

Engineering UK 2012

Executive Summary and Conclusions

We gratefully acknowledge contributions from



Engineering UK 2012

Executive Summary



The UK is emerging from the global recession more slowly than expected, and facing up to the harsh realities of the coalition Government's deficit reduction plans. Against this backdrop, it's good to see that the engineering and manufacturing sectors are still highly regarded. More than that, they are now actively supported as being key to rebalancing the economy and putting the UK on a stable and sustainable economic footing.

The engineering sector continues to be a huge success story. It generated £1.15 trillion in turnover in the year ending March 2010; 24.9% of the turnover of all businesses in the UK. The sector also employed 5.6 million people across 551,520 enterprises.

Alongside its importance in helping the UK recover from recession, engineering has a key role in helping us tackle much bigger problems: the 'global challenges' or 'grand challenges' that transcend national boundaries and pose significant threats to societies and ecosystems. In January 2010, members of the Inter Academy Panel on International Issues – a network of the world's science academies – met

at the Royal Society. Here, they identified climate change, global health, food security, biodiversity, water security, population and energy security as humanity's most pressing concerns.

On a local level, the tangible challenge for the UK engineering, manufacturing and science sectors is to develop and exploit emerging technologies: for example, advances in the fields of advanced manufacturing, manu-services, and low carbon and environmental goods and services (LCEGS). This is in addition to the £500 billion investment needed over the next 20 years just to maintain our transport and energy infrastructure.

Engineering employers have a central role to play in helping the UK meet these challenges. In the past, they have often been overlooked and unheralded. But ultimately, they will be (and indeed have always been) responsible for delivering economic success and social cohesion.

This year's report provides key in-depth analyses of, amongst other factors, supply and demand trends that will affect these employers and potentially affect the UK's ability to nurture and build its vital STEM capacity and capability.

Our new analyses show that, whilst demand is clearly there, we risk stalling economic growth if we leave various supply issues unabated. These include the insufficient numbers of students taking triple GCSE sciences, apprentices studying to Level 3 engineering, and girls studying physics A Level and engineering degrees.

What's more, we need to be aware that UK demographics are working against us. Between 2010 and 2035, the proportion of the population aged 16-64 (normally considered to be economically active), is due to fall from 65% to 59%, while the proportion aged 65+ will reach 23%. This reinforces our view that we should look creatively towards recruiting from the cohorts of 16- to 24-year-olds who are Not in Employment, Education or Training (NEETs), numbers of whom have increased by 47.1% over 10 years. We should also be recruiting more women; with only 8.7% of professional engineers being female, the UK has the lowest proportion in Europe.

How important is engineering in the UK?

- The engineering sector generated 24.9% of the turnover of all businesses in the UK in 2010.
- The International Monetary Fund (IMF) forecasts that the world economy will expand by \$20 trillion in current prices between 2010 and 2015. Advanced economies will contribute around \$8.5 trillion, while faster-growing emerging and developing economies will contribute around \$11.5 trillion.
- The UK is the seventh-largest manufacturing nation in the world (having recently slipped from sixth position), behind the USA, China, Japan, Germany Italy and France. In 2010, 2.5 million people were employed in UK manufacturing, representing 10% of all employees. Whilst the proportion of GDP attributable to manufacturing has fallen by two thirds since 1970, when it stood at more than 30%, the output of the manufacturing sector has actually grown by 25% in that time.
- Manufacturing is also a major investor in R&D which, in turn, is an important driver of technological innovation. Of the top 25 UK companies by R&D spend, eight are from the manufacturing sector.
- The manufacturing industry has moved beyond simply making things. It is now a complex industry that engages with customers and other businesses in a range of ways. The most important change is the rise of manu-services, whereby firms don't just sell goods: they sell solutions, outcomes or experiences. A 2009 EEF survey estimated that UK manufacturers generate between 15% and 20% of their revenue from services – between £24 billion and £32 billion at 2009 prices.
- The scale of investment into various sectors of the UK economy clearly indicates the strong presence foreign-owned companies have in UK manufacturing compared with other sectors. In 2008, 43.2% of investment in UK manufacturing was made by foreign-owned companies.
- The LCEGS sector, also referred to as the 'green economy', is one of the new technology-based sectors that has captured much political and public attention and has been closely aligned with the engineering and manufacturing sectors. The overall global LCEGs market value in 2008/09 was about £3.2 trillion, with 1.4 million companies employing about 28 million people. This is forecast to grow to £3.8 trillion by 2013/14, with its worth split across three main sectors: environmental, renewable energies and low carbon.



Concerted intelligent employer action

- The evidence in our report suggests that it is the engineering employers themselves who will make the most significant contribution to rebalancing the economy. Employers recognise their role in developing the skills of their staff. They also know how important collaborating with schools will be in achieving better educational outcomes. So they're undertaking concerted intelligent action around two central themes: training to improve the current supply of labour, and programmes to increase interest in STEM and to improve the future supply chain.
- Positive employer market signals:
 - At £26,440, the approximate mean salary for engineering technicians and craftsmen is slightly above the mean salary for all equivalent non-engineering occupations (£26,308) and above the 2009 UK gross median average salary (£25,900). It is also significantly above the median salary for 22- to 64-year-olds without a degree (£18,000).
 - At £24,953, the mean starting salary for graduates in engineering and technology was the fourth-highest, behind medicine and dentistry, business and administrative studies and combined subjects. By comparison, the average mean starting salary for all graduates was £22,364 and for creative arts and design graduates it was just £16,123.

- Within the engineering sub-disciplines, graduates in general engineering earn the highest mean starting salary, at £29,361. This is followed by chemical, process and energy engineering at £26,712. The lowest starting salary was for production and manufacturing engineering, at £22,584 – but this is still above the average mean salary for all graduates.
- For graduates who went to work for an engineering employer, the mean starting salary was £26,579. This compares very favourably to those who went to work for a non-engineering company, where the mean starting salary was 16% less at £22,298.
- BIS research shows that the average undergraduate premium is approximately £108,000, compared with someone with two A Levels. For engineering, it was substantially (around 33%) higher, at approximately £144,000.
- In many sectors, the UK has strong green foundations on which to build. It currently has around 3.5% share of the £3.2 trillion global environmental goods and services market, with a positive net trade position of £4.5 billion. By 2015, the UK market could be worth as much as £150 billion and could employ over 1.2 million people.
- Generally, firms in the UK provide less training than our competitors over the course of a working life. At 315 hours (or just under eight hours) a year, non-formal job-related training is significantly lower than in countries such as Denmark (934 hours), France (713 hours), the United States (471 hours) and Germany (398 hours).
- Examination of the qualification level of SET technicians working in jobs identified as needing Level 3 or Level 4 skills, show that at least 10% are qualified to below Level 2, or have no formal qualifications. This indicates a lack of appropriately-skilled workers.
- Examining Hard-to-Fill vacancies and Skills Shortage Vacancies by occupation shows that there are a disproportionately large percentage of vacancies for the engineering sector (compared with all establishments) for professionals and skilled trades people. In each case, the proportion of vacancies is double the average for all establishments.
- STEM skills are in demand at every level, with employers of every size struggling to find the STEM talent they need. This is particularly so with the evolution towards a more environmentally-friendly economy, where greener skills will be needed. One in five employers (21%) has difficulty finding graduates with STEM skills, and this proportion rises to one in three employers (33%) in the science, engineering and IT sectors. When looking to recruit experienced staff, 44% of science, engineering and IT employers struggle to find individuals with workplace experience in science, technology, engineering and maths.

What skills will be needed?

- Examination of the Sector Skills Assessments for the 10 engineering-related Sector Skills Councils shows that the estimated requirement for employees over the next 5-10 years will be an additional 2,217,500.
- In order for the engineering and manufacturing sector to rebalance the economy, the UK needs to fundamentally rebalance its skills capacity. According to the 2009 National Employer Skills Survey for England, the education system is not giving young people the skills that businesses need. Twenty percent of manufacturers reported skills gaps, while 31% of high-tech manufacturing firms, “had recruited people from outside the UK owing to a lack of suitably qualified people from within the UK”.
- In 2009/10, almost two-thirds (62%) of those qualifying with a first degree in engineering and technology went to work for an employer whose primary activity was engineering and technology. Of engineering and technology first degree graduates, 85% went into work or further study within six months of graduating.

Is the UK on course to supply these needs?

- *GCSEs:* GCSE biology, chemistry and physics have all tripled their size over 10 years, with growth of 200.8%, 201.1% and 201.4% respectively. In 2011, the number of entrants for physics rose by 16.4% to reach 140,183.
- *A Level:* In 2010, 16,624 students achieved an A*-C grade in both maths and physics A Level, generally considered a pre-requisite to studying a degree in engineering. Of these, just 21.4% were female. It is also noted that the number of entrants to maths at A Level is 2.5 times the number of entrants to physics.
- *Apprenticeships:* Two of the three Sector Subject Areas that fall within the engineering footprint have performed poorly in 2009/10. Despite total apprenticeship starts rising by 16.6%, the number of starts in construction, planning and the built environment actually dropped by 13.7%. For engineering and manufacturing technologies, the number of starts did increase to 37,860 in 2009/10, but by a lacklustre 2.4%.
 - The number of achievements in engineering and manufacturing technology increased by 14.0% in 2009/10. Engineering and manufacturing technology has been the largest engineering Sector Subject Area in each of the last eight years. However, at 215.1%, its eight-year growth is below the average growth of 304.5%.
- *Further Education:* In 2009/10, 1.74 million publicly-funded STEM qualifications were achieved by people aged 16+ in the FE and Skills sector in England, which was 28% of all qualifications achieved. (A further 0.64 million STEM qualifications were taken by 16- to 18-year-olds in schools.) However, the dominance of lower level qualifications and the relative paucity of Level 4+ STEM provision suggests that the sector looks poorly positioned to meet the higher STEM skills demand from employers.
- *Foundation degrees:* The total number of students enrolling continues to grow annually, with 3,595 new entrants to programmes in 2009/10. While the number of entrants to full-time programmes in 2009/10 was up by 22% compared with 2008/09, the number of enrolments to part-time programmes fell slightly during the same period.



- *Degrees:* Engineering and technology has grown by 12.9% over eight years, and it grew by 5.5% in 2009/10. With 21,955 first degree qualifiers in 2009/10, it was the second largest STEM subject area.
 - Looking specifically at engineering and technology numbers, the significant contribution of international students can be seen. Nearly a third (31.8%) of applicants were not from the UK and nearly a quarter (22.3%) were from outside the EU.
 - The importance of non-EU students to engineering is demonstrated by the fact that in 2009/10 they made up 26.0% of all first degree qualifiers. This compares with an average for all courses of 9.2%.
- *Postgraduate degrees:* There was an increase of 23.6% in the number of postgraduate qualifiers in engineering in 2009/10. However, growth has not been even. Numbers of non-EU qualifiers have more than doubled in seven years, rising 118.4%. By comparison, the number of EU qualifiers has declined by 1.8% over seven years, although it did grow by 17.7% in 2009/10.
- *International:* China and India are no longer only prepared to compete on a low-skilled basis, presenting a significant new and long-term threat to the UK. At the time of writing, EngineeringUK was concluding an investigation into the reality of the size of this threat and found it to be significantly less than is popularly believed. Of the bachelor engineering graduates in 2009, only 76,400 engineering graduates from China and 124,000 from India can be considered internationally competitive.

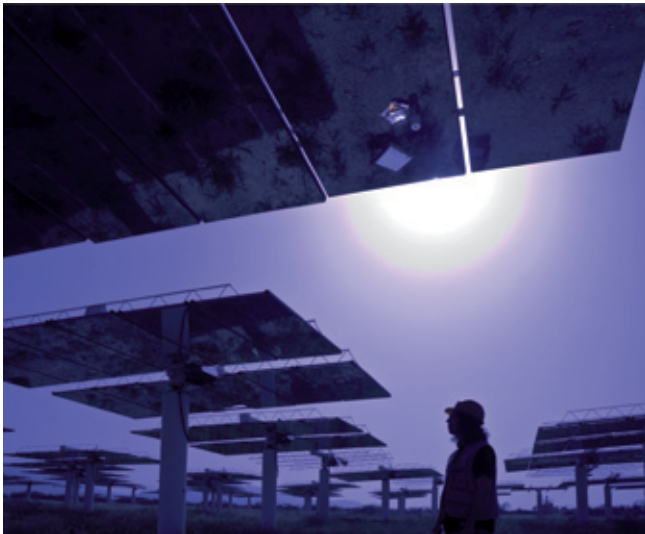
What are the challenges ahead for UK engineering?

- Specialist maths and science teachers are critical if children are to reach their potential within STEM subjects and ultimately pursue engineering careers. The Department for Education conducted a census of the school workforce in local authority maintained schools and Academy schools, which showed that a quarter (26%) of those involved in the teaching of maths do not have a relevant post A Level qualification. For physics, it is worse at 31.4%. The Government is, however, seeking to improve the recruitment and retention of maths, physics and chemistry teachers. Its target is that by 2014, 25% of science teachers will have a physics specialism, 31% a chemistry specialism, and 95% of maths teachers a maths specialism. In 2007, 19% of science teachers had a physics specialism and 84% of maths teachers had a maths specialism.
- The importance of the independent schools sector in increasing the number of STEM learners can be demonstrated by the number of students studying triple science subjects. The proportion of students studying biology (13.9%), chemistry (13.8%) and physics (13.4%) in an independent school was almost double the proportion for all subjects (7.8%).
- When examining the primary activity of employers of first degree qualifiers by gender, it is disappointing to note the imbalance. Nearly two thirds of men (64.9%) get employment with an engineering and technology company whilst, for women, the figure is just 46.9%. Over half (50.8%) of women get employment with an employer whose primary activity is non-STEM, compared with a third (33.5%) of men.
- Research by BIS shows that the return on an undergraduate engineering degree is around £157,000 for men but just below £100,000 for women.
- The full ramifications of the Government's drive to 'curb immigration' has yet to be enacted or realised, but the potential unintended consequences for UK R&D have been subject to much debate. The proposed changes to tiers 1 and 2 of the Points Based System have been criticised by employers in both the private and public sectors. This is because the workers who come to the UK through these routes are the most economically-valuable migrants and often fill serious skills shortages faced by particular sectors and employers.

Perceptions of engineering

- Selected findings from our 2011 annual Engineering and Engineers Brand Monitor (EEBM) show that, whilst nearly half (47%) of educators said a career in engineering is desirable, a fifth (21%) said it was undesirable for students. On the other hand, 70% of 12- to 16-year-olds did say that they liked science.
- Additional research by EngineeringUK shows that there is a decline in enjoyment of maths and science in Year 8 and that enjoyment is as important as attainment in determining a pupil's likelihood to pursue a subject when given the option. This is supported by further EngineeringUK research, which looked at student subject decision making aged 14 and 16. This identified that 89% of those asked said that enjoyment of a subject influenced their decision to select that subject at GCSE or A Level. For this reason, STEM enrichment and enhancement programmes, such as The Big Bang and Tomorrow's Engineers, are important, as they enthuse students about maths and science.
- The 2011 *Big Bang: UK Young Scientists and Engineers Fair*, led by EngineeringUK, engaged over 29,000 visitors in science, technology, engineering and maths. Independent evaluation showed that the event positively changed visitors' perceptions of engineering. When asked at the event, 74% of boys aged 12-19 and 81% of girls of the same age said that their visit had changed their view of engineering either 'much more' positively or 'slightly more' positively.
- EngineeringUK also conducted research with STEM teachers, looking at their awareness of and engagement with STEM enrichment and enhancement activities. The research identified that, whilst 91% of STEM teachers are aware of enrichment and enhancement activities, 53% have yet to get involved in them. Pleasingly, it also showed that 89% of STEM teachers did see providing careers information, advice and guidance as part of their role. However, our EEBM research indicated that 21% of teachers saw engineering careers as being undesirable for their students. Clearly, there is some more work to be done in order to increase the uptake of enrichment and enhancement activities by STEM teachers and to improve their sector knowledge, thereby pre-disposing them towards recommending engineering careers.

Engineering UK 2012 Conclusions



Despite the recession, the need to tackle the global challenges of climate change, global health, food security, biodiversity, water security and energy security remains as pressing as ever. Engineering employers will ultimately be responsible for addressing these issues, as well as helping to rebalance the economy.

Fortunately, the sector continues to be a huge success story, making it well placed to face the challenges ahead. But, if that success is to continue, the industry will need many more skilled people to join the 5.6 million it already employs: another 2,217,500 in the next five to ten years, according to estimates from the 10 engineering-related Sector Skills Councils.

If we don't address supply issues, such as the numbers of students taking triple GCSE sciences, the numbers of Level 3 engineering apprenticeships, and the numbers of girls studying physics A Level and engineering degrees, we risk stalling economic growth. Examining Hard-to-Fill vacancies and Skills Shortage Vacancies by occupation shows that there are already a disproportionately large percentage of vacancies in the engineering sector for professionals and skilled trades people, compared with other sectors.

With the number of economically-active 16- to 64-year-olds set to fall by 6% between 2010 and 2035, and 23% of the UK population over retirement age, we need to be creative in finding people to fill the void. Women are an obvious choice. The UK has the lowest proportion of female engineers in Europe (just 8.7%), earning, on average just below £100,000 extra compared to a premium of £157,000 for men. So encouraging more girls into the profession gives us an opportunity to redress these imbalances. Another target must be young people classed as NEET, a sector of society that has grown by 47.1% in the last 10 years.

It's not just having enough engineering employees to meet future needs that should concern us, but having employees with the right skills. In particular, we need to fundamentally rebalance our skills capacity towards a more environmentally-friendly green economy. The low carbon and environmental goods and services sector had a market value in 2008/09 of £3.2 trillion, with 1.4 million companies employing about 28 million. By 2013/14, its worth is forecast to grow to £3.8 trillion – provided a skilled workforce is available. At 315 hours, firms in the UK generally provide less training over the course of a working life than Denmark, France, the United States and Germany. And at least 10% of SET technicians are qualified to below Level 2, indicating a lack of appropriately-skilled Level 3 and 4 workers.

The drive to change this has to start early on. EngineeringUK has identified that, while 91% of STEM teachers are aware of enrichment and enhancement activities, 53% have yet to get involved in them. Eighty nine percent of STEM teachers see providing careers advice as part of their role, but worryingly our own research revealed that, if they did give careers guidance, 21% of STEM teachers saw engineering careers as undesirable. Clearly, there is more work to be done to increase the uptake of enrichment and enhancement activities by STEM teachers. If we want them to recommend engineering careers to young people, we need to work hard to improve their understanding and knowledge of the sector.