and Materials Engineering programmes had decreased.

In addition, some surveys have continued to indicate concerns around STEM skills supply. For example, a 2009 report from the Department of Innovation, Universities and Skills reported employer concerns about the quality of candidates in some subject areas, in particular noting that candidates lacked technical skills and relevant work experience. In response, employers are starting to take increased ownership of the design and delivery of STEM skills.

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[1] The Government recently announced in the Growth Review that it will invest £10 million (over the five years from 2013-14) in Project Enthuse to provide bursaries for teachers to attend courses at the Science Learning Centres. This funding will be matched by the Wellcome Trust, with additional funding expected from businesses.

So, the existing evidence on STEM skills supply and demand is somewhat contradictory. The next section of this paper reports the results of recent detailed data analysis on STEM skills supply and demand. It seeks to update this evidence base, and identify the key challenges relating to STEM skills supply and demand.

Does England have a STEM skills problem?

Frequently we read headlines that suggest England has a STEM skills problem: employers cannot find recruits with the skills they need, and there are not enough STEM graduates. However, evidence is often anecdotal, and where quantitative evidence is used, it is often partial or dated.

This section reports the results of detailed data analysis on STEM skills supply and demand, undertaken for the UK Commission, to investigate whether England has a 'STEM skills problem'.

Supply of high-level STEM skills

The supply of high-level STEM skills is formed of two elements: the flow of new graduates from STEM HE courses (as well as, increasingly, from higher apprenticeships), and the stock of STEM degree holders and people with high-level STEM skills already in the workforce.

Entrants to STEM undergraduate degrees are generally required to hold one or more Science A-Level (or equivalent). Between 1996/7 and 2003/04, numbers enrolled for A Levels declined in Chemistry, Physics, Other sciences, Maths, Further Maths and Computer Studies. However, in most subjects, this trend was reversed between 2003/04 and 2009/10, and the number of students enrolled for Science A-Levels increased significantly from 1996/97 to 2009/10. This has increased the potential pool of applications for STEM-related degrees.

Table 1: Post-16 A-Level entries by subject (England)

	% change 1996/97-2003/04	% change 2003/04-2009/10	% change 1996/97-2009/10	% total subjects (2003/04)	% total subjects (2009/10)
Biological Sciences	1%	9%	11%	6.6%	6.3%
Chemistry	-10%	20%	7%	4.7%	4.9%
Physics	-7%	-3%	-10%	4.0%	3.4%
Other Science	-4%	-3%	-7%	0.6%	0.5%
Mathematics	-18%	45%	19%	6.7%	8.5%
Further Mathematics	-4%	100%	92%	0.7%	1.2%
Design & Technology	71%	0%	72%	2.3%	2.0%
Computer Studies	-3%	-52%	-54%	1.2%	0.5%
ICT	-	-44%	-	2.5%	1.2%
STEM	**4%**	**12%**	**16%**	**29.3%**	**28.7%**
All subjects	**7%**	**14%**	**22%**	**100.0%**	**100.0%**

Source: Department for Education, Oxford Economics

The numbers of students enrolled on STEM-related higher education courses has increased significantly: from 660,000 to 840,000 from 2002/03 to 2009/10 (an increase of 180,000 or 27 per cent) (see Table 2). Non-STEM HE enrolments increased by 14 per cent over the same period across the UK.

Table 2: UK higher education enrolments – changes (2002/03-2009/10)

	STEM higher education enrolments			
	2002/03	**2009/10**	**Change**	**% change**
England	534,675	692,430	157,755	30%
Wales	36,342	42,400	6,058	17%
Scotland	69,727	85,499	15,773	23%
Northern Ireland	18,962	19,040	77	0%
UK total	**659,706**	**839,369**	**179,663**	**27%**

Source: HESA

Changes in enrolment levels by subject include:

- biological sciences (up by 61,000)
- subjects allied to medicine excluding nursing (up by 40,000)
- engineering, & technology (up by 30,000)
- physical sciences (up by 23,000)
- medicine & dentistry (up by 19,000)
- built environment (up by 18,000).

The number of STEM higher education qualifiers (i.e. those graduating in any one year) in England increased from under 140,000 in 2002-03 to over 193,000 in 2009-10 – an increase of 39 per cent (and 36 per cent for the UK as a whole) (Table 3). This compares to an increase of 27 per cent for qualifiers in non-STEM subjects over the same period (for the UK as a whole). So, following a period of decline, the number of students on STEM courses has increased significantly, albeit with variations between subjects, as has the number of qualifiers.

Table 3: STEM higher education qualifiers (all degree levels)

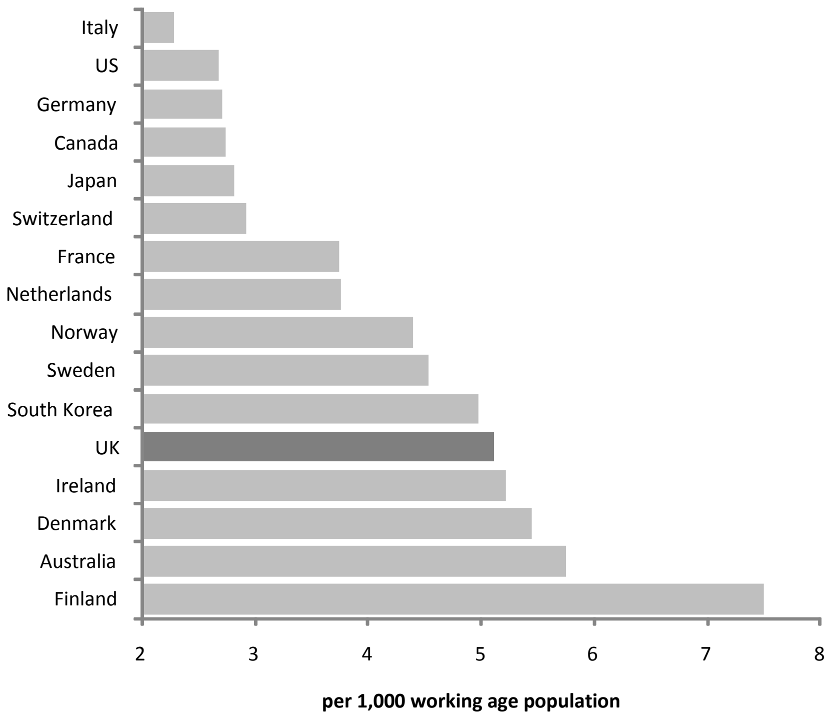
	2002/03	**2009/10**	**% change**
North East	8,449	13,025	54%
North West	18,810	26,683	42%
Yorkshire and The Humber	17,081	20,834	22%
East Midlands	11,887	15,756	33%
West Midlands	14,080	19,335	37%
East of England	10,542	12,931	23%
London	31,185	42,529	36%

	2002/03	2009/10	% change
South East	16,954	27,766	64%
South West	10,341	14,588	41%
England	139,329	193,447	39%
UK total	172,018	233,731	36%

Source: HESA

England's performance relative to international competitors is also important; as discussed above, STEM skills are important in ensuring global competitiveness. Our data analysis suggests that the UK is more than holding its own here: in terms of numbers of STEM graduates as a proportion of the working age population (see Figure 1), the UK scores more highly than the US, Germany and Sweden.

Figure 1: International STEM[2] graduate qualifiers per 1,000 working age population (2008)



Source: OECD, UN, Oxford Economics

There are over 2 million people with STEM degrees in employment in England, up from 1.4 million in 2002-4 (an increase of 41 per cent). Across the UK as a whole, there are 2.4 million STEM degree holders in employment, up from 1.7 million in 2002-4 (an increase of 42 per cent).

Both the number and proportion of STEM degree holders in employment increased from 2002-4 to 2009-10 (by 600,000 and 2.3 percentage points respectively in England, and by 720,000 and 2.3 percentage points across the UK as a whole) (Table 4).

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[2] includes life sciences, physical sciences, mathematical sciences & statistics, computer sciences, agriculture, engineering, manufacturing & construction and health& welfare subjects

Table 4: STEM degree holders in employment: change over time

	2002-04		2008-10		Change over time	
	Number	% of total employment	Number	% of total employment	Number	Percentage point increase
North East	41,386	4.0%	78,301	7.3%	36,915	3.3
North West	170,514	5.7%	249,697	8.2%	79,183	2.5
Yorkshire and The Humber	122,840	5.4%	178,182	7.6%	55,341	2.2
East Midlands	100,196	5.4%	139,651	7.1%	39,455	1.7
West Midlands	140,372	6.0%	167,921	7.1%	27,549	1.2
East of England	150,313	6.1%	212,201	8.2%	61,888	2.1
London	284,152	7.5%	414,563	10.4%	130,412	2.9
South East	293,674	7.8%	398,901	10.3%	105,227	2.5
South West	144,731	6.2%	207,185	8.4%	62,454	2.2
England total	**1,448,177**	**6.3%**	**2,046,601**	**8.6%**	**598,424**	**2.3**
Scotland	147,349	6.8%	217,635	9.5%	70,286	2.7
Wales	71,698	6.0%	104,675	8.3%	32,977	2.3
Northern Ireland	40,130	5.6%	56,459	7.6%	16,329	1.9
UK total	**1,707,354**	**6.3%**	**2,425,370**	**8.7%**	**718,016**	**2.3**

Source: LFS, ONS, DETI, Oxford Economics

Table 5 shows the distribution of STEM degree holders in employment across the UK. STEM degree holders are over-represented as a proportion of all degree holders in the South East (16.4 per cent compared to 15.0 per cent), and under-represented in London (17.1 per cent compared to 19.9 per cent).

Table 5: STEM degree holders in employment (2008-2010 average)

	STEM degree holders	% UK STEM degree holders	All subjects degree holders	% UK degree holders
North East	78,301	3.2%	246,314	3.2%
North West	249,697	10.3%	769,305	10.1%
Yorkshire and The Humber	178,182	7.3%	562,805	7.4%
East Midlands	139,651	5.8%	431,505	5.6%
West Midlands	167,921	6.9%	536,672	7.0%

	STEM degree holders	% UK STEM degree holders	All subjects degree holders	% UK degree holders
East of England	212,201	8.7%	654,910	8.6%
London	414,563	17.1%	1,523,872	19.9%
South East	398,901	16.4%	1,144,932	15.0%
South West	207,185	8.5%	611,854	8.0%
England total	**2,046,601**	**84.4%**	**6,482,167**	**84.8%**
Scotland	217,635	9.0%	625,259	8.2%
Wales	104,675	4.3%	342,702	4.5%
Northern Ireland	56,459	2.3%	196,888	2.6%
UK total	**2,425,370**	100.0%	**7,647,016**	100.0%

Source: LFS, ONS, DETI, Oxford Economics

Demand for STEM skills

Assessing the demand for STEM skills is slightly less straightforward than identifying supply. Analysis undertaken for the UK Commission shows that, in 2010, 3.9m people in the UK were employed in STEM occupations, with just under 2.4 million in STEM graduate occupations.

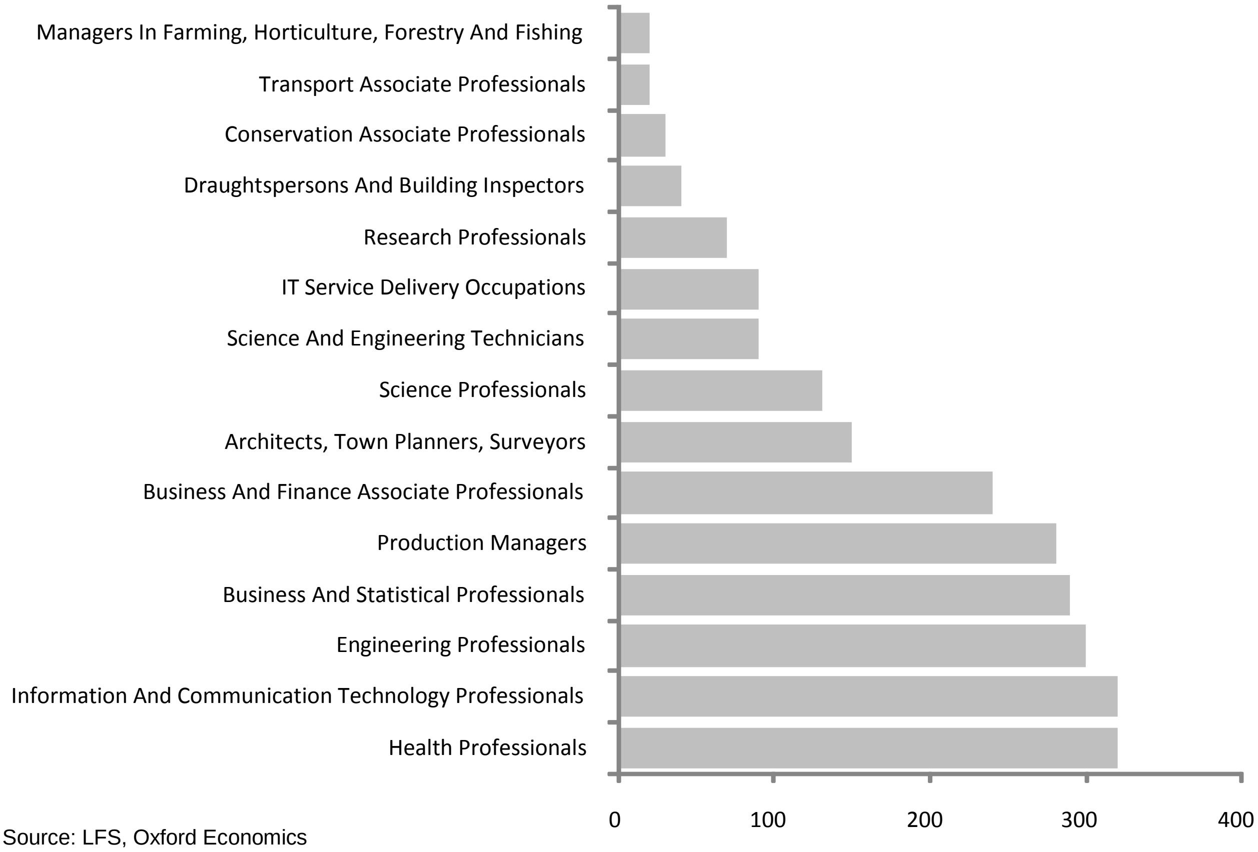
Table 6: Numbers in STEM occupations by region (average 2008-2010)

	STEM occupations	STEM graduate occupations
North East	129,000	81,000
North West	381,000	235,000
Yorkshire and The Humber	280,000	170,000
East Midlands	234,000	141,000
West Midlands	295,000	179,000
East of England	405,000	246,000
London	634,000	404,000
South East	634,000	391,000
South West	332,000	201,000
England total	**3,324,000**	**2,048,000**
UK total	**3,869,000**	**2,388,000**

Source: LFS, Oxford Economics

Strongly-represented occupations include health professionals; ICT professionals, and engineering professionals.

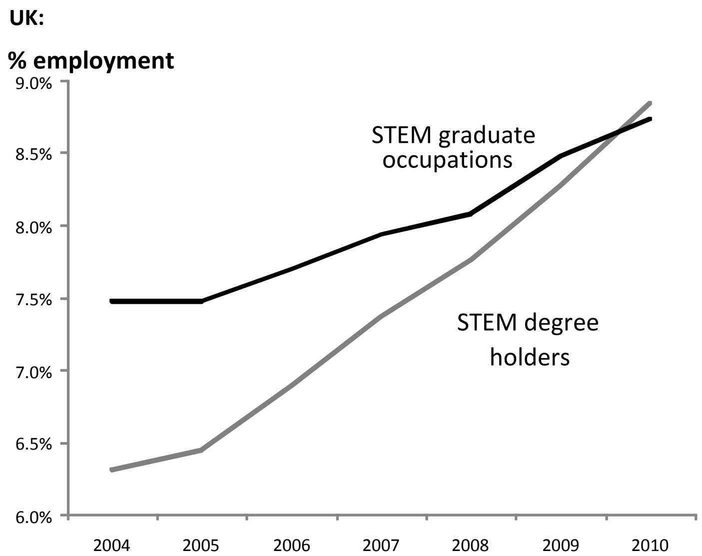
Figure 2: Numbers employed in STEM graduate occupations (000s), 2010 (UK)



Source: LFS, Oxford Economics

While the number of jobs classified as STEM graduate occupations previously exceeded the numbers of STEM degree holders in the workforce, the gap between the two has narrowed and the situation is now reversed. As shown in Figure 3, there are now more related-degree holders in the workforce than STEM graduate occupations. The same is true across most STEM graduate occupations, such as those in engineering and physical sciences, but excluding ICT.

Figure 3: STEM workforce degree holders and STEM graduate occupations as share of total workforce (2004-2010, UK)



Source: LFS, ONS, DETI, Oxfo

The National Employer Skills Survey for 2009 (NESS09) provides additional evidence on the demand for STEM skills. NESS data is reported by SSC and by SIC grouping. While STEM subjects don't map directly to SSC footprints, some SSCs have high proportion of employers in STEM fields, and these are used as a proxy here.

Across the economy as a whole, the proportion of employers reporting vacancies (including hard-to-fill and skill-shortage vacancies) in 2009 was lower than in 2007. In addition, skills gaps were less common in high-level occupations. Ten per cent of employers had recruited a graduate from HE, and 84 per cent of these stated that recent graduates were well-prepared for work.

Across all sectors, twelve per cent of employers felt that their graduate recruits were not well-prepared. Where graduates were seen as lacking skills, these were identified as:

- 'a lack of working world or life experience or maturity'
- a 'lack [of] specific skills or competencies, such as technical or job-specific skills'
- 'poor attitude, personality or a lack of motivation' (Shury et al, 2010, p47).

These are similar to the issues often reported as raised by employers recruiting for STEM occupations (see for example DIUS, 2009). NESS data also show that employers in STEM sectors report similar levels of vacancies to those in other sectors. This suggests that some of the recruitment issues commonly argued to be STEM-related are in fact relevant to all economic sectors.

Analysis of NESS09 data (based on SIC code of employing organisation) identified the following levels of vacancies by type:

Table 7: Employers reporting vacancies, by type

	% of STEM employers[3] (based on SIC)	% of all employers
% of employers reporting at least one vacancy	12.1%	11.8%
% of employers reporting at least one hard to fill vacancy	3.9%	3.3%
% of employers reporting at least one skill shortage vacancy	3.1%	2.5%
Vacancies as % of total employment	1.5%	1.6%
Hard to fill vacancies as % of total employment	0.4%	0.4%
Hard to fill vacancies as % of total vacancies	26.0%	22.3%
Skill shortage vacancies as % of total employment	0.3%	0.3%
Skill shortage vacancies as % of total vacancies	21.1%	16.3%
Skill shortage vacancies as % of hard to fill vacancies	81.2%	73.1%

Source: NESS09, Oxford Economics

[3] For this table, 'STEM employers' were defined by Oxford Economics as employers within SIC sectors which account for a high per cent of STEM graduate occupations.

This suggests that employers in STEM sectors are very slightly more likely than average to report vacancies of all types, but that vacancies as a proportion of total employment are slightly lower. Vacancies as a proportion of total employment were lowest in the industries covered by Proskills UK (process and manufacturing industries, at 0.7 per cent), Improve (food and drink manufacturing, at 0.8 per cent) and Cogent (chemicals, nuclear, oil and gas, petroleum and polymers, at 0.7 per cent). In addition, employers in these areas reported just one skill shortage vacancy (SSV) per 1,000 employees (Shury et al, 2010)[4].

There is also a geographical element: as shown in Table 8, reported skills deficits vary strongly by region of employer.

Table 8: Employer skill deficits by region (2009)

	North East	North West	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West
Difference from England average (=100)	101	93	100	88	86	111	111	99	97

Source: NESS09, Oxford Economics

Difficulties reported by employers in recruiting staff with relevant skills relate to:

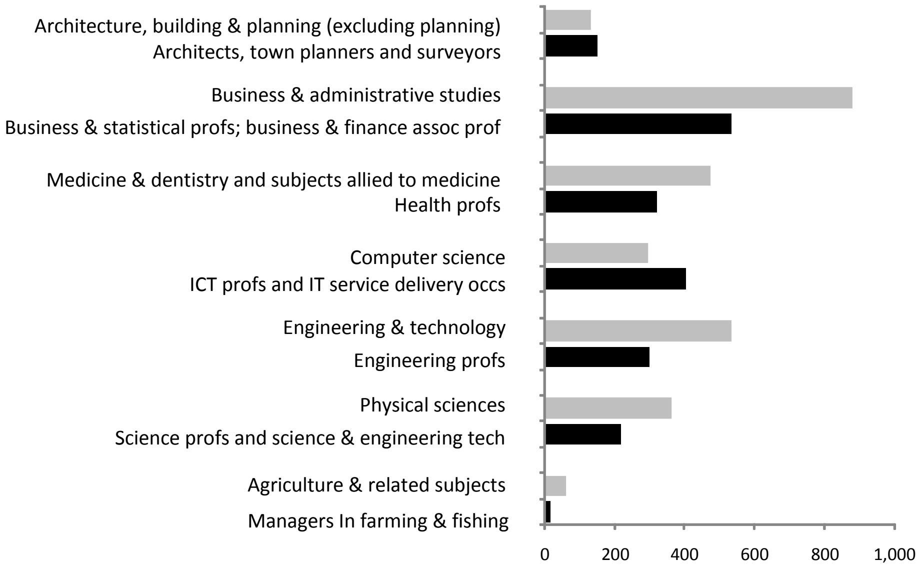
- Geography: certain areas of the country have a wider pool of individuals with STEM skills. For example, concentrations of STEM graduates in the Cambridge region support a research cluster there. Employers may find it more difficult to recruit to specific posts in more rural areas.
- Need for very specialised technical skills: as jobs become increasingly specialised, employers require very specific technical skills, which recent graduates may not have. It is not possible for HE institutions to predict and meet the full range of skills that employers may need; they are too numerous and too specialised to be covered in a four-year degree. In addition, as noted by HEFCE, 'it is very difficult to identify shortages that will be meaningful in early careers, let alone a full working lifetime (2010, p24)'.
- A lack of wider employability skills: Over 40 per cent of respondents to the 2011 CBI employer survey said they had difficulties recruiting staff with science, technology, engineering and maths (STEM) skills. However, respondents attributed these difficulties to poor employability skills, such as teamworking, and a lack of experience – not just a lack of STEM skills.

[4] Vacancies were highest as a proportion of total employment in the central government, health and social care, and hospitality and leisure sectors.

Reasons for mismatches between STEM skills supply and demand

While there is broad alignment between the numbers of people in the workforce with high-level STEM skills, and graduate-level STEM occupations, there are mismatches in certain sectors. For example, there are more people in the workforce with degrees in engineering and technology than in graduate-level engineering occupations (see Figure 4).

Figure 4: UK STEM workforce degree holders and graduate occupations (000s; av. 2008-2010)



Source: LFS, Oxford Economics

A key reason for difficulties in recruiting may be that a significant proportion of STEM graduates are not entering STEM occupations. Research undertaken for the UK Commission found that three-quarters of the graduate intake for ‘STEM occupations’ studied a STEM subject at HE level. However, in England, 40 per cent of STEM graduates went into non-STEM graduate occupations in 2008/09.

Three and a half years after graduation, 28 per cent of STEM graduates are in non-STEM graduate occupations. This varies significantly by subject studied; for example, 94 per cent of medicine and dentistry graduates were in STEM graduate occupations, compared to 62 per cent for agriculture and related subjects (Table 9).

Table 9: Graduate destinations: 3 ½ years after graduation[5]

Degree subject studied	STEM graduate occupation *	Non-STEM graduate occupation
Medicine & dentistry	94%	6%
Subjects allied to medicine**	27%	73%
Biological sciences	71%	29%
Agriculture & related subjects	62%	38%
Physical sciences	82%	18%
Mathematical sciences	85%	15%
Computer science	75%	25%
Engineering & technology	74%	26%
Built environment***	72%	28%
STEM subject total	**72%**	**28%**
Non-STEM subject total	**60%**	**40%**

Source: HESA Longitudinal Destinations of Leavers from Higher Education (LDLHE), Oxford Economics

It is clear that the discussion around STEM needs to differentiate between subjects, as well as between industry sectors. As Wilson (2009) notes, 'STEM graduates are not concentrated in the manufacturing and primary sectors. Many more STEM graduates and post-graduates now end up in jobs in other sectors' (p14) – particularly in health and care. In addition to health, 'public administration and defence and education services employ large number of people qualified in other [non-medical] STEM subjects, and these numbers have (in most cases) been growing very rapidly in the last few years' (p24). While 'the primary sector (including utilities) and construction both employ significant numbers of STEM graduates and post-graduates... these are small compared to the other sectors' (p24). STEM occupations are increasingly found outside traditional primary industries. Helping to meet the skills needs of different sectors may require new approaches and an increasingly nuanced understanding of the range of STEM occupations and their skills requirements.

In addition, the issue with STEM graduates does not appear to be a lack of quality applicants at the top end. Henderson et al (2010) note that 'a number of large R&D based companies ... who need to recruit the very best candidates into their research teams...say that the very best candidates are as good as any that they might recruit from abroad' (p2). However, the challenge is 'with regard to a broader range of candidates, a broader range of employers and a broader range of jobs – not just cutting-edge research but a whole range of development, testing, product refinement, modelling and advanced production jobs' (ibid).

Demand for STEM skills (DIUS, 2009) identified a wage premium for STEM graduates – but a significant proportion of this gap can be attributed to difference in factors such as ability and institution, rather than subject studied. The data analysis for this paper did not find any evidence of a significant wage premium (in either 2002/03 or 2008/09) for STEM graduates compared to non-STEM graduates (although there were differences by subject).

[5] *** based on 2-digit SOC; ** includes nursing subjects; *** includes planning subjects**

The analysis suggests that STEM graduates in STEM graduate occupations earn more, on average, than those in non-STEM graduate occupations (see Table 10). Across STEM graduate occupations, non-STEM graduates (particularly law and business studies graduates) earn more than STEM graduates. However, those in STEM graduate occupations earn more than those in non-STEM graduate occupations, regardless of area of study.

Table 10: Graduate first destination average annual wage earnings (2008/09)

	STEM graduate occupation			Non-STEM graduate occupation		
	STEM subject	**Non-STEM subject**	**% difference**	**STEM subject**	**Non-STEM subject**	**% difference**
North East	£24,210	£23,535	3%	£22,441	£23,385	-4%
North West	£25,355	£27,834	-9%	£23,616	£25,124	-6%
Yorkshire and The Humber	£23,987	£26,035	-8%	£26,625	£26,112	2%
East Midlands	£26,735	£29,719	-10%	£25,126	£25,536	-2%
West Midlands	£26,247	£29,026	-10%	£27,409	£29,448	-7%
East of England	£26,912	£28,087	-4%	£26,410	£26,049	1%
London	£35,712	£35,217	1%	£31,280	£30,691	2%
South East	£29,021	£28,879	0%	£27,131	£29,245	-7%
South West	£30,204	£29,379	3%	£27,785	£27,269	2%
UK total	**£27,459**	**£29,949**	**-8%**	**£26,170**	**£26,304**	**-1%**

Source: HESA Destinations of Leavers from Higher Education (DLHE), Oxford Economics

What are the key challenges?

This analysis poses a number of questions and challenges for STEM policy in England.

Recent initiatives to increase the number of students studying STEM subjects at HE level have been successful: more than 1 in 3 university students are following a STEM-related course: an increase of over 25 per cent from 2002/03 to 2009/10.

The proportion of people with high-level STEM skills in the workforce and the proportion of job requiring such skills are broadly matched. Skills shortage vacancies (where employers cannot fill posts) are generally low, including in STEM sectors. Employers recruiting young people from education are largely satisfied with their new members of staff.

However, some employers in specific sub-sectors report challenges in recruiting people with the appropriate skills – both STEM-based and more generic work skills. In particular geographical areas, sub-sectors and industrial specialisms, we need to improve both the supply and use of skills. In addition, almost 40 per cent of STEM graduates work in non-STEM occupations after graduation. (Conversely, 25 per cent of recent graduates working in STEM occupations do not hold STEM degrees).

There are number of issues for policy-makers to consider:

- How best to communicate the message that the supply of high-level STEM skills in the UK has improved and is now among the best internationally, and that the debate now needs to focus on particular sub-sectors and subjects?

- Is the proportion of graduates with STEM degrees working in non-STEM occupations a problem? STEM graduates have a number of transferable skills, including problem solving, hypothesis testing and data analysis, which are of value to all sectors of the economy.

- Is an over-supply of STEM graduates a problem? STEM subjects tend to be laboratory-based and are more expensive to teach at HE level. If employers value STEM skills regardless of occupation, does an oversupply of STEM graduates matter?

- How can we raise the demand for high-level STEM skills in those regions where it is below average?

- What can employers do to ensure that they support the development of a highly-skilled sector workforce? For example, could they work together to develop STEM networks, highlighting job opportunities in local areas and providing ongoing training?

Abbreviations and acronyms

CPD: Continuing Professional Development

FE: Further Education

GVA: Gross Value Added

HEFCE: Higher Education Funding Council for England

HE: Higher Education

HEIs: Higher Education Institutions such as universities

ICT: Information and Communications Technology

JACS: Joint Academic Coding of Subjects

OECD: Organisations for Economic Co-operation and Development

SIC: Standard Industrial Classification

SOC: Standard Occupational Classification

SSC: Sector Skills Council

STEM: Science, Engineering, Technology and Maths

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UKCES
Renaissance House
Adwick Park
Wath-upon-Dearne
South Yorkshire
S63 5NB
United Kingdom

T +44 (0)1709 774 800
F +44 (0)1709 774 801

UKCES
28-30 Grosvenor Gardens
London
SW1W 0TT

T +44 (0)20 7881 8900
F +44 (0)20 7881 8999

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