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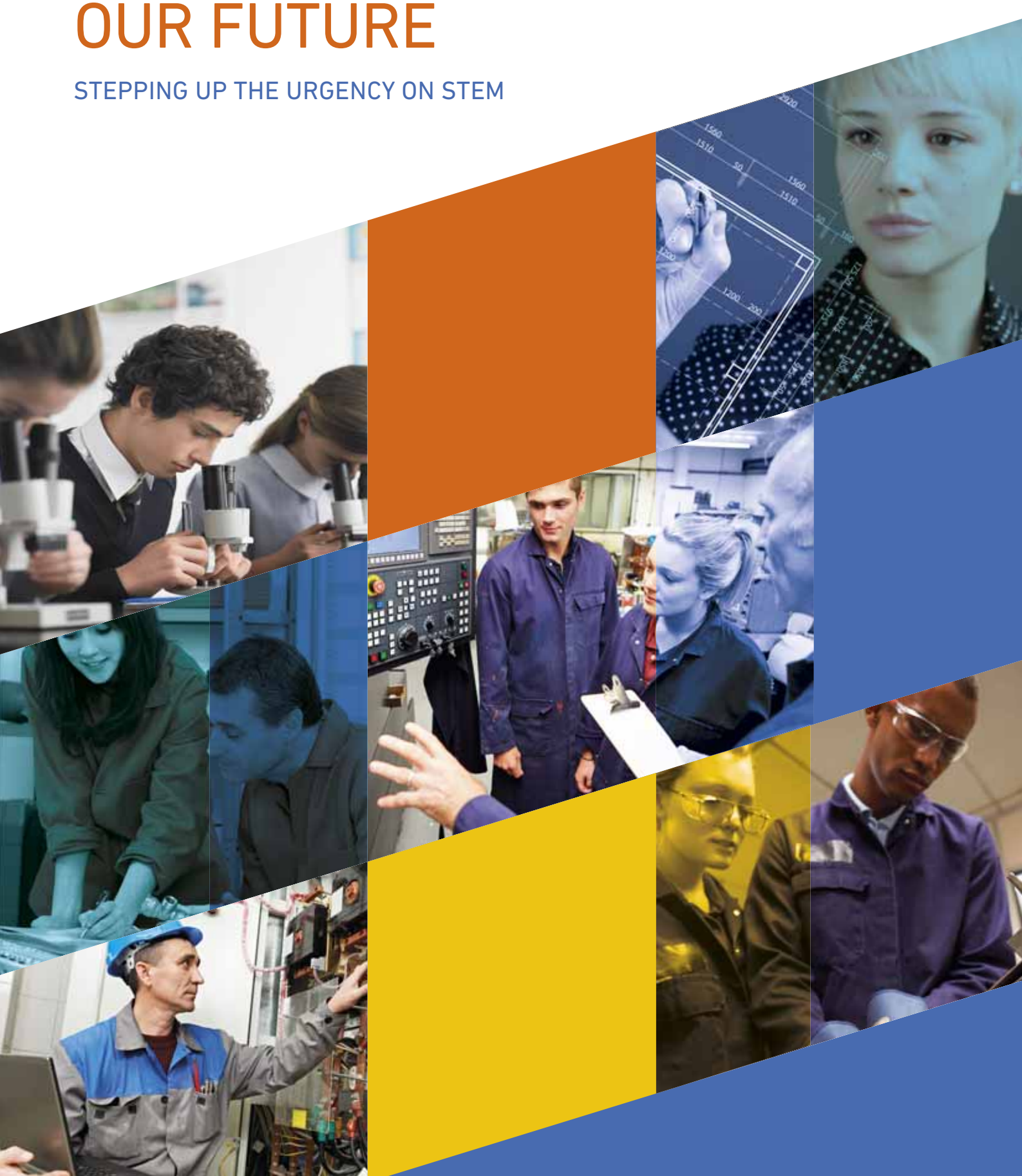
ENGINEERING OUR FUTURE

STEPPING UP THE URGENCY ON STEM



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Foreword

A competitive science, technology, engineering and maths (STEM) skills base is vital to our future as a knowledge-intensive economy. As the economy rebalances towards manufacturing, investment and exports, major growth sectors require these skills, and they must be confident that the UK's supply can grow with their businesses in the years ahead.

We have made real progress on STEM uptake in the last decade – but there is much more to do. These skills are central to the sectors that must be the anchors of our economy. A new urgency is required – in terms of both the existing and the future workforce.

And we must address this issue at every level – for university-qualified STEM professionals, but importantly also for skilled technicians. As well as bolstering STEM education at school and university level we also need to build wider gateways into STEM careers through vocational routes at the beginning of, and in mid-career. Improving the flexibility and responsiveness of our existing workforce is critical if people are to flourish in the occupations of tomorrow.

A key part of the solution to this is addressing the shameful STEM skills gender gap by improving the participation of girls and women. With the demand for STEM skills so great we simply cannot afford to draw on only part of the UK's talent pool.

Businesses are taking action to ensure that more talented women can access top jobs, but if girls are not supported to study underpinning STEM skills their paths in many sectors will be blocked.

It is our shared responsibility to make sure that we can fill the STEM jobs of the future. Businesses are already developing joint solutions, but more must be done to build a skills ecosystem that supports all our people to build the skills today that will fire growth tomorrow.

Katja Hall
CBI chief policy director

Executive summary

The UK's future economic success relies on us building an innovative, knowledge-intensive economy, underpinned by a highly skilled science, technology, engineering and maths (STEM) workforce. This report makes the case for a new urgency in building up STEM skills through a long-term, strategic commitment and swift action to address pressing needs.

STEM skills: vital for growth and higher living standards

To thrive in an increasingly competitive world, the UK must work to develop a high-value, knowledge-intensive economy, founded on high levels of productivity and innovation. Skill development is the backbone of this strategy, with a particular focus on the STEM skills which will underpin our future growth. Nowhere is the need for STEM skills more obvious than when we look to the challenges of rebalancing, with the major growth sectors identified by our industrial strategy heavily reliant on STEM skills.

Our STEM skills base is an important driver of productivity and innovation, supporting well-paid jobs across the country at all skill levels. As the economy shifts to more knowledge-intensive industries and the pace of technological change increases we must meet existing demand for skills and develop the skills of those who will drive future technological change and productivity.

Improving rates of progress on building our STEM skills

If a flourishing UK economy and rising living standards require a healthy supply of STEM-skilled employees at all levels, the fact that businesses are reporting widespread difficulties in recruiting STEM-skilled staff is a serious cause for concern. And as the economy continues on a path of sustained growth, these recruitment difficulties are set to escalate, particularly as we rebalance towards a more STEM-focused economy.

STEM education has long been identified as the critical lever in providing the necessary underpinning for success in the STEM workforce, and good progress is being made in increasing the numbers of students studying STEM subjects at schools and university. This good progress now needs to expand to vocational educational pathways, particularly apprenticeships, but importantly also retraining of the existing workorce, to give people the valuable STEM skills that open up high quality technician jobs. The UK's ability to flourish will depend on the capacity of both businesses and employees to continually renew and upgrade STEM skill levels, so support for a more diverse range of routes into STEM professions is needed.

The path ahead – building the pipeline we need

The past decade has seen significant improvement in the STEM skills supply. But demand for these skills has also risen. We now need to see a more ambitious and urgent approach to meet the skills demands of the decades ahead. A long-term, strategic government commitment to improving the STEM skill supply in the UK will provide the stability and confidence for businesses, universities and the education and training system to work together to invest in skills. Achieving this requires action in three major areas:

Widening the pipeline of young people making it to skilled STEM work – especially women

The place of STEM subjects in school is vital to providing a sustainable long-term answer to the shortages we face. An engaging, relevant curriculum delivered in a system where every young person has the option of taking three sciences at GCSE and the choice of a STEM-specialist route, like a university technical college, is essential.

Even when the system is in place, progress will be slow until the gender imbalance is addressed. Getting more girls and young women into the sector has a huge potential upside for the economy and women themselves in terms of career satisfaction and earnings. Women currently make up 46% of the UK's workforce, but just 15.5% of the core STEM workforce.

A key driver of progress on STEM participation has been the engagement of businesses with a wide range of programmes designed to build STEM skills and explain STEM careers. Over half of engineering, hi-tech, IT and science firms are already engaging with schools to promote STEM study. We must build on this momentum to ensure that all young people are exposed to engaging STEM learning experiences and the value of a STEM career.

Recommendations

- Focus on the development of capacity in schools to ensure the three sciences are available as a choice for every young person
- Support the development of more UTCs and Studio Schools to give young people exciting STEM options
- Require sixth forms, colleges and universities to set and report on Davies-style gender diversity targets for key subjects like physics
- Business and goverment should work together to align and expand STEM programmes in schools and share best practice.

Developing joint solutions across and between businesses for ongoing training

Long-term answers based on school reform are necessary, but they are not sufficient to address short-term pressure. Skilled technicians are often the most pressing area of shortage for firms, not graduates. Apprenticeships are an important way of bringing new staff into these roles, and their growth should be encouraged, but we should also look at how collaboration can deliver shorter-term benefits, through retraining of the existing workforce. The shape of the UK industrial base means that any solution to our skills shortage problems must address the needs of small and medium-sized firms in supply chains as much as the largest businesses.

Recommendations

- Apprenticeships are the key long-term route to address technician shortages, with greater business control of the system as the key enabler.
- In the shorter term, we should be using UKCES funding to seed collaborative clusters that can retrain workers in key sectors while developing the apprentice pipeline. This will enable businesses to step up to the challenge set down by the Perkins review of retraining existing staff who already have some STEM skills to fill gaps.
- To be effective, the Richard reforms will need to work for all sizes of business, which implies more simplicity and steps to ensure that small firms can take part.
- Government should invest in seeding a skills eco-system which enables local small business engagement through GTAs and ATAs, as well as sectoral and supply-chain solutions that use the work of large firms to help smaller ones.

Aligning higher education funding with the STEM strategy

Given the wide economic value of STEM skills and the cost of delivering many STEM courses, public funding should be more tilted towards STEM subjects. Additional funding for high-cost STEM subjects must be protected and made more visible to students. We should also look towards developing and finding cross-over courses, for both young people and mid-career workers, to help reduce the time taken to fill skills gaps.

Recommendations

- Government should adopt a more robust approach to funding for STEM in universities – making clear both the reason for and the scale of the subsidy as a tool to communicate the subjects' importance
- As part of a wider review of vital STEM subjects, the case for reducing fees on some courses to attract more students should be explored
- Universities, businesses and government should work together to develop crossover courses that help people switch back to STEM
- The relaxation of ELQ rules around part-time STEM students should be expanded if successful. This will also help businesses step up to the challenge of retraining set out by the Perkins review.

STEM skills: vital for growth and higher living standards

SECTION 1

To thrive in an increasingly competitive world, the UK must work to develop a high-value, knowledge-intensive economy, founded on high levels of productivity and innovation. This is why politicians of all parties have made an effective industrial strategy – encompassing a wide range of sectors – a key part of their policy.

Sectors based on STEM skills are central to our economic future

It is no surprise that skills development is a central part of most industrial sector strategies – raising levels of workforce skills, particularly science, technology, engineering and maths (STEM) skills, will underpin our future growth (**Exhibit 1**).

Nowhere is this more obvious than when we look to the challenges of rebalancing. As the UK moves towards an export-oriented economy – with a focus on investment and growth in sectors such as advanced manufacturing, the digital economy and green energy (**Exhibit 2, page 7**) – STEM skills are again at the fore. Integrating industrial strategy, economic policy and skills policy is essential.

STEM skills drive innovation and productivity growth

Success in meeting our STEM needs requires capabilities which are developed and anchored in the UK. We are not alone in seeking out high-growth, emerging sectors. With key STEM-based sectors looking to grow at home and internationally, global demand for appropriately skilled people will continue to rise. Germany, for example, prioritises a focus on core competencies in automotive, engineering, chemical and electronics industries, while Israel targets technology-based entrepreneurship flowing from competitive strengths in scientific and technical education and R&D.[1] And the global prominence of STEM jobs will grow as more and more countries industrialise, urbanise and specialise. The UK faces stiff competition.

Exhibit 1 Defining STEM

STEM is an acronym for science, technology, engineering and mathematics, commonly used in relation to education and skills.

While STEM skills are becoming increasingly important for every type of job there are a number of sectors where STEM skills are integral, including aerospace, advanced manufacturing and digital. There are a huge range of STEM occupations, including computer scientists, network and computer systems administrators, database administrators, nuclear technicians, engineers, materials scientists, microbiologists, biochemists, and many others.

The STEM acronym has been expanded by some commentators to STEAM – emphasising the value of arts skills to the economy alongside skills in science, technology, engineering and maths. In large part, this is about design – especially in key industries like the creative sector. In a knowledge-intensive economy, it's essential that alongside specific technical skills, people also have the creativity, design and entrepreneurial skills that facilitate innovation and problem solving. In our increasingly complex world blended skills can help drive activities, with skills interwoven and not used in isolation.

Exhibit 2 Major growth sectors

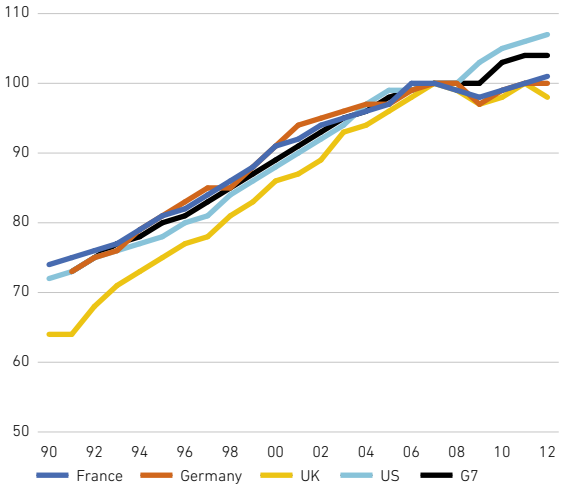
Advanced manufacturing	Advanced manufacturing is the UK's second largest sector, accounting for 12% of gross value-added (GVA) – £130bn in 2010. Advanced manufacturing employs nearly 10% of the UK workforce, approximately 2.6 million people in 2010. Sector productivity is high – GVA per employee stands at £49,000, while the average across the economy is £37,000.[2]
Digital and creative sectors	The UK has a world-beating digital economy. The digital sector directly contributes nearly £69bn to the economy and has seen employment growth of an average rate of 5.5% between 2009 and 2012. The sector will require nearly 300,000 recruits at higher skills levels by 2020 but nearly 20% of vacancies are already difficult to fill due to skills shortages.[3] In the digital environment creative firms need a fusion of core STEM skills as well as skills in art and design. Equally, the creative industries contribute 6% of GDP, employ over two million people and are forecast to play a bigger role in coming years.[4]
Green businesses	Green businesses are driving economic growth and generating STEM jobs. In 2011/12, the UK's green businesses grew by 4.8% and were worth £128bn, with exports up by £12.2bn or 3.9% on the previous year. The latest government figures show that around 938,000 people were employed in green business.[5] The market for these goods and services is set to continue to expand, underpinned by ambitious policy frameworks at home and abroad.[6]

With this in mind, we too need to underpin and develop the STEM-based industries already making a major contribution to the UK. That contribution can grow significantly in the years ahead. Developing a highly skilled STEM workforce will position the UK to take advantage of new global markets, create more high-wage, high-skill jobs and drive economic improvement to the benefit of all, as higher wages in key tradable sectors will support higher pay in less tradable sectors.

The method for achieving this improvement in living standards is raising workers' productivity. And relatively weak productivity has long bedevilled the UK economy, though we enjoyed a long period of catch-up on the back of new approaches to management and innovation from the 1990s until the crash (**Exhibit 3, page 8**).

Since then, at least in part due to the decision many companies and workers made to restrain pay to save jobs, productivity has fallen significantly. In 2012, output per hour in the UK was 16 percentage points below the average for major industrialised economies, the widest productivity gap since 1994. UK output per hour is still two percentage points below its 2007 pre-recession level, and 15 percentage points below the level it would have reached had productivity continued to grow at its average rate before the recession.[7] While UK productivity is high in sectors such as financial services and research and development compared with other countries, we perform less well in sectors such as mechanical engineering and electrical machinery and component manufacturing – key parts of the base we need to reinvigorate to make the industrial strategy work.[8]

Exhibit 3 International comparisons of productivity



Source: OECD, Office for National Statistics

Innovation is a fundamental source of productivity and economic growth and the Global Innovation Index 2013 ranks the UK third in innovation inputs and outputs across 142 countries. But when it comes to our performance on human capital and research, we rank substantially lower at 13th place, and are just 35th in terms of percentage of graduates in science and engineering.[9]

As the economy shifts to more knowledge-intensive industries and the pace of technological change increases, we must meet existing demand for skills and develop those who will drive future technological change and productivity if we are to retain our position as a world leader.

In key manufacturing industries, skills investment represents not only the ability of a sector to maintain itself or grow by replacing or adding to existing skills, but also the ability of those firms to be more efficient about what they do every day.

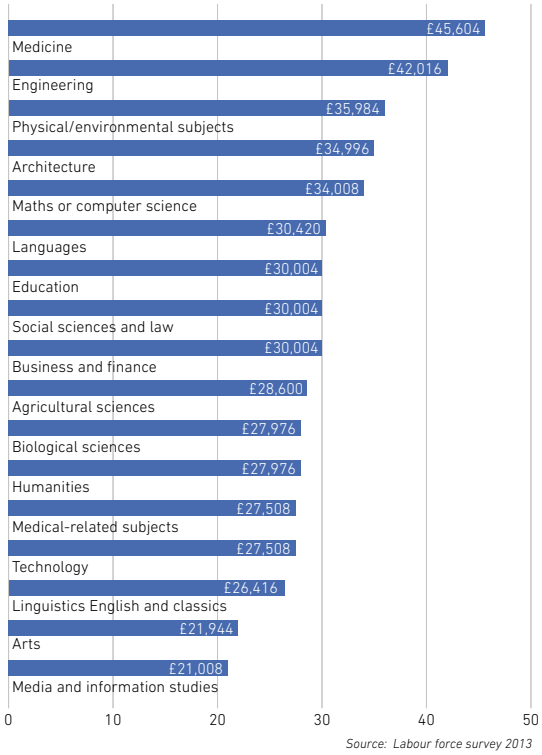
Our STEM skills base is a particularly important part of this. This is because a high growth economy requires sectors with a high gross value added (GVA) per employee. And STEM sectors enjoy higher than average productivity and contribute disproportionately to GVA.[10]

Royal Academy of Engineering analysis shows that, with the exception of finance and insurance, sectors with both above average productivity and above average wages have higher than average concentrations of science, engineering and technology-skilled workers.[11] The energy sector, for example, saw the highest productivity of any sector, with GVA per employee £137,000 a year in 2009.[12]

"The biggest single constraint on the growth of our business is the shortage of high quality engineers. With the north east regional strategy being manufacturing led, addressing this problem will not only ensure economic rebalancing but will also significantly reduce regional inequality"

Andrew Hodgson
Chief executive officer, SMD

Exhibit 4 Average annual pay for graduates by subject



Source: Labour force survey 2013

While almost all sectors saw labour productivity gains in the years leading up to the recession, many of the sectors that achieved the greatest gains rely on STEM skills, including high-tech manufacturing. Aerospace and automotive manufacturing have seen strong productivity growth and increased output since 2007.[12]

STEM skills lead to well-paid jobs across the country

STEM-based occupations are relatively well-paid at all skill levels. For example, STEM graduates have higher earnings on average than non-STEM graduates. The top five undergraduate degree subjects in terms of average annual pay are either core STEM subjects or, in the case of architecture, draw significantly on STEM skills (**Exhibit 4**).

Holding a first degree in a STEM subject is associated with a 4.47% wage premium compared to other subject areas. Pay premia are also found for a number of other intermediate and higher-level STEM qualifications.

STEM qualifications also have significant additional value at technician level if participants then go on to STEM occupations. This is particularly seen for a number of Level 3 STEM qualifications.[14] The CEBR estimates that those with apprenticeship qualifications in the engineering and manufacturing sector receive a wage worth 12% more on average than those without.

This differential can be explained by the productivity gains of £414 a week generated by an engineering apprenticeship, compared with productivity gains of £401 in the construction and planning sector and £268 in the business, administration & legal sector.[15]

Even so, apprenticeships alone will struggle to tackle the issue of skill shortages at the technician level, as they mostly deal with those in the early stages of their careers. With workers increasingly likely to spend almost 50 years in the labour market, a strategy for mid-career retraining to meet emerging economic needs in key sectors is also necessary.

A skills strategy linked to changing occupational needs will provide pathways of progression and upward mobility for individuals across the country at all stages of their career. We must boost awareness of where the jobs are in the economy – and where they are expected to be in the future – and equip people with the skills to access them. This means being clearer about the role of the private sector in creating wealth and the improved wages that STEM-enabled productivity gains deliver. Spill-over benefits will also flow to other workers via knowledge sharing and to other employers through labour mobility.

The growth of STEM sectors can also open up new employment opportunities in all parts of the country. While projections of output for the regions and nations of the UK to 2020 indicate a continuing pattern of the southern parts of England leading the way, the growth of key STEM sectors such as manufacturing and energy will spread opportunities far and wide.[16]

Exhibit 5 Transferable STEM competencies

- Critical thinking
- Analysis
- Data collection
- Deductive, inductive and mathematical reasoning
- Research
- Representing information quantitatively
- Observation and inquiry
- Identifying connections
- Modelling
- Numeracy
- Evaluation
- Interpretation
- Problem solving
- Strategic thinking
- Innovation
- Curiosity
- Use of statistics
- Collaboration

The energy sector, for example, has seen impressive job growth of 65% from 2008-11, with job growth particularly impressive in Scotland and the north west, up by 13.4% and 45.7% a year respectively.[17]

STEM skills have advantages beyond traditional STEM sectors

As the economy shifts towards manufacturing and other knowledge-intensive activities and businesses look to exploit new technologies and discoveries, the jobs of the future will increasingly require skills that STEM study helps to develop. This means not only technical skills, but also design and a broader grasp of scientific method. **Exhibit 5** sets out a few behaviours and characteristics that are of increasing value to employers, and developed by STEM study, when accompanied by investment in critical skills in communication.

The value of the foundation competencies underlying STEM skills means that demand for people with STEM skills is widespread, with boundaries between occupations blurring and demand growing from businesses outside traditional STEM sectors. Financial services, for example, have seen rapid STEM innovations in ICT and financial modelling. This shift in demand for STEM competencies makes increasing the supply of STEM-skilled people all the more urgent. Non-traditional sectors setting value by STEM should be a sign of our need to encourage more people into STEM, rather than begrudging these sectors the skills STEM qualifications can bring.

Even in traditional STEM sectors, like manufacturing, demand is changing with the industry. So, over time, the make-up of STEM skills required will change. An example of this would be the trend to needing more electrical engineers in the automotive industry rather than mechanical engineers. This changing demand will see a higher flow of apprenticeships and young people to these jobs, but retraining has to be part of the immediate solution.

Boosting understanding of the opportunities for exciting, pioneering and rewarding careers in STEM is vital if we are to encourage more people to gain the necessary skills. It is troubling, therefore that in a survey of students studying for engineering or STEM degrees, more than half the 41% of respondents who said they were considering careers outside of engineering said they considered that an alternative career offered the 'potential to do more interesting or fulfilling work'.[18]

We clearly need to do more to sell the potential of STEM to change our world. STEM skills equip people to make the technological advances that enhance our everyday lives. But STEM skills also play an essential role in the transformational, disruptive changes that will define the future of the global economy. It is through innovation in STEM that we will tackle long-term global challenges such as demographic change, urbanisation, climate change and energy security.

Improving rates of progress on building our STEM skills

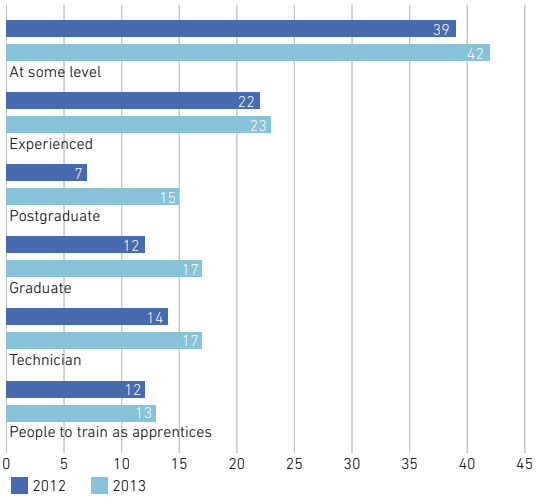
SECTION 2

If a flourishing UK economy and rising living standards require a healthy supply of STEM-skilled employees at all levels, the shortages we face today should be a cause for concern. Businesses report widespread difficulties in recruiting STEM-skilled staff already – even at the beginning of a sustained recovery from the crash.

Businesses are already reporting STEM skill shortages in key sectors

CBI survey evidence from 2013 suggested that among businesses seeking employees with STEM skills and knowledge, 39% faced difficulties recruiting those staff at some level (**Exhibit 6**). Given that our survey data comes from summer 2013, before the sustained upturn in the labour market in the autumn and winter of 2013-4, it is likely that these issues have worsened since the economy began to improve.

Exhibit 6 Employers reporting current difficulties in recruiting individuals with STEM skills and knowledge (%)



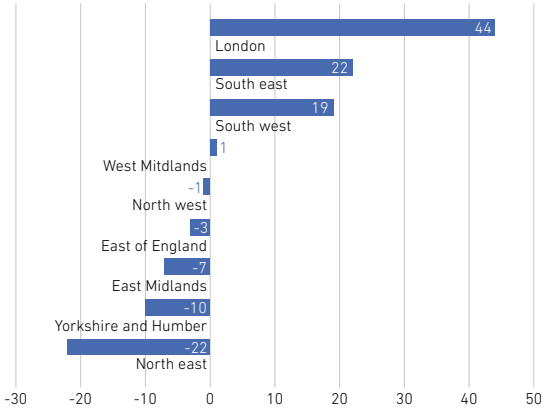
Source: CBI/Pearson education & skills survey 2013

We saw strong job growth in the professional, scientific and technical sector through the year to September 2013, adding 137,000 jobs – the most of any sector. This seems to be continuing. With this in mind, it is no surprise that January's release of the UKCES employer skills survey data pointed to a tightening of the labour market in several key sectors.

As the economy continues on a path of sustained growth, these recruitment difficulties seem set to escalate, with 41% of employers anticipating difficulties over the next three years.[19] The prospect of intensifying skills shortfalls is backed by other studies:

- The Social Market Foundation calculates that we currently face an annual supply shortfall of around 40,000 STEM graduates[20]
- Engineering UK forecasts that by 2020 engineering companies will need to recruit 1.86 million people with engineering skills, including a net increase of 204,400 new jobs[21]
- The Royal Academy of Engineering estimates that 820,000 science, engineering and technology professionals will be required by 2020 to replace existing skills and meet new demand[22]
- UKCES finds that 26% of core STEM vacancies in England are hard to fill.[23]

Exhibit 7 Estimated supply and demand for high-level STEM skills in England, 2020 (000s)



Source: UKCES. Data adjusted for commuting

The rebalancing towards a more STEM-focused economy that we discussed in the previous chapter can only make this trend more acute. UKCES modelling shows that a 1% change in employment demand for higher-level STEM skills would result in a skills shortage of 6,500 people. A 5% increase in demand would lead to a shortfall of 200,000 people.[24]

We also face significant issues around regional shortages. In England, businesses outside London find it harder to secure talent and there are regional challenges in hiring engineers, software developers and scientists. Whereas the south of the country is not predicted to see an overall shortage of people with high-level STEM skills, UKCES projects that by 2020 there could be significant regional shortages of high-level STEM skills in English regions including the East Midlands, Yorkshire and the Humber, the north west and especially the north east (**Exhibit 7**), home of key industries such as automotive, chemicals and oil and gas.

As we have already discussed, STEM skilled workers are critical to the majority of the priority industrial strategy sectors, with the majority of sector strategies highlighting a shortage of STEM skills as a major challenge to growth (**Exhibit 8**). UKCES also points to the difficulty of identifying skills gaps in emerging technologies and sectors where skills mismatches can be 'hidden' in broader data. This concern can be summarised as the UK having a good supply of qualified engineers, but finding some key areas in shortage and others with an oversupply.

Exhibit 8 STEM skill shortages in industrial strategy sectors

Aerospace	Thirty percent of firms in the sector have vacancies, with around 2,000 vacancies altogether, equivalent to 2% of the sector's direct employment. Some of the most severe shortages are faced by firms seeking to recruit technicians skilled in working with composite materials.[26]
Automotive	Vacancies are reported in 18 % of businesses in the sector. Hard to fill vacancies are above average and businesses are more likely to experience skills gaps than others elsewhere in manufacturing or across the economy as a whole.[27]
Life sciences	Key STEM skills, including the ability to apply scientific and mathematical knowledge, need to be developed to meet heightened demand as biotechnology opens up new markets and the sector changes in size and shape.[28]
Offshore wind	A lack of skills is currently most acute in engineering and technician roles.[29] Around 45,000 individuals are projected to be needed to meet sector growth to 2021, with the greatest increase in volume of demand in manufacturing skills and in operations and maintenance.[30]
Oil and gas	The demand for experienced engineers and geoscientists currently outstrips supply and an additional 15,000 STEM skilled staff will be required over the next 4-5 years.[31]

As we look to build momentum on industrial strategy, it's vital that a lack of suitably skilled people does not pose a barrier. Skills strategies need to be linked effectively to industrial and growth strategies to develop talent pipelines of skilled people, aligned with industry needs.

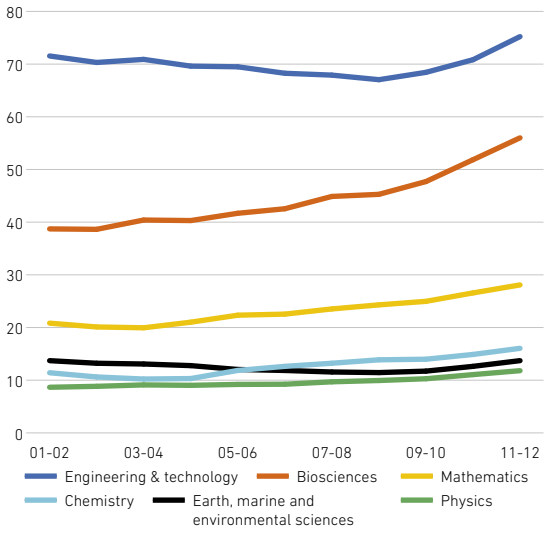
The good news: people are reacting to these signals – especially in education

Resolving our STEM challenges requires short-term and long-term answers. Raising STEM take-up in education and apprenticeships is the essential longer-term answer, while we also need shorter-term fixes due to the long-burn nature of education reform. Nevertheless, building a STEM-skilled workforce must begin with nurturing STEM skills in our education system. Without the underpinning understanding, students will not be equipped to progress to higher level study or vocational programmes. We face the challenge of a 'leaky pipeline' in STEM subjects, losing students at every transition point in their education.

STEM education has long been identified as a priority at both school and higher education level. The good news is that this strategy is starting to pay dividends. For example, in schools:

- We have seen continual increases in the numbers of students studying separate sciences at GCSE level: 2013 saw entries rise by 5% in biology, 4.4% in chemistry and 2.1% in physics. Maths entries increased by 2.5%[32]
- Some 93% of GCSE pupils are set to take double or triple science GCSE in summer 2014, the highest proportion since 1994[33]
- At A level, sciences accounted for 17.8% of all A Levels taken in 2013, up from 15% in 2009 (an additional 23,914 entries). Chemistry entries were up by 5.2% and physics entries rose by 3.1%
- All three sciences are now in the top ten subjects as a percentage of total A-level entries, and physics in eighth place assumes its highest ranking over the period 2002-13.[34]

Exhibit 9 Number of full-time undergraduates in selected STEM subjects, 2001-02 to 2011-12 (000s)



Source: Higher Engineering Statistics Agency

Initiatives to increase the number of students studying STEM subjects at university have also had some success. Undergraduate numbers in key STEM subjects have risen over recent years, with a trend of growth in maths, physics and chemistry that has seen entry to these subjects rise to their highest level since 2003-04 (**Exhibit 9**).[35]

But the 8% increase in the number of undergraduate STEM students over the decade has not been spread equally across subjects. Some of the largest increases were in biological sciences (pharmacology up by 66% and biosciences up 45%) while engineering saw an increase of only 5% and computer sciences actually decreased, by a substantial and worrying 33%.[36]

As young people adapt to the higher education reforms, acceptances to science subjects are holding up well, no doubt driven by the high employability a STEM degree brings. Despite a 1% decrease in full-time enrolments in science subjects in 2012/13 compared to the previous year, the proportion studying science subjects remained the same at 44% of all full-time enrolments (40% of part-time enrolments in 2012/13).[37] In total, 39% of higher education qualifications in 2011/12 were in science subject areas.[38]

As fee reforms begin to bed in, we hope this strong performance will continue. The 2013 UCAS figures showed that acceptances to STEM courses have broadly increased in line with the 7.1% increase in applications overall. Acceptances to engineering courses increased by 9.3%, physical sciences by 5.8% and biological sciences by 9.8%.[39]

This good overall progress in increasing the number of STEM graduates is reflected in UKCES data showing that in 2007 the vacancy ratio for graduate-level STEM occupation vacancies was only slightly higher than the overall vacancy ratio for England (2.7 compared to 2.6). But this masks shortages in specific job roles – for example, the vacancy ratios for specific core STEM occupations, such as engineers, are significantly higher than average.[40]

Fewer firms are now reporting difficulties in finding suitable STEM graduate recruits, with 12% of firms reporting difficulties in 2013 compared with 17% in 2012 (**Exhibit 6, page 11**). Encouragingly, some further progress is expected, with the proportion of employers anticipating problems in the next three years dropping to 10% from 18% last year.[41] But given the expected increases in demand across the economy, there is no room for complacency.

There remains huge demand for technicians

While graduate numbers are improving, it is at the technician level that businesses are most concerned. A truly comprehensive STEM agenda must address the demand for both highly educated STEM professionals and the skilled workers critical to the output, implementation, development and commercialisation of ideas and innovations. While the overall supply of university-level STEM professionals shows positive trends, other critical STEM workers are in short supply.

A large percentage of the workforce in industries and occupations that rely on STEM knowledge and skills are technicians, a field in which businesses report a significant shortage. CBI data suggests that technicians and experienced STEM staff are expected to be particularly hard to recruit (20% and 17% respectively). Some 20% of employers requiring STEM skills expect to have difficulties recruiting technicians in the next three years – twice the proportion of those expecting difficulties with graduate recruitment.[42] Existing STEM technicians tend to be older,[43] meaning that replacement demand will be high in the coming years as people retire (**Exhibit 10**).

Exhibit 10 STEM expansion and replacement demand in key STEM occupations by 2020, EU-27s

	Replacement demand, 2020	Expansion demand, 2020
Physical, mathematical and engineering science professionals	2,364,000	1,183,000
Physical, mathematical and engineering science associate professionals	2,253,000	543,000
All occupations	4,617,000	7,627,000

Source: Cedefop, 2012

Crucial skills and decades of experience will be lost when these workers retire. We must tackle this demographic time bomb now, ensuring there is adequate time to transfer workplace knowledge to a new generation of employees. The Royal Academy of Engineering forecasts the UK needs 50,000 STEM technicians to replace retiring technicians every year.[44] In skilled trades and among process, plant and machine operatives, data shows that replacement demand already outweighs a decline in overall demand Apprenticeships are vital, but not sufficient alone – we need a retraining agenda.[45]

Opening wider gateways into STEM careers

Long undersold as an option for young people, education reforms underway must do more to establish clear routes into vocational education from age 14 and raise esteem by delivering a gold-standard vocational qualification.[46] Widening gateways into STEM careers means maximising the potential of vocational routes. From secondary school through to apprenticeships and beyond, vocational education gives people the opportunity to acquire and apply the valuable technical STEM skills that open up high quality technician jobs. We hope that reforms currently underway in the system, following the Wolf, Richard and Whitehead Reviews of vocational qualifications, will boost the simplicity and relevance of vocational education and encourage increased participation.

Apprenticeships in STEM sectors are an important means of tackling the shortages of technicians, but engineering apprenticeships accounted for only 2% of apprenticeship growth since 2006/07.[47] Nearly half of employers cite more STEM apprenticeships as a priority area for action.[48] Survey evidence shows that 73% of 15 to 24 year-olds say they know little or nothing about technician occupations compared to other occupations (64% across all age groups). This makes it unsurprising that just 24% of young people said they were very likely or fairly likely to choose a career as a technician over another occupation.[49]

Improvements at school and university level must also be accompanied by multiple strategies to up-skill the existing workforce, focused on training, development and opportunities for career progression. As the labour market shifts towards more higher-skilled posts,[50] equipping people with the technical skills needed for today – by developing apprenticeships and supporting retraining – can lay the foundation for progression into higher-skilled work and learning to meet the needs of tomorrow.

Our STEM skills base must become more flexible and responsive

In an increasingly complex and connected world, improving the mobility and transferability of skills will also help build competitive advantage. The UK's ability to flourish will depend on the capacity of both businesses and employees to continually renew and upgrade STEM skill levels. Rapidly changing technologies and global competition make it increasingly difficult to predict the occupations of the future, so the supply of STEM skills must become more responsive and adaptable.

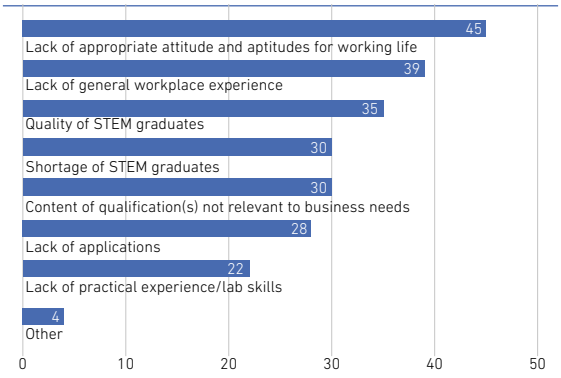
To achieve this, support for a more diverse range of routes into STEM professions is needed. As emphasised in the CBI's *Tomorrow's growth* report, more flexible learn-while-you-earn routes to higher skills are particularly relevant to more experienced incumbent workers who need to upgrade their skills or build new ones. They can also help dislocated workers looking to find jobs in the industries of the future.[51]

Beyond concerns about the number of people with STEM qualifications there are also worries about whether individuals have the required competences to succeed in the workplace. High-quality technical skills must be complemented with a wider breadth of skills. When asked about the barriers they have encountered in filling jobs that require STEM-linked skills and qualifications, employers point to a range of concerns.

Weaknesses in attitudes and aptitudes for working life among candidates and lack of general workplace experience among applicants rank highly. Around a third of employers reporting difficulties in filling STEM-related vacancies cite shortcomings in the quality of STEM graduate applicants, while 30% are concerned that the content of qualifications held by applicants for STEM roles is too often insufficiently relevant to business needs (**Exhibit 11**).

Occupations can and do change, so it's vital that STEM education speaks to broad workforce needs, complementing and underpinning more technical and specific occupational skills. Alongside the need for a skilled STEM workforce, everyone – regardless of their future career pathway – will require STEM knowledge and competencies to fully partake in an increasingly scientific and technological society.

Exhibit 11 Barriers to recruiting STEM-skilled staff (%)



Source: CBI/Pearson education & skills survey 2013

"In the future, all young people will need a wider breadth of STEM knowledge. For example, we think that few subjects will open as many doors for students in the 21st century as computer science. That's why the Oracle Academy provides resources to help awaken and deepen student interest in this important field of study."

Jane Richardson
Director, Oracle Academy, EMEA

The path ahead – building the pipeline we need

SECTION 3

The past decade has seen significant improvement in the STEM skills supply. We now need to see a more ambitious and urgent approach to meet the skills demands of the decades ahead. A long-term, strategic government commitment to improving the supply of STEM skills in the UK will provide the stability and confidence for businesses, universities and the education and training system to work together to invest in skills. In this section, we set out what that might look like – and what businesses can do themselves.

A long-term, strategic commitment is needed

As we've seen, the jobs of the future will increasingly require higher, more flexible STEM skills. We must raise skill levels across the board, finding new and diverse pathways to higher skills – as set out in the recent *Tomorrow's growth* report.[52] This demands a focus not only on qualifications at Level 4 and above, such as higher apprenticeships, but also on Level 3 vocational qualifications as a gateway into higher skills. Alongside increasing the quantity of people with STEM skills, we must also look to improve quality to ensure that people are equipped with the skills they need to enter and succeed in the workplace.

Achieving this requires action in three major areas:

- Widening the pipeline of young people making it to skilled STEM work – especially women
- Developing joint solutions across and between businesses for ongoing training
- Aligning higher education funding with the STEM strategy.

We have to recognise that our global competitors are also taking action to up-skill workforces – China is projected to award 3.6 million engineering degrees in 2015, up from 2.6 million in 2010.[53] They are also seeking talent from the global STEM skill pool. A highly skilled workforce is a major factor in attracting investment. The UK must work hard to remain a competitive destination for both domestic and international STEM talent. An effective and responsive work permits system for highly-skilled migrants to ensure that the UK remains a world-leading location for high-skill STEM industries is essential, but we need much more urgency in addressing issues with our domestic supply. These measures will help.

Widening the pipeline of young people making it to skilled STEM work – especially women

The longer-term solution to our STEM issues lies in making sure more of our young people have access to the rewarding nature of work in STEM-based careers. As we set out later, there is more that we, as a business community, can do to share the excitement that such work can offer. But selling the benefits of choosing STEM is only as effective as the options we offer young people to get involved in the subjects.

Last year, we saw a welcome change in approach from government on the curriculum for design and technology at GCSE. This progress – moving away from a craft-focused curriculum to one more linked to the design and technology needs of key sectors – needs to continue. That means ensuring the curriculum is engaging, experiential and up to date. As the CBI report *First steps* pointed out, giving schools the time and freedom – as well as support to develop high-quality teaching – will help ensure the excellent work of programmes like STEMNET continues throughout the year.

Even so, there is more we can do. First and foremost, we should aspire to offer the three sciences at GCSE in every school. The English Baccalaureate has driven a real uptick in take-up of double award science, but it is when young people do all three that routes really open for them.

In addition to this, but in no way as a replacement for it, developing more schools that offer an in-depth STEM-led curriculum to those who have already decided to commit to the subjects by the time they are 14 will help. The University Technology College (UTC) movement is a great response to this, something that offers the potential to achieve a long-term aim of many businesses: a UK system of truly high-quality technical schools. Their continued growth – alongside similar programmes like Studio Schools – will underpin our supply of skilled STEM workers and offer a more hands-on learning experience to those who learn better in that way.

More than any other change, boosting participation by women would help

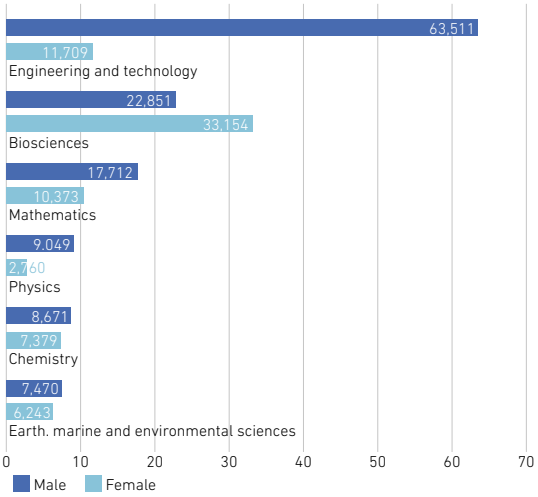
Improving STEM participation by girls and women, and that of other underrepresented groups, must be a policy priority. Women make up 46% of the UK's workforce, but just 15.5% of the core STEM workforce.[54] They are particularly underrepresented in engineering, where just 8% of engineering professionals are female. According to the Royal Society of Edinburgh, increasing the participation of women in the STEM labour market could be worth at least £2bn to the UK economy.[55]

STEM sectors need to be able to draw on the whole of the UK talent pool. Concerns around shortfalls would decrease significantly if STEM sectors were successful in attracting a higher number of women to their professions. A diversity of ideas, backgrounds and perspectives will also benefit STEM vibrancy and innovation, and discourage groupthink. The diversity it brings would seed the innovation that is so vital to our economy.

For girls and women to make informed choices about their futures we need to tackle misconceptions about STEM careers. In a survey by Atkins, three quarters of female engineers said they believe engineering is still regarded as being 'a male career'. But 84% of respondents also reported they were happy or extremely happy with their career choice.[56] Businesses requiring STEM skills need to work at tackling stereotypical views about the reality of a STEM career as early as possible, exploring the diversity of career pathways that STEM skills open up and encouraging their female employees to talk about their experiences of the workplace.

The leaky pipeline of women at successive stages of STEM career paths shows that supporting and retaining women is as important as attracting more into STEM pathways in the first place. Good progress has been made in encouraging young people of both genders to study STEM subjects up to GCSE (**page 13**) but female participation begins to fall at A-level. Girls made up just 21% of physics entrants, 39% of maths entrants, and 29% of further maths entrants in 2013 (although 48% of chemistry entrants and 58% of biology entrants were female).[57] Rather than tackling these gender divisions, the Institute of Physics has found that almost half of co-educational state-funded schools across England are strengthening gender imbalances in subject choice at A-level, with physics and maths showing a male bias and biology showing a female bias.[58]

Exhibit 12 Number of male and female full-time undergraduates in selected STEM subjects, 2011-12 (000s)



Source: HEFCE, Strategically important and vulnerable subjects

Unsurprisingly this gender-divide flows through to university level (**Exhibit 12**). Among 2012 graduates, women predominated in biology and accounted for approximately half of all chemistry graduates and physical and geographical science graduates, but only 21.5% of physics graduates.[59] Vocational STEM qualifications also show poor female participation. In the 2011/12 academic year in England women made up just 3% of those taking an engineering framework apprenticeship, with a similar gender gap found in other types of vocational engineering qualifications.[60]

Even in subjects where women account for a large proportion of students this is not reflected in the workforce, especially at management level. A 2012 European Commission study found that around 42% of UK academic staff are women but at the most senior research grade it is around 17%, below the EU average. This low workplace participation of highly trained women is both economically and socially damaging, and inefficient in terms of investment in education and training. But more than this, it acts as a further disincentive to the next generation by embedding the idea of STEM subjects as inherently male.

A number of valuable initiatives already exist to attract women to STEM roles (**Exhibit 13, page 20**), but with concerns over future STEM skill supplies we must redouble our efforts. It is time to think big, and consider solutions that link funding and recognition of STEM courses to clear diversity goals. As part of this, it is time for providers of education and training in STEM subjects to set clear targets and plans for addressing the issue of poor take-up of subjects among women. Drawing on the experience of business, and the Davies review in particular, every school, sixth form, college and university should be setting a target for female participation and reporting against it. This approach is working to change the senior teams of a large number of businesses and it will help focus the minds of education providers too.

Build on and align the good work of business schemes

One of the key drivers of progress on STEM participation has been the engagement of businesses with a wide range of programmes designed to explain STEM careers and share the excitement the subjects can offer. Over half (52%) of engineering, hi-tech, IT and science firms are currently engaging with schools to promote STEM study (**Exhibit 14, page 20**). Businesses have a vital role to play in providing careers guidance and support – helping young people to understand the pathways are available to them, and what employers are looking for in terms of knowledge, skills, attitudes and behaviours. STEM sector businesses are also actively partnering with universities to help students understand the practical relevance of their courses – 47% firms in the engineering, hi-tech/IT and science areas work with universities to provide 'real-life' projects and resources.[61]

In addition to firm-level engagement, other organisations are doing outstanding work with young people and schools (**Exhibit 15, page 21**). These schemes are particularly valuable for the many smaller businesses that do not have the capacity to engage individually.

Exhibit 13 Inspiring women to pursue STEM

Women in Manufacturing Ambassador Programme

WiM is a business-led initiative bringing together the UK manufacturing and engineering community and education networks to support, attract and retain women in the sector. Industry ambassadors volunteer their time to share their experiences with students in schools and the workplace, from primary school to higher education.

Large Engineering Employer Apprenticeship Consortium (LEEAC)

The LEEAC, including Rolls Royce, Network Rail, BAE Systems and Bentley Motors, successfully bid for a share of government funding to work together to inspire more women into the sector and support their career development. Seeking to engage 2,500 young women in schools, the programme will encourage female participation at multiple stages, from encouraging the uptake of STEM subjects at GCSE to sponsored full degrees and ultimately into a career in the sector.

This project will deliver a structured extra-curricular education programme comprising:

- Inspirational STEM enrichment days in schools reaching 2400 14-18 year-old females
- After-school clubs, developing STEM and employability skills
- Outward Bound Trust five-day residential courses for 240 females
- Supporting incumbent female engineers to become part of a mentoring programme.

Women in Science and Engineering (WISE)

With over 30 years of experience, WISE's mission is to improve the gender balance in the UK's STEM workforce, pushing the presence of female employees to 30% by 2020. WISE takes a pipeline approach from classroom to boardroom – running inspirational workshops in schools, for example.

Young Women in the Know

As part of its 'Inspiring tomorrow's engineers' education programme Jaguar Land Rover's *Young Women in the Know* course aims to change outdated perceptions of the engineering industry and encourage more women into engineering and manufacturing roles.

They are vital in helping young people see the links with what is learned and how, in the workplace, this is translated into technology, products and innovations, as well as signposting job opportunities and the subjects and qualifications required to secure them.

Exhibit 14 Employer engagement in action

IBM hosts a range of programmes to involve school-aged children in STEM, engaging talent at an early age to encourage prolonged study in industry related subjects. The annual Blue Fusion event allows 14-15 year-olds to use their scientific knowledge, thinking and teamwork skills to complete fun STEM activities.

To build on the momentum of effective programmes, employers should join forces and build on existing success, seeking out opportunities to think creatively and collaboratively on how they work together to inspire young people. Co-ordinating initiatives will mean that, as well as developing specialised skills, programmes will be more adept at developing cross-cutting, transferable STEM skills that allow people to move within and between industries, making our STEM skills base more flexible and nimble.

STEM programmes and initiatives should be evidence-based. They should be evaluated to build on effectiveness, 'raise the bar' of quality and the impact of provision, and reduce administrative burdens. Streamlining initiatives will allow those that are most

Exhibit 15 STEM engagement programmes

STEMNET
STEMNET works with thousands of schools, colleges and STEM employers to enable young people of all backgrounds and abilities to meet inspiring role models, understand the application of STEM subjects in the real world and bring STEM to life.

STEMNET runs three core national programmes:

- STEM ambassadors - 26,000 volunteers who promote STEM subjects to learners and help teachers deliver the STEM curriculum, as well as raising awareness of STEM careers
- STEM clubs programme – STEM clubs allow children to explore, investigate and discover STEM subjects outside the classroom
- Schools STEM advisory network - 45 organisations across the country offer free, impartial advice to schools to support the curriculum and increase the number of students moving into STEM education, training and employment.

The National Science and Engineering Competition is open to all 11 to 18 year-olds living in the UK and in full-time education. The competition recognises and rewards young people's achievements in all areas of STEM.

The Big Bang Fair is the largest celebration of STEM for young people in the UK, showing 7 to 19 year-olds the existing and rewarding opportunities there are for people with STEM qualifications.

successful to prosper and be scaled-up. Promoting coordinated 'best practice' approaches and a more systematic approach to building links should not come at the cost of damaging existing, successful provision, but should instead look to enhance all provision.

Recommendations

- Focus on the development of capacity in schools to ensure the three sciences are available as a choice for every young person
- Support the development of more UTCs and Studio Schools to give young people exciting STEM options
- Require sixth forms, colleges and universities to set and report on Davies-style gender diversity targets for key subjects like physics
- Business and government should work together to align and expand STEM programmes in schools and share best practice.

Developing joint solutions across and between businesses for ongoing training

It cannot be emphasised enough that STEM is about a lot more than graduates – indeed, the most pressing shortages are often for skilled technicians. The right training tool for these staff is a mix of apprenticeships for new entrants and the creation of vehicles for retraining existing members of the workforce. These should be linked to key sectors in the industrial strategy, supply chains and – for the smallest firms – local areas.

A new approach will require public authorities and businesses to work together to develop a more robust skills eco-system. This should encourage collaboration – as a tool to progress apprenticeships and retraining as answers to the technician shortage. Retraining, in particular, is an important short-term response to shortages that can help tide us over until a stronger supply line is delivered from schools and colleges.

Exhibit 16 Collaborating on apprenticeships effectively

The Energy & Efficiency Industrial Partnership (EEIP)
The EEIP brings together over 90 employers from across the energy and efficiency sectors to improve skills and productivity by delivering a range of STEM-based traineeships & apprenticeships. The EEIP Council is composed of CEO-level representatives from across the EEIP's footprint and is chaired by Steve Holliday, CEO of National Grid. The total programme is worth £105m, delivering 11,000 new jobs over the next three years.

Information Economy Shared Apprenticeship
The Industrial Partnership for the Information Economy's Shared Apprenticeship scheme helps SMEs jointly employ apprentices. By acting together businesses can offer apprenticeships and share costs, and run a wider range of experiences to apprentices.

Getting apprenticeships right for all businesses is a crucial part of the mix...

For new entrants to STEM, the Richard review proposals offer a step-change in the potential for apprenticeships, by giving firms more control over content and training quality. There is the potential to deliver a genuinely business-focused system, rather than one that dances to the government's tune. If got right, they could deliver a simpler, more relevant system. The CBI has supported these proposals, subject to the approach chosen being simple for all firms, attractive for SME participation and introduced in a way that maintains the UK's training capacity through the changeover period, including allowing firms to maintain provision they are happy with. This includes ensuring apprenticeships have a clear set of standards to meet – but also that they are designed and applied by firms themselves.

Despite this strong progress, too few employers are currently engaged with apprenticeships. In part, this is a legacy of high costs and red tape that has gradually been being tackled. But it also reflects the structure of today's businesses – smaller, more specialist and operating in complex supply chains.

Addressing the challenge of getting more businesses to sign up to apprenticeships requires an eco-system that helps medium and smaller businesses that lack capacity to do more in their own and the sector's interest. We need to help firms build training clusters that will draw together communities of practice from across a relevant group of businesses, whether that is a supply chain, a local area or a sector. This is a particular challenge for small businesses, for whom accessing a larger partner's training academy, Group Training Associations or Apprenticeships Training Agencies (GTAs/ATAs) may be the best option.

...but so is building up collaborative models of working in supply chains and sectors on retraining

In key industrial strategy sectors, using supply chains also offers significant opportunities for growth. The Automotive Council, for example, have identified £3bn of opportunities for UK suppliers with the right skills.[62] Supply chains can be important sources of innovation and are core to the success of UK STEM sectors. But with demand for STEM skills so strong, many suppliers in supply chains can find it difficult to source skilled staff. Research from Jaguar Land Rover suggests that 29% of UK-based SMEs in the sector struggle to win new business because of skill shortages – it is likely that some of this work ends up going abroad.[63] As well as facing greater challenges in attracting talent, smaller businesses may also find sourcing appropriate training or developing their own tailored provision very challenging or impossible.

More can be done to strengthen the UK supply chain network to grasp this growth quickly through retraining the existing workforce, as well as building on apprenticeships. Collaborative solutions like the Talent Retention Scheme, set up to ensure that advanced manufacturing and engineering skills are retained in the UK supply chain, have provided a significant boost. Building up the strong relationships required for this kind of solution needs cross-sector analysis and more intensive co-operation between UK businesses of all sizes.[64] Joint initiatives can help ensure that we are developing the right mix and agility of skills, with employer collaboration helping to cascade higher skills and standards through the chain.

Exhibit 17 Effective skills investment in the supply chain

The Advanced Skills Accreditation Scheme (ASAS) education scheme, based on a programme developed by Jaguar Land Rover (JLR), offers engineers the chance to develop the green and future engineering skills needed to create new technologies. In partnership with the Sector Skills Council for Science, Engineering and Manufacturing Technologies (Semta), JLR has now made the programme available to supply chain companies and other hi-tech industries to raise skill levels across the supply chain.

The UKCES Employer Ownership of Skills Pilots (EOP) have already demonstrated the potential of this approach. It has helped employers to work with others in their area or supply chain to develop the skills needed for growth. We can do more to seed these developments, especially on behalf of fast growing medium-sized businesses in the supply chain, who will be the heart of a sustainable recovery.

Some businesses are already leading the way in investment in skills in their supply chain (**Exhibit 17**). Incentivising greater supply chain collaboration on skills, including sharing best practice, as well as exploring incentives to drive further collaboration will help to make similar collaboration more widespread.[65] One way to do this could be through the new Employer Ownership Fund.

Recommendations

- Apprenticeships are the key long-term route to address technician shortages, with greater business control of the system as the key enabler.
- In the shorter-term, we should be using UKCES funding to seed collaborative clusters that can retrain workers in key sectors while developing the apprentice pipeline. This will enable businesses to step up to the challenge set down by the Perkins review of retraining existing staff who already have some STEM skills to fill gaps
- To be effective, the Richard reforms will need to work for all sizes of business, which implies more simplicity and steps to ensure that small firms can take part.
- Government should invest in seeding a skills eco-system that enables local small business engagement through GTAs and ATAs as well as sectoral and supply-chain solutions that use the work of large firms to help smaller ones.

Aligning higher education funding with the STEM strategy

The teaching of many STEM subjects is expensive to deliver and the cost is not fully covered by tuition fees. As a result these high cost subjects – including laboratory-based science, engineering and technology subjects – receive additional funding, worth £330m to institutions in the academic year 2013-14. Very high cost STEM subjects – chemistry, physics, chemical engineering and mineral, metallurgy and materials engineering – have received additional funding worth £23m in 2013-14.[66] The announcement of an additional £200m STEM capital funding for the 2015-16 academic year, requiring match-funding on at least a one-to-one basis, is another welcome investment in science and engineering teaching at universities. These additional funds are critical to the teaching of high-cost STEM subjects and must be protected in real terms.

This additional public funding means that while STEM students receive a larger subsidy than other students relative to cost, these additional subsidies are not clearly visible to students. Students may, however, calculate the opportunity costs of STEM study – in terms of hours spent on study or in terms of the years needed to complete the courses – and consider this higher than for many other subjects.[67] It is time for this to end – the scale of government support for STEM must be made clear to university applicants.

Students should be helped to be rational consumers of education, making informed decisions based on the true cost and value of degree programmes. Survey evidence from the Institution of Mechanical Engineers shows that 48% of the public say that government subsidies for STEM degrees would persuade them to encourage their children to consider a career in engineering, compared to 14% who said it would not.[68] To incentivise people to study for the skills the economy needs, it may be necessary to enhance

this subsidy further, by cutting tuition fees. Given the longer-term economic pay-off for the state, this would be a decision worth taking for some key courses.

Businesses also have an important role to play in subsidising or sponsoring relevant STEM courses or qualifications to help reduce the cost to students (**Exhibit 18**). Nearly a quarter of CBI members (23%) responding to a recent survey say they already offer some student sponsorship.[69] Sandwich degrees also play a vital role in aligning students with future career paths and opportunities.

Besides the need to more clearly sign-post, and enhance, the government subsidy for STEM subjects, it is also desirable to ensure young people are not closed off from higher STEM skills by decisions made many years earlier. As well as being better for the young person, addressing this will also shorten the time-lag on new entrants to the STEM labour market.

Developing one-year intensive cross-over courses – an approach used in the legal profession after graduation – for young people to take for a year at 18, would enable more young people to study for a STEM degree. This would include many young women, who perhaps gave up the sciences at 16, a trend we noted above. These courses could be developed by universities working with businesses and government, so that the individual did not face another year of full fees for making a decision that was in both their own and the national interest.

Changing tack on STEM is not an issue only for the young. As the market for STEM skills evolves, it is important to remove barriers to retraining for mid-career workers, too. The government has announced a partial relaxation of the current equivalent or lower qualification (ELQ) rules, enabling part-time students who have previously studied for a degree to access some tuition support to retrain part-time in engineering, technology and computer science. This is something the CBI called for in *Tomorrow's growth*. If successful in its early stages, this programme should be expanded.

Employers requiring specific skills should also look to help people convert their existing STEM skills and knowledge to fill labour market gaps. The CBI endorses Professor John Perkins' recommendation that employers should be encouraged to develop innovative ways to support people to convert existing STEM skills by pursuing a second degree in engineering.

Recommendations

- Government should adopt a more robust approach to funding for STEM in universities – making clear both the reason for and the scale of the subsidy as a tool to communicate the subjects' importance
- As part of a wider review of vital STEM subjects, the case for reducing fees on some courses to attract more students should be explored
- Universities, businesses and government should work together to develop crossover courses that help people switch back to STEM
- The relaxation of ELQ rules around part-time STEM students should be expanded if successful. This will also help businesses step up to the challenge of retraining set out by the Perkins review.

Exhibit 18 STEM scholarship programmes

BP STEM scholarships
Each year BP offers scholarships to up to ten students studying certain STEM subjects at the University of Birmingham. Each scholarship is worth up to £20,000. As well as financial support, scholars are offered unique access to the energy industry.

Aerospace Growth Partnership
As part of the Aerospace Growth Partnership the UK aerospace industry and government have committed £3m each over three years to provide financial backing to Masters (MSc) level degrees in aerospace engineering, covering the cost of tuition fees up to a maximum of £9,500. The bursary is available to support the up-skilling of current aerospace employees already qualified to graduate level, and current BSc students to study at masters level.

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