



Department
for Business
Innovation & Skills

Engineering Skills: Perkins Review Progress Report

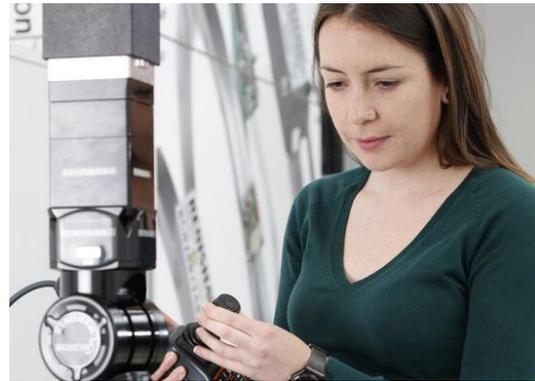


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Acknowledgements

Foreword

The Rt. Hon. Dr Vince Cable MP, Secretary of State, Department for Business, Innovation and Skills

I am pleased to introduce this very encouraging one year on outlook from Professor John Perkins. His Review of engineering skills highlighted important questions that this Government and the engineering profession have worked extremely hard to address. I am delighted that engineering and science applications to universities have increased over this year. I also am deeply appreciative of the significant collaboration across the engineering community to increase awareness of engineering as a challenging and rewarding option for young people. I look forward to these partnerships continuing long into the future. Only by working together over the long term can we have a reasonable hope of increasing the supply of engineers in the UK, a critical requirement for our Industrial Strategy.

Foreword

Sir Richard Olver FREng, Chair of Engineering the Future

One year ago, Professor John Perkins published his Review of Engineering Skills and set a challenge for the engineering community to help deliver the key recommendations. I am delighted to report that the engineering community, through the Engineering the Future alliance, has risen to that challenge and addressed key recommendations in the review. One year on, we have set in train actions through four task and finish groups focusing on increasing employer engagement in schools, colleges and universities at both undergraduate and postgraduate level. However, this progress report only marks the end of the beginning; we have much more to do to ensure that these actions make a meaningful impact on the engineering skills supply challenge. Our profession remains committed to continuing to support of the Perkins Review of Engineering Skills through Engineering the Future and working with stakeholders across the engineering community.

1 Investing in Change

Professor John Perkins CBE FREng, Chief Scientific Adviser, Department for Business, Innovation and Skills

The Perkins Review of Engineering Skills set out a call to action for engineering employers, the profession and educators, to join with each other and with Government over the long-term to increase the supply and quality of engineering skills. One year on, the strong and positive response to this challenge has exceeded expectations, with many new partnerships created across Government and the profession to take forward a sustained programme of work. I would like to extend my heartfelt thanks to the engineering community for facilitating concerted action from employers and educators to tackle my recommendations through their task and finish groups. Their progress and future plans are described in this report.

1.1 Inspiration

Inspiring more young people to take up careers in engineering is crucial and that is why I recommended further action. Widespread recognition of this need had prompted a wealth of activities. I recommended strategic coordination of activities to increase their impact and coverage and strongly endorsed the Tomorrow's Engineers programme created by the engineering community to co-ordinate their outreach and engagement with schools.

Government has responded by providing seed funding of £250,000 to EngineeringUK to support the nationwide roll-out of the Tomorrow's Engineers employer engagement programme. Pilot activity in the North and South East of England has shaped the full national roll-out, which will take place from January 2015 based around regional hubs that will act as one-stop shops for those seeking engagement with the engineering community. The programme is underpinned by the Tomorrow's Engineers Schools Database which maps engineering careers engagement undertaken in secondary schools. This enables the programme quickly to identify the available capacity for employer engagement and to target schools that are not yet being reached. All employers participating in Tomorrow's Engineers will share their data via this route. Figure 1 shows an example map of engineering careers engagement derived from the database.

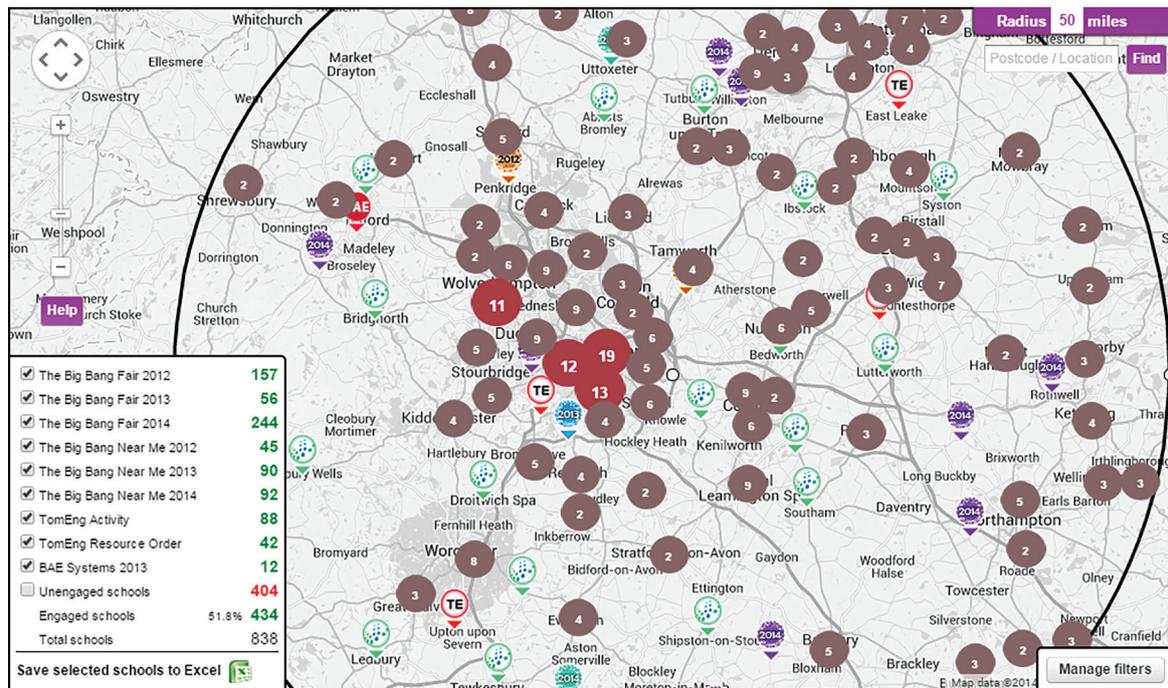


Figure 1: Engineering careers engagement in the Birmingham area

Building on the collaborative ethic of Tomorrow's Engineers, Government initiated and led "Tomorrow's Engineers Week" in November 2013; a highly-focused media campaign to tackle out of date, gender-biased perceptions of engineering and raise awareness of engineering careers. The week saw more than 70 partners deliver over 65 events and activities across the country with a strong focus on reaching 11-14 year old girls. The campaign generated substantial media coverage and #TEWeek13 trended nationally. Polling showed that 26% of 11-14 year olds heard about engineering careers during the campaign and there was a 6% increase in the number who would consider a career in engineering. The number of parents saying that they had encouraged their child to consider engineering as a career option increased by 4%. Following the success of the inaugural Tomorrow's Engineers Week, EngineeringUK has taken the initiative to deliver the week as an annual event on behalf of the engineering community.

Tomorrow's Engineers Week demonstrated the power of collaborative action by the engineering community. The Your Life Call to Action has adopted a similar approach by inviting employers, educators and the profession to make concrete pledges to increase the number of women in engineering and technology. Already over 200 organisations including Arup, Ford, Airbus, Balfour Beatty and Laing O'Rourke have pledged to create more than 2,000 new entry level positions including Apprenticeships, graduate jobs and paid work experience posts as well as actions to support their female workforce.

Specific examples include:

- The Royal Academy of Engineering with Women into Science and Engineering has developed a checklist of ten actions employers can take to improve the retention and progression of women in predominantly male work environments.
- Shell is expanding its Girls in Energy Scheme offering young women 160 hours of engineering and science education, field visits and careers advice from women working in the industry.
- MBDA UK is maintaining female apprentice recruitment at a minimum of 50% and has a minimum 5% of its workforce on recognised and formalised training programmes, such as apprentice and graduate schemes.

1.2 Academic Foundations

In my Review, I emphasised that engineers need a strong foundation in mathematics and physical sciences. Government is investing £135 million over the current spending review period to improve science and mathematics education. Over £30 million is also being invested to support the Further Education Workforce Strategy, which aims to improve leadership and teaching in further education and increase the quantity and quality of maths teachers in that sector.¹ The trends are promising: since 2010 A-Level entries have increased in mathematics (up 15.3%), further mathematics (up 20.5%) and physics (up 18.5%).

Industrial experience gives teachers an understanding of engineering in the workplace, enabling them to better inspire their students. Government is providing professional development opportunities for science teachers and technicians through a network of science learning centres. To attract the best maths, physics, chemistry and computing graduates into teaching, Government is offering bursaries and scholarships worth up to £25,000. A £9,000 bursary is available for those aspiring to teach Design and Technology. Grants of up to £30,000 are being awarded by the Education and Training Foundation to help further education providers recruit maths teachers. As part of the Your Life Call to Action, a programme has been launched to recruit post-doctoral maths and physics researchers to train as teachers, sponsored by industry, alongside a campaign to increase the number of students taking A-level physics and maths.

Government has renewed its commitment to support the Stimulating Physics Network, led by the Institute of Physics, which provides professional development for teachers and pupil activities to increase progression to physics A-level. £4.3 million will be invested over 2014-16. The continuing gender gap in A-level physics constricts the number of women in the talent pipeline for engineering; the network is testing

¹ www.gov.uk/government/publications/further-education-workforce-strategy

different interventions to improve the number of girls progressing to physics A-level. These will look at building confidence and resilience, girls in the physics classroom, and a 'whole school' approach to gender stereotyping.

1.3 Vocational Education

Vocational education continues to flourish. This year has seen a 17% increase in the number of Level 3 BTEC qualifications in engineering and a 53% increase in the number of female students since last year³. Government has expanded the University Technical College network which offers 14-19 year olds high-quality education with a clear focus on employment. Fifty colleges are now open or in development, creating 27,000 opportunities for young people to train as engineers and scientists. Provision for engineering has also been increased through the new Prospects College of Advanced Technology which will have three specialist apprentice training centres for engineering. Government is investing up to £50 million in new National Colleges focussing on key sectors of the economy including Manufacturing Technology, High Speed Rail, Software Engineering and Nuclear.

Government is investing £30 million for employers to implement innovative approaches in tackling skills shortages in engineering. Following consultation with employers and professional engineering institutions, two £10 million skills grant schemes were launched in June 2014. The "Improving Engineering Careers" scheme provides funding for training and re-skilling programmes and raising workforce skill levels towards professional status. The "Developing Women Engineers" scheme has been made available for employers to develop their female engineering workforce. This could be for 'returner training' to enable women to return to engineering after a career break, programmes to help women into apprenticeships, mentoring and support to help them progress their careers. Both funds offer 50% match-funding for employers seeking to invest in engineering skills. A further £10 million fund will support smaller firms in strengthening their engineering skills supply.

Engineering employers have been at the forefront of implementing the Government's reforms of apprenticeships. Sectors such as aerospace, automotive, food and drink manufacturing and energy and utilities were involved in the first phase of Trailblazers, launched in October 2013. The second phase of Trailblazers, launched in March 2014, also featured a range of engineering sectors including rail design and land-based engineering. Government has published the third phase of Trailblazers which again include a strong engineering presence in areas such as welding, engineering design and rail engineering.

³ uk.pearson.com/home/news/2014/october/btec-results-2014.html

1.4 Higher Education

I am pleased to note that this year has seen significant growth in university applications for engineering (up by 6.1%). My Review highlighted the need to ensure that delivery of high quality engineering subjects taught in higher education is financially sustainable. Government has invested significantly to meet the teaching costs of additional places in high cost subjects including engineering and science. Extra funding of £185 million will be available over four years from 2015-16 to support engineering and science teaching. Government has provided a £200 million teaching capital fund, match-funded to leverage a minimum of £400 million in engineering and science capital investment. Criteria for awarding funding will include: a commitment to increasing diversity, support for Industrial Strategy aims, investment in high quality engineering and science provision and student demand.

Employer engagement is key to the success of the higher education engineering sector for effective course design and delivery, provision of work placements and where appropriate, sponsorship for students. Government has stimulated activity between employers and universities to investigate and pilot options to increase participation in postgraduate level engineering education.

A concerted approach between employers and educators is critical in achieving our aim of increasing engineering skills supply across the whole education system. The engineering community has been investigating mechanisms to improve engagement through task and finish groups, as set out in the next chapter.

2 Working in Partnership

Engineering the Future

A number of recommendations from the Perkins Review concerned the identification of mechanisms to improve employer engagement with schools, colleges and universities because of the importance of such links for inspiration and delivery of high quality higher and further education. It was agreed that Education for Engineering (E4E), the education arm of Engineering the Future, would be best placed to drive the work. The community, through E4E convened four 'task and finish' groups to identify and implement solutions which would have impact and longevity in the areas of:

- 1 **Experiencing industry** by providing work experience in engineering for students and teachers. *Chaired by Steve Holliday FREng, Chief Executive Officer, National Grid*
- 2 **Cutting edge skills in further education** by encouraging employers to share up-to date knowledge. *Chaired by Carol Burke FREng, Managing Director, Unipart Manufacturing*
- 3 **Employer engagement in higher education** by helping employers and universities work together, improving visibility of employers on campus. *Chaired by Dame Julia King DBE FREng, Vice Chancellor Aston University*
- 4 **Increasing the supply of specialist skills** by boosting postgraduate training in engineering. *Chaired by Professor Helen Atkinson CBE FREng, Immediate Past President, Engineering Professors' Council, Head of Department of Engineering, University of Leicester*

An oversight committee, Sir Richard Olver FREng, Judith Hackitt CBE FREng, Allan Cook CBE FREng, was set up to ensure effectiveness and coherence across these work streams.

Common themes

It is clear that, at all levels from school to university, many good schemes and activities already exist for employer engagement but coverage is patchy and we need to do more. At every level we need to publicise these more widely and share good practice with both education providers and companies, as well as working to increase engagement and impact. The communication of why and how educators and employers can work together effectively is key to increasing engagement on both sides. Describing the benefits, through compelling ‘business cases’, will be central to gaining the commitment of employers and educators. Case studies, examples and guidance, delivered through appropriate communication channels, will encourage, support and motivate our target audiences. The work of the groups is summarised below and their full reports can be accessed on the E4E website: www.educationforengineering.org.uk/perkinsreport

2.1 Employer Engagement in Schools

This group has addressed two of the recommendations from the Perkins Review; how to improve the opportunity and up take of industrial continuing professional development (CPD) for teachers, and enabling post-16 year old students to have access to high quality engineering work experience.

Teacher industrial professional development. To motivate businesses, schools and teachers to engage in more teacher industrial CPD, the group has developed a compelling case for all parties to support industrial placements for teachers. To help schools and employers engage in CPD activities, the group has taken information from existing successful schemes to create an ‘escalator’ of activity for teachers, which also includes guidance on best practice and examples of activity. It is intended that this will ‘lift’ both teachers and engineering businesses from an initial short activity, to something longer and with more impact. The National Science Learning Centre has agreed to disseminate the information and provide a national and regional structure of support.

Work experience. To make it easier for employers to offer work experience for post-16 students, the group has created a number of project briefs to enable employers to use ‘off the shelf’ projects. It also created documentation, based on good practice, to help a company before, during, and after a work experience placement. This documentation includes considerations such as diversity and inclusion in making places available, guidance for supervisors and how to help a work experience student prepare for a placement.

2.2 Cutting Edge Skills in Further Education

This group was tasked with increasing engineering employer engagement in the further education sector. This could be through mentoring, curriculum development, facilities sharing, or schemes such as the Education and Training Foundation's Teach Too programme. The Teach Too programme provides support for practising engineers to teach in further education on a part-time basis, as well as for the professional development of existing teachers.

Joint business case. The group identified that articulating joint objectives helps both employers and colleges understand their common goals and what activities they might undertake to achieve them. They are developing a 'joint business case' which identifies a number of shared aims for engineering employers and further education providers. This will articulate the specific benefits to each party, and provide guidance on activities that help both achieve these aims.

Good employer engagement in practice. Investigating the existing relationships between engineering employers and the further education sector has revealed a great deal of existing good practice. This has been captured through case studies and other information exchange with companies and providers who are particularly effective at building relationships.

Teach Too is moving into its second phase of implementation, and the group has benefitted from the insight of the Education and Training Foundation, the organisation delivering the programme. Engineering staff who also teach in further education are benefitting from true 'dual professionalism', keeping their technical skills sharp while sharing their expertise with teachers and the next generation. As a piece in the 'engineering employer engagement in further education' puzzle, it is a key element, providing companies with much more than just an insight into 'how to teach'.

Learning technologies. The group was also tasked with looking at how innovative learning technologies can help engineering companies do more to support further education. The Royal Academy of Engineering is leading a project to develop virtual learning environments for the delivery of contextualised mathematics and other engineering content and the group is considering how best to expand this.

2.3 Employer Engagement in Higher Education

Communication, a compelling case and sharing good practice. Much high quality, interaction between engineering employers and universities is already taking place. To extend the reach and impact of this activity the compelling 'business case' benefits need to be clearly identified and communicated to all: students, universities and businesses, both large and small. Sharing good practice in a competitive higher education environment has emerged as an issue. An active, central hub would enable sharing of good practice and case studies between universities, businesses, and students. The National Centre for Universities and Business (NCUB) has agreed to

host such a hub and the group will engage with them to establish a strong pipeline of material and case studies. But people have to want to find the information. The professional institutions, NCUB, and a range of organisations including the CBI, the EEF, Chambers of Commerce, and Confederation of Small Business have agreed to work with their members to get the message out.

Placements. One important form of engagement is student placements in companies. Research shows that placements in industry increase graduate employability, improve students' degree performance, and act as excellent recruitment tools for employers. To achieve more placements in engineering means stimulating both demand from students and supply from companies. In the short term we should have a target to double the number of engineering and technology undergraduates taking placements.

Demand: students

- Where placements are not a normal part of a degree, students need to be able to identify opportunities. The NCUB hub will offer links to sites such as 'Rate my placement' and to companies and schemes such as the 'Year in Industry' offering placements, as well as highlighting good practice in terms of different types and length of placement available.
- All universities should supervise and give academic credit for placement activity so that students can see it contributes towards their degree achievement.
- With many students studying four year MEng degrees, there is little appetite to extend this to five with a placement year. The Institution of Engineering and Technology and the Institution of Chemical Engineers already accredit 'Integrated MEng' degrees which include a year in industry. All of the professional engineering institutions should work with universities and industry to offer accreditation for degrees of this type.

Supply: small and medium companies

Many large companies are already offering significant numbers of placements. Much of an increased pool will need to come from small and medium companies. To enable this we need to overcome real and perceived barriers to smaller companies offering placements.

- The hub will offer good practice examples of large companies engaging their supply chains in placement programmes.
- The hub will offer useful resources such as standard placement contracts, both two party (company-student) and three party (company-student-university).
- Small business organisations and networks will actively communicate the benefits and guide companies to the places they can get support and advice, eg to their local universities, professional institutions and the information on the hub.

- We will engage Local Enterprise Partnerships (LEPs) and develop advice on using LEP funding to support placement and internship activity with small and medium businesses.

2.4 Specialist Skills

The advanced knowledge and expertise that postgraduates offer are essential to help businesses address the major challenges that drive innovation and growth. The numbers of students of UK origin studying at Master's degree level have, however, been falling and nearly two thirds receive no financial support for their studies. An excellent and growing number of innovative initiatives between universities and businesses to try and address the issues have been identified, but there is still more to do.

Developing a trusted source of information and advice. Even where businesses are convinced of the advantages of employing postgraduates, identifying appropriate programmes to meet their needs can be challenging as there is no single trusted source of information, making researching the options daunting. The group will work with the Industry Strategy Councils, the Engineering Council, UCAS, Engineering Professors' Council members and others to develop a portal through which comprehensive information about Master's and postgraduate research programmes and related funding can be delivered. Focused on the needs of industry, it will set out the benefits for employers, employees and students.

Identifying and developing programmes which improve access for smaller businesses. Small businesses are the engines of innovative growth, yet accessing postgraduate programmes in ways that meet their particular needs and challenges can be difficult. In addition to the information portal, the group will work with universities and businesses which have developed such programmes (eg the University of Derby's MSc in Innovative Engineering Solutions) to share experience on how this can be done.

Improving supply. Postgraduate engineering students tend to fall into three broad categories:

- Self-motivated career developers. The group will work with HEFCE and the universities taking part in its Postgraduate Funding pilot to promulgate schemes which provide improved access to loans and other sources of funding (eg the Cranfield University/Prodigy scheme). It will also use the learning from the pilot to identify initiatives that succeeded in attracting under-represented groups.
- Employer-sponsored specialism-seekers. The group will work with the Industry Strategy Councils to ensure that specialist skills initiatives and sustainable models of funding are reflected in their strategies. There is a range of existing successful collaborative initiatives from which experience can be drawn to develop new schemes, tailored for the sectors' particular needs. These include, for example,

the Marine and Nuclear Technology Education consortia and the Automotive Council's model pathways for continuing professional development.

- Converters. Existing initiatives which enable students to 'convert' their undergraduate degrees to an engineering specialism will be showcased and the potential to offer conversion programmes for those without a science degree but with the necessary aptitude will be explored.

3 Forward Look

Engineering the Future, EngineeringUK, Royal Academy of Engineering

The task and finish groups have initiated a number of actions to address Professor Perkins' recommendations, but this is simply the end of the beginning. Engineering the Future will take forward the work and partnerships already begun and will document progress in an annual report. To have long-term and sustained impact, the following questions will also be addressed by the engineering community:

- How can schools and colleges be encouraged to work more closely with engineering employers, in ways which benefit both parties?
- How can teachers and tutors in schools and colleges be supported to improve their understanding of the engineering sector?
- How can the professional engineering institutions use their networks and influence with employers and universities to promote activities that are known to be effective?
- How can post graduate study in engineering be made more attractive and attainable for potential students?
- What can be done to recognise and encourage institutions, companies, and individuals who are really making a difference to the engineering experience of students?

In parallel with this continuing effort, EngineeringUK will, lead the engineering community in delivering the national roll-out of the Tomorrow's Engineers programme. The membership of the Tomorrow's Engineers Programme Board has been broadened to include the Institution of Engineering and Technology, Institution of Chemical Engineers, Institution of Mechanical Engineers, Institution of Engineering Designers, EEF and STEMNET to reflect the increasing stake the community has in the programme. In addition, the Royal Academy of Engineering will pursue the design and implementation of the industry supported 'Marketing the dream' campaign to make progress towards closing the engineering skills gap by 2020 and further support the national roll-out of the Tomorrow's Engineers programme.

Acknowledgements

Professor John Perkins

As with my original review, the work leading up to the publication of this document has been a collective effort involving many individuals and organisations. The Royal Academy of Engineering and EngineeringUK have each played a leading role in the past year. My thanks to their Chief Executives, Philip Greenish and Paul Jackson, for the efforts of their respective organisations and for their unstinting support. Again, the profession as a whole, through its major institutions, has been tremendously helpful.

Clearly, the Task and Finish groups have played a key role in what has been achieved this year. Thank you to all the volunteers who gave of their precious time to advance the work on this project. A special thanks to the four chairs of these groups: Steve Holliday, Carol Burke, Julia King and Helen Atkinson, all important and very busy people who found the time and energy to provide the leadership essential to success. The Oversight Committee, chaired by Dick Olver, and involving Allan Cook and Judith Hackitt, took on the task of co-ordinating the work of the Task and Finish groups, and keeping them on track. The significant efforts of all involved in this activity are greatly appreciated.

The physical production of this report has been a collective effort, involving staff from the Royal Academy of Engineering, EngineeringUK, the Engineering Professors' Council and BIS. Thank you to Rhys Morgan, Claire Donovan and John Puddy (seconded from BAE Systems to work on this project) from the Royal Academy of Engineering, Beth Elgood and John Halton from EngineeringUK, Susan Kay from the Engineering Professors' Council, and Amanda Dickins and Stephanie Fernandes (seconded from the Institution of Engineering and Technology) from BIS. Stephanie in particular has been responsible for pulling together contributions from a variety of sources to arrive at a coherent whole. My heartfelt thanks to her for her sterling efforts.

Membership of the task and finish groups

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Allan Cook CBE FREng

Judith Hackitt CBE FREng

Experiencing Industry in Schools

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Yvonne Baker, Chief Executive, Myscience, and Director, National Science Learning Centre

Kirsten Bodley, Chief Executive, STEMNET

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Specialist Skills

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John Puddy, Seconded from BAE Systems to the Royal Academy of Engineering

Picture Credits: Engineers featured on the front cover

- 1 Jessica Bestwick is a Higher Technical Apprentice at Rolls-Royce, developing and testing large aircraft engines. Credit: Institution of Engineering and Technology
- 2 Students from the Samuel Whitbread Academy in Clifton taking part in the Greenpower engineering competition. Credit: Institution of Engineering and Technology
- 3 Lucy Ackland is a Project Manager at Renishaw, working on the next generation of metal 3D printing machines. Credit: Renishaw
- 4 Yang Gao is a Professor of Space Autonomous Systems at the Surrey Space Centre of the University of Surrey. She heads the Surrey Technology in Autonomous systems and Robotics (STAR) Lab developing various autonomous micro-rover technologies. Credit: Professor Yang Gao
- 5 Laurie-Ann Marshall is an Apprentice Circuit Engineer at ABB Ltd, designing electricity sub-station protection and control systems. Credit: Institution of Engineering and Technology
- 6 Marie Adeyemi is a senior engineer at Atkins working in the aerospace division. She has worked on flight control system installations and on developing the next generation long-range jetliner. Credit: Institution of Engineering and Technology

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