House of Commons

Science and Technology Committee

Educating tomorrow's engineers: the impact of Government reforms on 14–19 education

Seventh Report of Session 2012–13

Volume II

Additional written evidence

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Science and Technology Committee

The Science and Technology Committee is appointed by the House of Commons to examine the expenditure, administration and policy of the Government Office for Science and associated public bodies.

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The Reports of the Committee, the formal minutes relating to that report, oral evidence taken and some or all written evidence are available in printed volume(s). Additional written evidence may be published on the internet only.

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List of additional written evidence

Written evidence

Written evidence submitted by Carre's Grammar Scholl, Sleaford

1. Mr Gove has embarked on a crusade for raising standards through a back to basics ideology and a traditional curriculum with the perception of tougher subjects at the heart. Nobody can argue with the sentiments. However, where I take issue is the narrow approach to what is required. Margaret Thatcher placed great importance on Technology in the education curriculum; Mr Gove does not seem to understand it or its potential. If he did the Ebac would be a little more rounded to include an element of creativity.

2. The Wolfe review on vocational education had much merit. However, the unforeseen consequence has been extremely negative on creative subjects in the curriculum. The very subjects that are required to create a manufacturing/engineering base in the UK.

3. Engineering and Design Technology, are suffering more than most. In the rush for Ebac subjects, students are being guided away from these creative and necessary subjects. If we are not careful the potential damage to this country could be devastating, and pulling back from the cliff edge will prove harder and harder the more engineering and DT curriculum is reduced.

4. It is interesting; my school has been involved in an exchange visit with a Chinese school. The exchange was with Design and Technology. The Chinese are beginning to see the value in the subject as we turn our back on it. If we move to a design and made in China scenario then the outlook for the UK is very concerning indeed.

5. We hear about the importance of the three R's. Interesting to note that when this phrase was first muttered it referred to Reading, Wroughting and Arithmetic, the wroughting being applied education as in wrought Iron work (Engineering). How enlightened the Victorians were and look how dominant the UK was in that era. So in Mr Gove's desire to revert to tradition he needs to go back further. Engineering and design are essential if the UK is to prosper.

6. Jonathan Ives, James Dyson, Paul Smith, Royal Academy of Engineers, Rolls Royce, JCB, Toyota UK cannot be wrong. Please listen to them. The two articles below are worth considering.

7. I am more than happy to discuss my thoughts with the committee as I am passionate about the need for creativity in the curriculum. It might be nice to hear from somebody on ground.

8. http://creative-blueprint.co.uk/thinkpieces/item/reading-wroughting-arithmetic http://ojs.lboro.ac.uk/ojs/index.php/JDTE/article/view/418

Keith Jones
Director of Faculty (Technologies, ICT and Business)

Written evidence submitted by Blast Absorption Systems Limited

1. As a chartered engineer who is trying very hard to make a go of a new high technology materials startup company, and one who also tries to make use of people with engineering skills to maintain his boat and perform other tasks, I am very concerned about the fact that I seem to be unable to find competent, hard working engineers who have been through the English state education system in the last couple of decades. Instead, the only competent people I can find, whether engineers or technician engineers, are either of my own elderly generation or are the products of foreign education systems. The one exception is the CEO of our fledgling company, but I have to say that she is not of English ethnic origin and benefitted from winning a scholarship to a traditional English public school. As regards the relative importance of chartered engineers with degrees, and technician engineers with vocational qualifications based on apprenticeships, both roles are equally important. I would not expect a technician to be able to invent the materials we are developing, but equally, I would not expect a chartered design engineer, including myself, to know how to safely maintain the brakes on a heavy goods vehicle, or investigate, strip down and successfully rebuild an engine.

2. I do not think that changing the structure of engineering qualifications and exactly what goes into a degree makes much difference. Having spent too many years of my youth—nine years in all—at the University of Cambridge, I am convinced that the only real way to acquire real engineering knowledge is to do it, because it was only when I started to tackle real problems that I really learned to be an engineer. Fortunately, I realised this while still at university and went out of my way to get placements during vacations. On one occasion I joined the university officer training corps and got onto a workshop course through the Royal Engineers and on another occasion, talked my way into the engineering company my father worked for. In addition, I started an engineering enterprise while undertaking my doctoral research, encouraged by my research supervisor, who himself came from an industrial background. Whatever happened to sandwich course degrees?

3. The skills of Scottish engineers are legendary. Engineering degree courses in Scotland tend to take four years as opposed to three and eligible Scottish domiciled students studying full-time in Scotland are not required to pay tuition fees. Scottish engineering can be expected to maintain its traditional high standards.

5. The Government could greatly raise the status of technical subjects by legislating severe punishments for anyone calling themselves an engineer who is neither a chartered engineer nor a technician engineer. Doctors who are not properly qualified are not allowed to practice medicine and the same should apply to engineers.

6. One way of attracting and retaining a more diverse technically skilled workforce would be to broaden apprenticeship schemes. I recently spent a fascinating evening with Roger Greensted, the managing director of F H Browne and Sons in Ash near Canterbury in Kent. This firm rebuilds pipe organs, applying modern computer technology, materials and manufacturing techniques to a very traditional industry. Mr Greensted told me that although he has taken on a young man, he cannot give him a proper apprenticeship because there is no category for pipe organ rebuilders. What the firm does falls into the category of applying electromechanical engineering ingenuity to old problems, which is a very general and useful skill to acquire. We have a large number of similar companies in this part of the world that work in niche areas with great success, but which use similarly general skills which are highly transferable. Is there not some way in which apprenticeships can be organised for these businesses, regardless of bureaucratic difficulties in categorising them?

7. Much of the present problems with training engineers start, in my opinion, in the state school system. As a volunteer STEM ambassador I get the impression that pupils in state schools are expected to be entertained and "Stimulated" rather than educated and taught the importance and benefits of working hard. From conversations I have had with teachers, I get the impression that the requirements of Ofsted and their inspections are responsible for a lot of this. A return to traditional values and methods while taking advantage of the capabilities of modern technology to provide visual aids that my generation could only dream of, must be of benefit. Furthermore, since coursework offers so many opportunities for input by teachers and parents and plagiarism from the Internet, the only valid way of establishing knowledge should be, as before, by conducting rigorous examinations.

8. Finally, if the government or anyone else wants more young people to become engineers, they should make it more financially attractive. For a start, outstanding students engaging on engineering courses should not be charged fees. I personally benefitted from having an entirely paid for university education, but I did get three A grades at "A" level, with scores which I was told were in the 90s, plus a college Exhibition from the Cambridge entrance examination.

June 2012

Written evidence submitted by The Open University

SUMMARY

1. The Open University (OU) welcomes the House of Commons Science and Technology's inquiry into engineering skills

2. The OU is a major provider of part-time higher education in engineering—about 40% of UK part time undergraduate students in Engineering & Technology are OU students. The University's tradition of flexible provision has enabled its students to integrate their study and career development.

3. The OU works closely with employers to provide flexible routes to initial qualification and options for career progression in engineering.

4. With changing patterns of 14–19 qualifications and changing student behaviour, the OU has the capability to work with other institutions to provide flexible pathways into the engineering professions for students with a variety of previous educational and employment experience.

5. The Government could do more to raise the status of technical subjects. They have not been given the prominence they warrant given the need to rebalance the economy towards manufacturing industries and to overcome the enormous challenges associated with development of the infrastructure needed to address sustainability and the reduction of carbon dioxide emissions.

6. Our traditional focus on work based part-time learners has given us much experience in transforming careers by providing opportunities for progression to higher level qualifications. We feel that working closely with employers to upgrade the existing workforce should be a priority that provides rapid payback to both employer and individual through immediate workplace application of learning. Our qualifications structures are aligned to the Engineering Council requirements hence it is possible to construct a career development path, with multiple entry points, from Foundation Degree to Chartered Engineer and beyond to Masters qualification through part-time OU study.

7. We can work in collaboration with employers to enable them to *grow their own* engineering professionals. Building the professional learning culture that enables individuals to respond to change with confidence is the most important contribution to achieving sustainable engineering growth.

8. We are happy to provide the Committee with further evidence of how the OU has evolved around the changes in qualification and education structures to deliver engineering skills to learners from across the UK.

Does the current engineering skills base meet the needs of employers? Do employers in the engineering sector prefer an academic or a vocational profile?

9. To address the needs of employers, the professional qualifications structure in engineering recognises that at all levels engineers are required to demonstrate a combination of vocational and academic skills. The emphasis differs with level in the progression from Engineering Technician to Incorporated Engineer to Chartered Engineer but at all levels engineers are expected to integrate academic knowledge and vocational skills.

10. The OU is a major provider of part-time higher education in engineering—about 40% of UK part time undergraduate students in Engineering & Technology are OU students.[1] The University's tradition of flexible provision has enabled its students to integrate their study and career development. Historically, many OU students have used OU study to achieve a transition from ONC and HNC vocationally related qualifications to higher education qualifications. In effect, their study pattern sequence was the reverse of that of conventional students who first acquired academic knowledge and then enriched this with practical knowledge in employment in preparation for their submission for Chartered status.

11. We have evolved OU engineering programmes that are accredited by the major professional bodies as fulfilling their educational requirements at both Incorporated and Chartered Engineer levels and that enable students to integrate their workplace skills with their academic study.[2] Since securing these important accreditations our engineering programme has seen the most rapid growth of all our STEM programmes showing more than 10% year-on-year growth since 2008–09.

12. In addition to BEng (Hons) and MEng qualifications, we have recently introduced two engineering foundation degrees (FDs), one in collaboration with The Welding Institute (TWI), that enable students to gain credit for work based activities incorporating TWI qualifications.

13. Our conversations with employers and Sector Skills Councils lead us to believe that employers recognise the need for diversity in the routes through which their engineers secure qualifications and that flexibility in career development and progression is vitally important. The national student destinations survey shows that 97% of those graduating with an OU BEng are in employment six months after graduation (27% of those combining work and further study) with salaries significantly above both OU and national graduate means.[3]

14. Our teaching activities in Europe indicate that the UK's flexible approach to engineering qualifications is also valued by German employers.

15. Open University Validation Services validates honours level Engineering programmes at Duale Hochschule Baden-Württemberg (DHBW). The provision is truly jointly funded and supported by employers, offering theoretical study in college interspersed with blocks of practical training in industry. Students are selected and also employed throughout their programme by one of several thousand companies or partner employers participating in the scheme.

16. In our distance teaching activity a major German telecommunications company sponsors its technicians wishing to progress to Bachelors degrees. These students are granted credit exemption for a suite of the company's internal programmes.

17. In the post-Browne environment we plan to work more closely with employers to provide flexible routes to initial qualification and options for career progression. Wherever possible these routes will provide the opportunity for recognition of work-based professional learning.

What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?

18. As the OU has not specifically set out to attract the 18 year-old school leaver population we are not in a position to comment directly on the impact these changes will have on recruitment to our programmes. We acknowledge the conflicting pressures between the perceived need to improve performance in the traditional underpinning subjects of mathematics and science and the need to develop the problem solving skills that high value modern engineering demands of practitioners at all levels.

19. The Engineering Council UK SPEC standards incorporated within the QAA's benchmark statement for engineering[4] emphasise that a creative approach to engineering challenges requires an awareness of socio economic factors, a suite of professional skills and ethical behaviours in addition to technical knowledge. This view of the profession is shared by the European Accreditation Board for Engineering Education (EUR-ACE) and the US Accreditation Board for Engineering and Technology (ABET). The UNESCO report[5] on the global status of engineering identifies a widespread need for engineering curriculum reform to emphasise the problem solving and team working aspects of the profession.

[1] Percentage based on HESA data for 2010/11: 5,612 FTE OU students, JACS Subject Area (9) Engineering & Technology.
[2] http://engineering.open.ac.uk/getting_started provides information on OU engineering programmes
[3] Source: Destination of Leavers from Higher Education Institutions 2009/10 (HESA).
[4] http://www.qaa.ac.uk/Publications/InformationAndGuidance/Documents/Engineering10.pdf
[5] http://www.unesco.org/new/en/natural-sciences/science-technology/basic-and-engineering-sciences/engineering-sciences/

20. The practice of engineering has also been transformed by the universality of ICT applications both through the software tools employed and the global nature of engineering companies and service providers.

21. It would run counter to international trends if changes in the 14–19 curriculum and qualification suite caused a reversion of the progress that the profession has made in projecting its role in providing solutions to societal needs and underpinning economic development. It is important that potential students are aware of the breadth of skills required of engineers and that the problem solving aspects of the profession are not overshadowed by over emphasis on the engineering science and mathematical requirements. We are particularly concerned that the English Baccalaureate downgrades exposure to technologies in general and ICT specifically.

22. The OU has particular interests in widening access to higher education by working with employers and other institutions. The collaboration with TWI to offer a FD in Materials Fabrication and Engineering is one example. In addition, through the work of Open University Validation Services, FE colleges provide OU qualifications in engineering—a notable example being Havering College's partnership with Ford Motor Company. The programmes are BEng (Hons) Engineering, FD in Engineering and FD in Motorsport Engineering. The College has over 30 years' experience of delivering HE programmes and utilises a curriculum map that indicates each curriculum area and the progression routes from FE through to HNC/D, FD or Bachelor degree. The undergraduate and FD provision is part of a combined engineering provision including HNCs via part-time study delivered at a purpose built campus resourced by Ford to cohorts of students from the company.

23. At graduate level OU collaboration with National Skills Academy Nuclear has resulted in an industry recognised Certificate of Nuclear Professionalism that focuses on the additional high level professional skills and behaviours engineers need to operate in its highly regulated, high integrity environment. The Nuclear Institute describes these skills as the Nuclear Delta and it is anticipated that the Certificate will be acknowledged as evidence of fulfilment of this requirement for Nuclear Institute membership.

24. We maintain our commitment to open access entry routes to the university and are making significant investment in the redevelopment of our suite of "Openings" modules for the STEM subjects. These modules will provide the study skills and subject knowledge to enable students lacking the normal university entrance requirements to prepare for entry to our formal degree programmes.

25. Our Science Faculty works in partnership with 15 universities—many of whom are Russell Group universities—to offer students a 2+2 study pattern in which two years of part-time study with the OU is followed by two years of campus-based study. This scheme is called OpenPlus.[6] Development is underway for extension of this programme into the engineering domain, broadening the routes available for entry to engineering programmes.

26. The changes brought about by digital technologies mean that much of engineering practice is concerned with the interface between the physical and digital worlds. Provision of practical experience has always provided a challenge for the OU that has been successfully met by mechanisms such as our Residential Schools. Increasingly, our suite of online facilities is addressing these requirements. Students now have access to full online library facilities and the university is active in the development of Virtual Laboratory environments enabling access to experimental simulations and remote laboratories. Funding from the Wolfson Foundation is enabling the development of a demonstrator OpenScience Laboratory that we aspire to extend to cover engineering science. Our academic staff are contributing to national and international debate on the role of online practical activity in engineering education.

27. One particular example of innovation in practical activity has been the introduction of a single board computer, the Senseboard, enabling students on an entry level module *My Digital Life TU100,* with 5,000 students, to learn programming at the all-important digital-physical interface. The specially developed Open Source programming language Sense, provides a flexible visual programming environment in which students can develop applications that respond to sensors and control output devices. The rationale for the module is consistent with recent broadly publicised analyses suggesting the reinstatement of formal programming within the 14–19 curriculum. Our hardware and software provides a platform that can be further exploited in more advanced courses within our own or other HE institutions or could migrate downwards into the schools and FE sector.

28. With changing patterns of 14–19 qualifications and changing student behaviour, the OU has the capability to work with other institutions to provide flexible pathways into the engineering professions for students with a variety of previous educational and employment experience.

How do the approaches taken by the Devolved Administrations to produce a technically skilled workforce differ to the current approach in England? What are the strengths/weakness of the different approaches?

29. The OU operates across the four nations of the United Kingdom with student funding arrangements varying between the administrations. Our Nation Directors have close relationships with their respective Higher Education departments and are able to respond to national initiatives, whether targeted at particular industry sectors or subject areas. In Scotland, for example we are actively engaged in projects relating to the renewables and the offshore oil and gas industries.

[6] http://www8.open.ac.uk/choose/openplus/

Could the Government and others do more to raise the status of technical subjects?

30. The Government could do more to raise the status of technical subjects. They have not been given the prominence they warrant given the need to rebalance the economy towards manufacturing industries and to overcome the enormous challenges associated with development of the infrastructure needed to address sustainability and the reduction of carbon dioxide emissions.

31. Government departmental websites provide information on policy but do not provide an analysis of the challenge of supplying enough engineers and technicians to meet imminent demands.

32. Clearly in an environment in which students are encouraged to invest in their education creation of a positive image of technical subjects and the professions to which they lead is of vital importance.

33. The OU contributes in this area through its partnerships with the BBC and other broadcasters to develop programmes of interest to a broad sector of the population. In the areas relevant to the committee we would point to our ongoing role in the BBC's *Bang Goes the Theory* series that aims to convey the excitement of engineering and science. Through six series since 2009 a wide range of topics have been covered. Viewers (average audience 2.6 million) are able to visit the series website[7] to access additional information, and suggested kitchen table experiments.

34. The annual OU's *Bang* roadshow is a face-to-face outreach activity visiting cities around the UK with the objective of raising interest in STEM subjects, with a typical attendance of 100,000 per year. The *How to Build a ……* series[8] on BBC 2 (average audience 1.4 million per programme) has demonstrated the complexity of the work undertaken by major British Engineering companies like Rolls-Royce, QinetiQ, BAE Systems, Airbus, McLaren and Astrium. Derivative programmes specifically for schools and clips for teachers to use in classroom settings provide high quality insights into the work of engineers at all levels.

35. In line with the OU's policy of making its resources widely available to support individuals who wish to undertake independent learning, many of these resources are available through OpenLearn[9], iTunes U[10] and other portals through which we reach millions of users.

What more should be done to attract and retain a more diverse technically skilled workforce?

36. From an OU perspective our traditional focus on work based part-time learners has given us much experience in transforming careers by providing opportunities for progression to higher level qualifications. Hence we feel that working closely with employers to upgrade the existing workforce should be a priority that provides rapid payback to both employer and individual through immediate workplace application of learning. Our qualifications structures are aligned to the Engineering Council requirements hence it is possible to construct a career development path, with multiple entry points, from Foundation Degree to Chartered Engineer and beyond to Masters qualification through part-time OU study.

37. Potentially we can work in collaboration with employers to enable them to *grow their own* engineering professionals. Building the professional learning culture that enables individuals to respond to change with confidence is the most important contribution to achieving sustainable engineering growth.

June 2012

Written evidence submitted by the Baker Dearing Educational Trust

SUMMARY

1. The Baker Dearing Educational Trust is supporting the development of University Technical Colleges (UTCs) throughout England. Two are open already and a further 32 will open within the next two years. Very soon, over 20,000 young people will be enrolled at UTCs. This will make a very positive difference to the status of technical education and encourage more young people to become engineers.

2. During Key Stage 4 (years 10 and 11), UTC students spend 40% of their time in practical and technical learning. They need and deserve qualifications which fully recognise their achievements. Originally, UTCs expected to offer the Diploma in Engineering, which consisted of principal, generic and additional and specialist learning. More recently, UTCs planned to offer the principal learning component as a stand-alone qualification, the Engineering Principal Learning Qualification (PLQ). However, the level 2 PLQ will in future count as equivalent to only one GCSE in Key Stage 4 performance tables, even though it takes the same time to deliver as four GCSEs. The Royal Academy of Engineering has now proposed a suite of four qualifications to take the place of the PLQ. This is a most encouraging development, which we support.

3. Ministers are already taking action to raise the status of technical, practical and vocational education, not least through their welcome commitment to University Technical Colleges. Organisations including the Edge Foundation, the Gatsby Charitable Foundation, awarding organisations, the Association of Colleges, the

[7] http://www.bbc.co.uk/programmes/b00lwxj1
[8] http://www.bbc.co.uk/programmes/b017lyld
[9] http://www.open.edu/openlearn/
[10] http://www.open.edu/itunes/

Association of Employment and Learning Providers and engineering organisations are also working hard to raise the status of technical, practical and vocational education.

4. The Government should:

(a) ensure that the pre-14 curriculum includes a significant element of practical and technical learning so that all young people can make informed choices at 14, 16 and 18;

(b) retain Design and Technology in the pre-14 National Curriculum;

(c) support efforts to widen young people's horizons through visits to workplaces, FE colleges and universities from an early age, together with opportunities for young people to meet Apprentices, students and young people already in work;

(d) explain the benefits of technical education to young people, parents and teachers, making it clear that technical education is just as valuable as any other form of learning;

(e) increase investment in excellent technical education at all levels, including mainstream schools, UTCs, further and higher education and apprenticeships; and

(f) set an immediate target to open at least 100 UTCs before the next general election.

About the Baker Dearing Educational Trust

5. The Baker Dearing Educational Trust is a charity dedicated to establishing a network of University Technical Colleges in England. It was founded by Lord Baker of Dorking and the late Lord Dearing.

Does the current engineering skills base meet the needs of employers? Do employers in the engineering sector prefer an academic or a vocational profile?

6. The Committee is likely to receive detailed evidence about skills shortages in engineering. We will therefore comment only briefly on this question before describing our contribution to meeting future skills needs.

7. For many years, employers in Britain have found it difficult to recruit talented young people for demanding roles in engineering and technology. As a result, there are marked shortages of engineers and technicians in many sectors. A report by the Institute for Employment Studies for the Gatsby Foundation[11] found that the UK has a lower proportion of technicians than our European competitors, particularly at the intermediate skills levels, and that this damages our economic competitiveness. At the same time, young people, parents and teachers do not appreciate the tremendous career opportunities offered by engineering and other technical occupations.

8. Technical schools ("Realschule") have been a prestigious part of the German educational landscape for many decades. Their continued existence helps to explain why Germany has retained a tradition of excellence in technical and vocational education, linked to world-class manufacturing industries. It is notable, too, that fewer young people are NEET (not in education, employment and training) in Germany than in the UK.

9. Lord Baker and Lord Dearing spoke to many employers, who explained that they need (and will continue to need) recruits who have both academic and technical abilities. They were convinced that a new generation of technical schools, to be known as University Technical Colleges (UTCs), would help meet future needs for technicians and engineers and help rebuild the reputation of technical and vocational education in this country.

10. With support from the previous Government, two UTCs are already open: the JCB Academy in Staffordshire, and the Black Country UTC in Walsall. The Coalition Government has pledged further support, and another 32 UTCs will open over the next two years.

11. UTCs provide full time courses which combine practical and academic studies for students aged 14 to 19. Each UTC is supported by a university and a number of employers, who between them form a majority of the governors and are involved from the start in shaping and delivering the curriculum. Each UTC will have around 600 students when fully operational. Students attend through choice, not selection. They receive a broad education including English, maths and science combined with practical and technical qualifications which are recognised by employers and universities. They also develop business and financial literacy.

12. UTCs prepare young people for further study and a wide range of careers. Except in the context of post-16 Apprenticeships, they do not provide specific occupational training. After completing studies at a UTC, students may progress to further education, higher education or jobs with training, including Apprenticeships.

13. The first full set of qualifications will be awarded to JCB Academy students this summer. Students have done well not only in their chosen technical subjects, but also in their general education. Indeed, many students are achieving better results in English and maths than their previous schools predicted, because they enjoy the curriculum and want to do well. In addition, mainstream subjects are linked, wherever possible, to the chosen technical specialism. Students learn more and remember better when subjects are put into a meaningful context, such as maths for engineering.

[11] Jagger N, Sigala M and Sumption F (2010), SET Based Technicians: Lessons from the UK and European Labour Force Surveys. Brighton: Institute for Employment Studies. http://www.gatsby.org.uk/Education/Projects/~/media/Files/Education/10%20SET%20Based%20technicians%20IET%20report.ashx

What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?

14. Many employers—large and small—were actively involved in developing the Engineering Diploma, ensuring that it reflected the needs of the modern economy. Employers were equally committed to helping schools and colleges deliver exciting curriculum projects based on problems and challenges encountered in the workplace. The Diploma provided breadth rather than focussing narrowly on the skills needed to do a particular job. It also emphasised skills such as teamwork and problem-solving, which employers regard as essential, together with functional skills in English, maths and ICT.

15. The Higher Diploma (level 2) consisted of the following three components which—collectively—required 800 guided learning hours (GLH), approximately the same as seven GCSEs:

(a) principal learning (420 GLH, including at least 210 GLH applied learning);

(b) generic learning (200 GLH); and

(c) additional and specialist learning (minimum 180 GLH).

16. The Advanced Diploma (level 3) also consisted of principal, generic and additional/specialist learning, required 1,080 GLH, and was equivalent to three and one-half A levels.

17. The Engineering Diploma seemed ideally suited to the new generation of University Technical Colleges, both at Key Stage 4 (14–16) and post-16. It was therefore at the heart of early plans for UTCs.

18. However, mainstream schools and colleges found the Diploma complex. It was difficult and costly to deliver all elements of the Diploma, and a whole new bureaucracy—the Diploma Aggregation Service—was needed to keep track of each student's achievements.

19. The Coalition Government decided in 2010 not to fund the future development of the Diploma, and it was announced that the Diploma Aggregation Service would be withdrawn. Nevertheless, awarding organisations said they would continue to offer the most important element of the Engineering Diploma, the Principal Learning Qualification (PLQ).

20. The Baker Dearing Educational Trust and the Edge Foundation commissioned the Royal Academy of Engineering (RAEng) to identify qualifications which would command respect in the engineering profession. The report, "Respected", listed qualifications which UTCs could consider offering to Key Stage 4 and post-16 students. These included the PLQ, based on "the significant, continuing and well documented employer and University input into these qualifications".[12]

21. The PLQ in Engineering therefore seemed set to be a qualification of choice in most UTCs.

22. In the wake of the Wolf Report on Vocational Education, however, the Government decided to simplify Key Stage 4 (KS4) performance tables. From 2014, no qualification will be deemed equivalent to more than one GCSE.

23. Some UTCs may continue to offer the PLQ to students in KS4, because it is popular with students, teachers employers and universities. When KS4 performance tables are published, however, these UTCs will *appear* to perform less well than schools which offer a larger number of smaller qualifications. A high-performing UTC student might gain six GCSEs at A* to C plus the PLQ in engineering—a total of seven qualifications. A high-performing student in a mainstream school might gain ten GCSEs at A* to C. They will have worked equally hard, for the same number of guided learning hours; but the performance tables will not give full credit to the UTC.

24. Against this background, Professor Matthew Harrison (Royal Academy of Engineering) has drafted proposals to split the PLQ into four discrete qualifications, each requiring 120 GLH. Taken together, they would cover essentially the same ground as the PLQ. We fully support this development and have been working closely with Professor Harrison, employers and awarding organisations to make it happen as soon as possible.

25. There are, of course, other qualifications available to UTCs. Few level 1 and 2 qualifications met the criteria for inclusion in the RAEng report, "Respected", but most of those which did will be included in future Key Stage 4 performance tables. All being well, the removal of many qualifications from the performance tables will enhance the reputation of the few that remain. Again, however, no qualification will be deemed equivalent to more than one GCSE, no matter how many guided learning hours they require.

26. It is unfortunate that the qualifications best suited to the UTC curriculum have been caught up in the wider reform of vocational education. It would be even more unfortunate if young people, parents and the general public gained the impression that technical subjects are less valuable than academic subjects: they are not. Employers need more people with technical and vocational qualifications. Technical subjects can be every bit as demanding as academic subjects. And most important of all, many people enjoy practical learning, do well in it and go on to excellent careers in engineering and other technical occupations.

[12] Harrison M (2011), Respected: Technical Qualifications Selected for Use in University Technical Colleges. London: Edge Foundation (http://www.edge.co.uk/media/73505/respected_hires_29.9.11.pdf)

Could the Government and others do more to raise the status of technical subjects?

27. English education has been biased towards certain forms of learning for well over a hundred years. In the 19th century, grammar schools came to the fore by offering a curriculum based on the classical traditions of public schools. Factory work was deemed to require little education of any kind. This was in marked contrast with Germany, which invested heavily in technical and vocational education—a tradition which survives to this day not only in the secondary school system, but also in the famous "dual system" of apprenticeships supported by classroom study.

28. In present-day England, many children, young people and adults find the best way to learn is by making, doing and trying things for themselves. This is how young people develop their abilities in art, music and sport, for example.

29. Worryingly, however, hands-on learning is less common in other subjects, particularly in secondary schools. Even in science, there have been growing concerns that children undertake fewer practical experiments today than they would have done 20 or 30 years ago.

30. We believe all young people should experience some "learning by doing" as part of a broad and engaging curriculum throughout Key Stages 1–3. Teacher training programmes (including continuous professional development programmes) should help teachers deliver effective hands-on learning to all age groups.

31. For young people who actively prefer practical and technical learning, there should be opportunities to combine it with core academic subjects at Key Stage 4 and beyond—precisely what UTCs will offer. We are therefore delighted that the Government has supported the development of UTCs. 34 have already been approved instead of the 24 promised in the 2010 Budget. There is demand for many more, and we recommend the Government should set an immediate target to open at least 100 before the next general election. This will undoubtedly help to raise the status of technical subjects.

32. Equally, the Government is committed to expanding Apprenticeships. Young people are starting to see Apprenticeships as a genuine alternative to direct entry to higher education: they can earn a wage while learning, and can move on to higher education at a later stage if they wish. New Higher Apprenticeships will further broaden the appeal of this important path to success.

33. We welcome the Government's clear commitment to high quality UTCs, Apprenticeships and other vocational pathways. Ministers should take every opportunity to explain the vital importance of technical and hands-on learning. They must challenge the idea that academic learning is inherently superior to technical and vocational learning. Over time, this will make a real difference to the status of technical subjects.

34. Obviously, this is not a matter for Ministers alone. The Baker Dearing Educational Trust has been generously supported by the Gatsby Foundation, which has campaigned to raise the status of technicians, and by the Edge Foundation, which champions technical, practical and vocational education. Working with awarding organisations, colleges, training providers and universities, Edge organises an annual celebration of vocational success, VQ Day. This year's event takes place on 20 June. Other significant annual events include Colleges Week, National Apprenticeship Week, Adult Learners Week and a large number of skills competitions, which will—from this year—culminate in the Skills Show at the National Exhibition Centre, from 15 to 17 November. All these events should be seen as part of a concerted annual programme to raise public recognition of the value and success of technical and vocational education.

What more should be done to attract and retain a more diverse technically skilled workforce?

35. UTCs are keenly aware that more young men than young women choose engineering and other technical specialisms, such as construction. In health, the opposite applies. This is not a new phenomenon, and it is not unique to the United Kingdom.

36. We have not shaken off the outdated image of engineering as a male occupation involving dirty, noisy working conditions and a lot of heavy manual labour. The reality is that growing numbers of women are engineers; that a lot of engineering requires clinically-clean conditions; and that many engineering operations are controlled using computers, not by wielding spanners.

37. A lot of good work is already being done to promote careers in Science, Technology, Engineering and Maths (STEM) occupations. Some are specifically targeted towards girls and women; others work with black and minority groups and people with disabilities. These efforts are making a difference and must continue.

38. However, we believe more needs to be done to introduce children to technical and engineering occupations from primary school upwards, and to enable them to experience practical and technical education throughout their time at school.

39. This does not mean we should steer children prematurely into particular careers. UTCs recruit at 14 precisely because young people need the full benefits of what R A Butler called "the common mill" of education throughout the first nine years of compulsory education. Even then, choosing to attend a UTC at 14 does not commit young people to specific jobs or careers: because UTCs offer a broad curriculum, they can change direction at 16 or 18 if they wish.

40. Instead, we believe all young people should have opportunities to visit workplaces, colleges and universities, to meet people from many walks of life, and to find out from people a few years older than them why and how they chose their current job, Apprenticeship or course of study.

41. Young people should also experience practical learning at both primary and secondary school. We are particularly concerned about proposals to downgrade the status of Design and Technology: we firmly believe it should remain part of the National Curriculum, and that there should be a concerted drive to improve the way it is taught. This should include better links with employers, so that young people can appreciate the direct relevance of Design and Technology to the world of work. Teacher training and development should include techniques for delivering engaging and effective hands-on learning at all ages.

42. UTCs are of course keen to play their part. They will offer open days and taster sessions to younger students, and will work in partnership with teachers in neighbouring schools and colleges to enhance the practical curriculum. They will also support campaigns to promote diversity in STEM careers.

June 2012

Written evidence submitted by The Society of Motor Manufacturers and Traders (SMMT)

INTRODUCTION

1. The Society of Motor Manufacturers and Traders (SMMT) is one of the largest and most influential trade associations in the UK. It supports the interests of the UK automotive industry at home and abroad, promoting a united position to government, stakeholders and the media. The UK automotive industry is dynamic and globally competitive. Our sector is a vital part of the UK economy with £50 billion turnover and £10 billion value added. With over 700,000 jobs dependent on the industry, it accounts for 11% of total UK exports and invests £1.3 billion each year in R&D. The industry plays an important role in the UK's trade balance, with vehicle manufacturers exporting almost 80% of production. The UK is home to the world's largest number of low volume vehicle manufacturers.

2. SMMT welcomes the opportunity to respond to the Science & Technology Select Committee's inquiry into engineering skills. SMMT and the automotive industry is committed to ensuring that engineering skills provision within the UK meets the ever-changing and increasing demand of the sector, and calls on government to ensure that this provision is supported through sustained support and incentives for investment and an effective and comprehensive skills infrastructure. In this response, SMMT outlines some of the key challenges and opportunities for the industry in relation to engineering skills, in summary:

- High-quality engineering skills are critical to the sector's competitiveness and growth.
- The industry employs a workforce with a range of levels of skills and itself invests and supports widespread up-skilling to meet present and future needs.
- A shortage of engineering skills is present in the UK, automotive supply-chain companies find recruitment of engineers particularly challenging.
- In addition, engineering graduates often lack the practical "hands-on" engineering skills applicable in a working environment.
- The sector welcomes initiatives to encourage more engineers and to improve the image of engineering based careers.
- Government ambitions for increased apprenticeship numbers are welcome and critical.
- The National Curriculum must, from an early age, encourage the uptake of STEM subjects and communicate the related career opportunities , including practical experience through, for example, D&T.
- The sector must not be inhibited from recruiting the best talent from abroad, whilst in the process of upskilling its domestic capabilities.

ENGINEERING SKILLS—CRITICAL TO AUTOMOTIVE

3. The UK automotive industry provides 719,000 jobs to the UK workforce, with approximately 139,000 employees directly involved in the manufacturing process. Engineering roles in the automotive sector are incredibly diverse, including positions in R&D, the supply chain, low and high volume manufacturers, through to positions in the aftermarket and retail sectors. The sector employs technicians and engineers with different qualification levels and specialisms (for example electrical or mechanical engineers), and is committed to training and up-skilling its workforce.

4. The success of the automotive industry in the UK is therefore heavily dependent on having access to a large, highly-skilled, and flexible talent pool that can cater for a diverse array of complex manufacturing processes. In addition, the fast pace of technological development within the automotive sector, particular with regards lower carbon technologies, requires a constantly evolving skills base in order for the UK to remain internationally competitive. In the last 18 months, the sector has committed over £5.5 billion worth of investment in the UK, supporting growth and creating jobs where skilled workers are critically needed. Whilst

many of these large global companies who have committed this investment need skills, their extensive and growing supply-chains in the UK also need to ensure they have the engineering and other skills to be competitive and support a global industry.

5. The Automotive Council has set out strategic investment priorities for the move to lower carbon technologies, identifying five "sticky" or priority technology groups, where the UK has the potential for a significant return on investment, and which industry, government and R&D funding bodies should strategically exploit and support. The "sticky" technologies are: energy storage and management, electric motors and power electronics, internal combustion engines, lightweight vehicle and powertrain structures, and intelligent mobility.[13] Ensuring that the mechanisms are in place to meet the ever-changing engineering skills requirements that these emerging technologies demand is of vital importance to exploit the UK automotive industry's opportunities for growth. This is particularly pertinent for the UK's ambitions to be at the forefront of the potentially high-growth ultra-low carbon vehicle market and low-carbon economy.

6. The automotive industry works closely with academia, Sector Skills Councils (SSCs)—SEMTA & IMI—and other bodies to seek to ensure future engineering needs are met. An example of this is SMMT's work with the IMI to develop hybrid-electric vehicle technical qualifications.[14] Whilst these initiatives can address some skills shortages, they do not address the fundamental issues around the strength of the UK's engineering supply-base.

Engineering Skills—Addressing Skill Shortages

7. At present the engineering skills base in the UK does not meet industry needs, creating a real barrier to growth in the sector. 24% of companies within the SEMTA footprint recorded skills gaps in 2009,[15] and over 60% of employers in the science, engineering and IT sectors have difficulty recruiting individuals with STEM skills. In addition, the science, engineering and IT sectors were the least confident of accessing highly-skilled employees in the future, with 66% of employers reporting they were not confident. Employment projections developed by the 10 SSCs that make up the UK engineering footprint estimate the requirement for employees over the next 5–10 years as an additional 2,217,500, highlighting the importance of addressing the shortfall in skills immediately.[16]

8. For many supply chain companies, the availability and quality of skills in the UK is a critical issue. A recent SMMT survey of automotive suppliers as part of the BIS mid-sized business growth review (companies with a turnover of £25 million—£500 million) revealed that 50% of mid sized supply chain companies surveyed felt that government did not assist their businesses enough in improving their capabilities and skills. Industry is keen to work with government to address this trend.

9. As aforementioned, the Automotive Council has developed key technology priorities for the UK industry. In addition, work has been done to develop strategies for growing and strengthening UK supply-chains. The demand for this shift to local suppliers was heightened by international tragedies, such as the Japanese tsunami and Thai floods. The increasing opportunities for suppliers already present in the UK to grow, or for new businesses to start or open sites in the UK, are very positive, but these businesses face major challenges with engineer recruitment, an issue which becomes ever more difficult further down the supply-chain.

Engineering Skills—Routes to Industry

10. The UK automotive industry welcomes engineers from both academic and vocational routes, and supports government's recent focus on improving and developing the Apprenticeships scheme and uptake. However, industry believes more attention is needed to ensure that engineering students are equipped with skill-sets that are directly applicable for UK businesses. Anecdotal evidence from industry has illustrated that this issue is most widespread amongst engineering graduates, who often do not have hands-on experience with the right technologies/equipment and therefore require additional training. This skills deficit acts as a significant barrier to growth, particular for SMEs—many of whom are within the supply chain—who do not have the resources, either financial or otherwise, to support such training.

11. Industry believes that many undergraduate degrees would benefit from a work experience/vocational element. Providing engineering undergraduates with up to a year in industry as part of their course would be highly beneficial to the quality of engineers being produced, and their ability to be "ready-for-work" once their studies are completed. Feedback from members has shown that the students themselves often find this aspect the most valuable part of their degrees, providing them with "real-world" challenges for their academic studies.

12. If government is committed to revitalising and strengthening manufacturing in the UK, it should investigate the feasibility of incentives to encourage the take-up of engineering careers. For example, a reduction in an engineering graduates' student loan, reliant on the satisfactory completion of a number of years of relevant work within the engineering sector, could be one such option.

[13] Source: IMI http://www.automotivecouncil.co.uk/wp-content/uploads/2010/12/Tech-Road-Maps-RD-Capability-Final.pdf

[14] Source: IMI http://www.imiawards.org.uk/qualifications/details/level-2-award-in-hybrid-electric-vehicle-operation-and-maintenance-qcf—954.html

[15] Source: SEMTA http://83.223.124.19/~semta/store/files/Automotive_fact_sheet.pdf

[16] Source: EngineeringUK 2012—The state of engineering—p.235, 241

13. Industry has a number of concerns over recent and proposed changes to the National Curriculum. The downgrading of the engineering diploma from five GCSEs to one is a retrograde step, out-of-sync with government's stated intentions to rebalance the economy towards manufacturing. The downgrading of the diploma is likely to discourage its uptake, further decreasing the number of students studying engineering. The possible removal of D&T as a compulsory subject in the upcoming National Curriculum Review has also raised concerns within the automotive industry. Early exposure to engineering disciplines, such as those experienced within the study of D&T, is crucial in engendering enthusiasm for careers in manufacturing, and therefore for developing and sustaining a strong engineering base in the UK. SMMT supports the Design and Technology Association's "Believe in D&T"[17] campaign to keep Design & Technology as a subject on the National Curriculum, and as an option under the baccalaureate system. Industry calls on government to ensure that their ambition to rebalance the economy is communicated and applied consistently across departments, ensuring that positive initiatives from the Department of Business, Innovation and Skills are complimented by actions elsewhere.

14. The Apprenticeship scheme is another vital tool that must be utilised to increase the UK's engineering skills base. It is critical that these schemes provide business with highly skilled, ready to work employees at all levels, and therefore increasing and improving the frameworks at Advanced and Higher level Apprenticeships is a must. SMMT and industry welcome recent government announcements committing additional funding to the programme, and call for continued long-term investment to ensure that the Apprenticeship scheme continues to grow in both quality and quantity.

Image of Manufacturing—Promotion of Engineering Careers

15. Careers within engineering and manufacturing have suffered from perception issues in recent decades, in part contributing to the current skills shortfall in the UK. Addressing the perceptions of learners, careers advisers and teachers at all levels of the education system is critical to increasing the uptake of engineering studies and apprenticeships, and ultimately growth in the manufacturing industries.

16. The "See Inside Manufacturing" initiative, introduced in 2011 by the Automotive Council and the Department of Business, Innovation and Skills, is one such scheme that has been effective in raising awareness of engineering and manufacturing careers. This scheme saw manufacturers across the UK opening their factory doors to students and careers advisors to showcase the variety of careers available in the UK automotive sector. Feedback from the initiative showed positive outcomes, with 95% of those surveyed stating that their knowledge about the careers and opportunities available in the automotive sector improved through attending the event, 82% stating that their perception of the career opportunities within the automotive industry has become more positive, and 82% of those surveyed stating that they are more likely to advise their students/ contacts to consider a career in the automotive sector.[18] Continued and long-term strategic government investment on such initiatives is crucial to attract the best and brightest into careers in engineering.

17. Ensuring that those that enter engineering studies stay within the discipline is a key issue that needs to be addressed in order to grow the UK's engineering skills base. The Talent Retention Solution scheme is a positive programme that facilitates the recruitment and redeployment of those with engineering skills. However, more must be done to ensure that careers within engineering are available and attractive to those with the necessary skills. This is a particularly issue for women who study engineering. In 2009–10 nearly two thirds (64.2%) of men who graduated in engineering and technology disciplines entered employment within engineering and technology, whilst for women this figure is much lower at 45.8%. This trend is echoed amongst those who obtained a postgraduate qualification (59.7%—43.9%).[19] Addressing the shortage of women who take up engineering careers will be a positive move in diversifying and upskilling the UK's engineering talent pool.

18. As the UK takes steps to address shortages in the engineering skills base, increased recruitment from abroad will be critical to fill skills gaps and continue the growth of the sector. In 2009, 31% of high-tech manufacturing firms had to recruit people from outside the UK, owing to a lack of suitably qualified people within the UK.[20] SMMT and its members have raised with government its concerns over the possible impact of immigration policy changes to the skills capabilities within their businesses, including highly-skill positions, such as engineering roles. The global scope of the automotive industry means that the UK is reliant on foreign investors, and these investors are reliant on their ability to recruit widely and stay competitive through such means as intra-company transfers, which should not be included within migration limits.

19. In order for the UK automotive industry to remain globally competitive, government must ensure provision for the building up of domestic engineering capabilities, to encourage more people into careers in engineering, and ensure that the UK stays open to transfers and recruitment across the globe. The £5.5 billion that has been invested in the UK automotive industry in the past 18 months provide a unique growth opportunity

[17] http://www.believeindandt.org.uk/
[18] Source: BIS http://nds.coi.gov.uk/content/detail.aspx?NewsAreaId=2&ReleaseID=422062&SubjectId=2
[19] Source: EngineeringUK 2012—The state of engineering—p209–211
[20] Source: EngineeringUK 2012—The state of engineering—p14

that must be utilised and exploited now, and ensuring UK companies have access to the widest talent pool is critical in fulfilling this aim.

June 2012

Written evidence submitted by The Royal Society

The Royal Society has noted with interest the Science and Technology Committee's inquiry into engineering skills. The Royal Society is a Fellowship of 1,400 scientists and engineers based around the world. These Fellows and Foreign Members are all world class researchers, and many are also successful entrepreneurs and innovators. I am writing to share with you some considerations from our recent work on science and mathematics education relevant to the discussion of academic routes into engineering, which may inform your inquiry.

A strong grounding in science and mathematics is essential if engineering is to thrive in the UK. Provisioning this depends fundamentally on the quality of science and mathematics teaching in schools and colleges and the availability of and access to suitable qualifications.

The Royal Society's analyses of trends in UK 5–19 science, mathematics and computing[21] have shown that at a time when science and mathematics are compulsory across the UK up to age 16 (with the exception of Northern Ireland) only a small proportion of students chooses to study these subjects, or computing, post-16.

These reports, copies of which are included for your reference, highlight constraints on the UK's capacity to encourage more young people to choose a career in engineering. In particular:

1. The chronic shortages of specialist science, mathematics, information technology and computer science teachers. Evidence shows that a teacher's knowledge of their subject affects pupils' attitude toward, and attainment and progression in science and mathematics education.[22] Specialist teachers are likely to be more confident and enthusiastic in teaching their subject, including running practical sessions that are essential to developing the skills and conceptual understanding that are integral to engineering.
2. Departmental data show that, historically, less than one-third of the total A-level cohort in England takes any mainstream science A-level (with or without mathematics).[23] Of the proportion that did so in 2009, only 10% took the most popular combinations obtained by students accepted onto engineering first degree courses. By comparison, in the same year some 26% of students taking Scottish Highers were taking such suitable combinations. This may well be because the Scottish education system actively encourages students to take a larger number and broader range of subjects. There are concerns, however, that this may be about to change with the introduction of new Scottish National qualifications.
3. The fact that too many young people are taking subject combinations post-16 that would not be considered most appropriate for entry onto undergraduate engineering (or other STEM) courses reflects poor provision and access to high-quality careers information, advice and guidance. Since 90% of careers advisers have no scientific background, many young people are unable to make informed choices about their future.
4. It is notable that 18%, 12% and 43%, respectively, of post-16 learning institutions in England, Wales, and Northern Ireland failed to present any physics A-level candidates in 2009 and this clearly relates to the poor availability of specialist teachers in this subject. We note the Coalition Government's Initial Teacher Training strategy, which aims to address both this shortage and other issues related to the supply of sufficient specialist teachers in science and mathematics at both primary and secondary levels in England.[24] Other key action areas which will be required from the relevant UK education authorities are:
    - Ensuring access to subject-specific continuing professional development (CPD) for science and mathematics teachers throughout their careers.
    - Recruiting and retaining satisfactory numbers of qualified technicians.
    - Ensuring that secondary schools and colleges have high quality, well-equipped laboratories and computer hardware.
    - Facilitating the provision of a solid and inspirational grounding in science, mathematics and digital literacy for all students through the right curriculum content and associated pedagogy.
    - Encouraging the use of methods of assessment that genuinely support students' progress rather than being focused on narrowly constructed measures of school performance, as well as ensuring the provision of appropriate and meaningful qualifications to support this.

[21] http://royalsociety.org/education/policy/state-of-nation/; http://royalsociety.org/education/policy/computing-in-schools/
[22] http://royalsociety.org/State-of-the-Nation-The-UKs-Science-and-Mathematics-Teaching-Workforce/
[23] http://royalsociety.org/education/policy/state-of-nation/higher-education/
[24] *Training our next generation of outstanding teachers: Implementation plan* Released 8 November 2011 http://www.education.gov.uk/schools/careers/traininganddevelopment/a0078019/training-outstanding-teachers

— Supporting research on how children learn science and mathematics and applying this to inform teaching practices.

The Royal Society will continue to monitor the provision of STEM education in the UK. We believe it is too early to draw conclusions about the few University Technical Colleges that have opened since September 2010 or to assess the impact of the English Baccalaureate, introduced in early 2011. However, it will be important to measure the impact of both of these changes in future and of raising the participation age in England to age 17 next year and to 18 from 2015.

June 2012

Written evidence submitted by the National Apprenticeship Service

SUMMARY

1. STEM makes up a significant share of the education landscape—for all ages, at all stages (from Key Stage 4 upwards)—including around 62,000 STEM apprenticeships each year at Intermediate and Advanced levels and an increasing number at Level 4 and above.

2. There are issues of under-representation in STEM Apprenticeships—notably in science and a dilution in engineering and construction—and Apprenticeships are at risk of becoming the norm for non-STEM Frameworks.

3. Young people and adults need nuanced STEM messages to encourage growth in STEM Apprenticeships at all levels.

4. The UK economy needs 1.5 million more STEM qualified people by 2020 and we need to understand how those numbers will be delivered from the different components including A-Levels, Vocational Related Qualifications, Advanced Apprenticeships, Higher Apprenticeships and first degrees.

5. We are supporting the growth in uptake of STEM related Apprenticeships by stimulating employer and individual demand for Advanced and Higher level Apprenticeship programmes alongside the development of a Higher Level Apprenticeship programme.

6. We recognise the need to raise the status of technical subjects and look to address the deficiencies in technician training by creating viable Apprenticeship route ways at the Advanced and Higher levels.

THE NATIONAL APPRENTICESHIP SERVICE

7. The National Apprenticeship Service (NAS) supports, funds and co-ordinates the delivery of Apprenticeships with end to end accountability for expanding the high quality Apprenticeship Programme throughout England.

8. NAS was created in April 2009 following the publication of *World-Class Apprenticeships: Unlocking Talent, Building Skills for All* which concluded that there was an urgent need for a dedicated service that would drive the expansion of Apprenticeship opportunities.

9. NAS is responsible for increasing the number of Apprenticeship opportunities and providing a dedicated, responsive service for both employers and learners.

10. NAS also manages WorldSkill UK, a portfolio of skills competitions and activities run in partnership with organisations from both industry and education and supports a highly influential national Apprenticeship Ambassadors Network, chaired by Sir Roy Gardner.

11 Since its creation, the National Apprenticeship Service has seen an increase in:

(a) *Employers*—50,000 new workplaces with apprentices in 2010, compared to the previous year.

(b) *Apprentices*—91% more Apprenticeships in the past two years including 50% more 16–24 year olds.

(c) *Advanced and Higher Level Apprenticeships*—with a faster growth at level 3 than level 2 and the establishment of Apprenticeship provision at level 4 and above.

(d) *Success*—with an overall success rate of 76% in 2011–12 compared to 71% in 2008–09.

(e) *Success at international skills competitions*—with Team UK finishing fifth place overall at World Skills London 2011.

(f) *Apprenticeships in London*—with growth of 103%.

(g) *Opportunities on-line*—with 100,000 website hits per week.

Growth in STEM Apprenticeships

Economic context

12. "STEM" groups together the subjects of science and technology with engineering and mathematics. It takes place, in varying degrees, in *all* sectors of education and training and in varying concentrations in *all* sectors of the economy.

13. NAS recognises that the Further Education (FE) and Skills Sector, including Apprenticeships, has an essential role to play in STEM education and training, improving progression through, not just in, STEM related subjects and servicing the needs of employers with a suitably qualified workforce. FE also plays an important role in raising STEM literacy, particularly though the provision of large numbers of numeracy qualifications.

14. Before the recession in 2008, employers predicted that future occupations will demand increasing STEM skills—55% of all new jobs will be STEM related. There will be significant growth in jobs but massive replacement demand. Economically valuable skills will matter most (Working Futures 2007–17, UKCES, 2009); namely technician level and higher STEM skills.

15. Despite downward employer predictions which leave the immediate outlook for the labour market bleak, where growth is predicted in marketed goods and services, it is increasingly likely to be technological.

(a) It is estimated that at least 96,300 engineers, scientists and technologists will need to be recruited by 2016 and 1.5 million qualified in STEM subjects by 2020 (Skills Assessment, Semta, 2009).

Apprenticeship trends

16. The following observations emerge from an analysis of the latest Statistical First Release data on Apprenticeships (March, 2012).[25] There is:

(a) An almost complete absence of science Apprenticeships.

(b) Some evidence of STEM dilution amongst the overall growth in Apprenticeship participation giving a mixed picture overall (with, for example engineering and manufacturing technologies accounting for around 20% of all apprenticeship achievement at Level 3 in 2011–12 compared to over 45% in 2006–07).

(c) Growth in STEM overall, at Intermediate and Advanced levels, for all ages although not always in every science, technology, engineering or maths related subject.

(d) No evidence of STEM dilution amongst 16–18 year olds and those aged 19–24 at the Intermediate Apprenticeship Level (Level 2).

(e) Strong dilution of engineering in the overall mix for 16–18 year olds at the Advanced Apprenticeship Level (Level 3).

(f) A strong dilution in engineering and construction Apprenticeships at all ages and for both Level 2 and Level 3 in the overall mix since 2007–08.

(g) In funding terms NAS continues to invest heavily in engineering and construction, spending 9% of our budget on engineering and on construction—more than on any other frameworks.

17. The National Apprenticeship Service recognises that:

(a) The dilution of STEM Apprenticeships, particularly in engineering, matters most given that labour market outcome from Apprenticeships will fall if participation in engineering Apprenticeships continues to lose its share.

(b) The risk that Apprenticeships increasingly become the norm for non- STEM subjects.

(c) Together, the dilution of engineering Apprenticeships and the paucity of science apprentices potentially work against the professional technician agenda; one which NAS is committed to ensuring aligns, as far as possible, Apprenticeship Framework achievement with professional registration, recognition and status at Level 3 and above.

STEM Strategy for Apprenticeships

18. NAS is currently working with Semta, the Sector Skills Council for science, engineering and manufacturing technologies, and partners from The Royal Academy of Engineering, STEMNET, Cogent, Gatsby Charitable Foundation and UKCES on developing a cohesive STEM strategy and action plan for Apprenticeships. The Executive Board is chaired by Nigel Whitehead of BAE Systems.

19. The purpose of this work is to make the case to employers for investing in STEM Apprenticeships and to provide a strategy for growth in STEM Apprenticeship starts. Agreement has been reached to focus on the following work strands:

(a) *Stimulate Employer Engagement for STEM Apprenticeships*—to encourage a greater number of employers who require STEM related skills in their business to engage with Apprenticeships.

[25] http://www.thedataservice.org.uk/statistics/statisticalfirstrelease/sfr_current/

(b) *STEM Apprenticeship Funding*—to investigate options for a public funding methodology to increase employer engagement in STEM Apprenticeships.

(c) *Appropriate STEM Apprenticeship Frameworks*—ensure appropriate and timely Apprenticeship framework development to service current and future STEM growth sectors.

(d) *Capacity to Deliver STEM Apprenticeships*—to understand and stimulate capacity and capability in the system to deliver high quality STEM Apprenticeships, particularly at Advanced and Higher level.

(e) *Develop Innovative Delivery Models for STEM Apprenticeships*—to work with STEM employers, Apprenticeship providers and third parties to develop Apprenticeship delivery models that will deliver an increase in high quality STEM Apprenticeships, particularly for small and medium sized employers.

(f) *A STEM Career via STEM Apprenticeships*—to articulate career opportunities via Apprenticeships in STEM based occupations, to high quality candidates, together with the development of coherent and integrated pathways into, and from Apprenticeships, aligning with current and future school and Higher Education STEM policies.

Meeting the demand from employers: Higher Apprenticeships

20. The clear expectation of NAS arising from Leitch and continuing with the Coalition Government was to increase the number of Apprenticeships particularly at the Advanced and Higher Apprenticeship level to meet the demands of the economy going forward.

21. The result can be demonstrated in the rise in the number of Apprenticeships at Advanced Level (Level 3) and above which grew by 75% in 2010–11 and continues to grow in 2011–12.

(a) In science, engineering and IT the total number of starts at Advanced and Higher Apprenticeship level increased by 26% in 2010–11.

22. Alongside this has been the development of a Higher Level Apprenticeship programme driven, in the main, by the Government's £25 million investment in the Higher Apprenticeship Fund (managed by NAS) which is targeting support at smaller employers to benefit from Advanced and Higher Apprenticeships by working with large employers and their supply chains. First set out in the Government's Plan for Growth last year and finally announced as an initiative in July 2011, this investment confirms the strong interest in the rapid development of Higher Level Apprenticeship opportunities—including technical training—and in the creation of progression pathways within Apprenticeships that will transform an individual's experience and career development prospects from Level 4 to Level 6 (equivalent to a first degree level) and beyond.

23. The original aim was to generate 10,000 higher apprentices. The successful proposals expect to support the creation of 23,000 additional Higher Apprenticeship places (as a minimum) as employers pledge to make those places available once the new frameworks are in place.

24. The result of the investment is thirty-one proposals of which seventeen have a strong link to STEM; each are creating new and revised route ways to professional qualifications in addition to opening up new sectors to apprenticeships.

25. Of the ten Higher Apprenticeship frameworks at Level 4 currently available to deliver, seven are STEM related. Current participation has grown from a small base in 2006–07 (200) to 2,200 starts in 2010–11 and a success rate of 85% (compared to 77% for all Apprenticeship completions).

26. The table below details both the existing and proposed STEM Apprenticeship frameworks:

Sector	*Framework*	*Proposed Starts 2012–14***
Advanced Manufacturing and Engineering		
	Level 4 Higher Apprenticeship in Energy Engineering with pathways in the sub-sea and renewable sector**	*120*
	Level 4 Higher Apprenticeship in Vehicle Manufacture**	*510*
	Level 4 and Level 6 Advanced Engineering Manufacturing**	*4,800*
	Level 4 Science and Engineering Research and Development**	*250*
	Level 4 in Engineering Environmental Technologies**	*840*
	Level 4 and Level 5 Higher Apprenticeship Frameworks in Waste/Water Management and Power/Utilities Operations**	*500*
	Level 6 Higher Apprenticeship in Space Engineering**	*250*
	Level 4 Higher Apprenticeship in Engineering Manufacture (Senior Technician)*	-
	Level 4 Higher Apprenticeship in the Water Industry*	-
Business and Professional Services		
	Level 4 Higher Apprenticeship in Providing Financial Services with pathways in insurance and banking**	*270*
	Level 4 Professional Services Higher Apprenticeship with pathways including tax and audit**	*1,500*

Sector	*Framework*	*Proposed Starts 2012–14***
	Level 6 and Level 7 Apprenticeship Framework in Accounting and Professional Services**	*600*
	Level 4 Higher Apprenticeship in Accounting*	-
	Level 4 Higher Apprenticeship in Providing Financial Advice*	-
Construction		
	Level 5 Higher Apprenticeship in the Sustainable Built Environment**	*500*
	Level 5 Higher Apprenticeship in Construction Operations Management**	*1,200*
	Level 4 Higher Apprenticeship in Sustainable Building**	*500*
	Level 4 Higher Apprenticeship in Construction Technical Supervision and Management*	-
Digital Economy & IT		
	Level 4 Higher Apprenticeship for the Creative Industries including pathways for creative and digital media**	*500*
	Level 4 Higher Apprenticeship in IT**	*1,000*
	Level 4 in IT Software, Web and Telecoms Professionals*	-
Health		
	Level 4 Higher Apprenticeship in Emergency Care**	*1,600*
	Level 4 and Level 5 Higher Apprenticeship in Life Sciences and Chemical Science Professionals**	*430*

*Current Higher Apprenticeship Framework.

**Higher Apprenticeship Fund funded Framework in development or newly launched.

27. NAS is working to ensure that the demand for more highly skilled employees in science, engineering and technical occupations is met with a high quality Higher Apprenticeship offer that ensures clear and achievable ladders of progression for apprentices, from Advanced and technician levels, to pursue their aspirations for higher level skill achievements including post-graduate study and the attainment of professional qualifications.

28. The importance of applied technical knowledge in many of our most dynamic STEM industries, together with a need to link them with practical, vocational skills and career development have made Apprenticeships at the higher level a model that offers another acceptable route to achieving higher level success.

29. Apprenticeships in the UK have not typically been considered a preferred route to a managerial or professional career or higher level learning. Where apprentices or their employers wish to progress there has been limited opportunity in the workplace; our £25 million programme of investment and development is changing that perception.

Raising the Status of Technical Subjects and Technician Professions

30. NAS is taking steps to explore with the Gatsby Charitable Foundation how best to tie technician—through to Chartered—registration in science, engineering and IT *with* Apprenticeship achievement.

31. One of the major advantages of registration is that it provides a workplace route into the professions and NAS and Gatsby jointly believe that Advanced and Higher Apprenticeships are the natural training programmes for this vocational route.

32. It is also believed that more can be done to strengthen the links between Apprenticeships and professional body registration, in particular:

(a) Mapping and linking the relevant Apprenticeship Framework to the standards required for registration and recognition.

(b) Making employers of apprentices and apprentices themselves, aware of the link between Apprenticeships and registration.

33. NAS has agreed to lead a steering group with UKCES and the University Vocational Awards Council to match the relevant Apprenticeship Frameworks at Level 3 and above to the professional standards set by the Engineering and Science Councils with a view to establishing STEM Advanced and Higher Apprenticeships as an accepted vehicle for establishing a professional technician workforce and a recognised route to professional status in science, engineering and IT.

Raising the Demand for STEM Apprenticeships

34. NAS has, in 2012, refreshed its Partnership Agreement with Semta to further improve employer and learner engagement; targets include:

(a) A doubling of Advanced Apprenticeships in engineering and manufacturing from 8,000 to 16,000 by 2014–15.

(b) A take-up by SMEs of 2,000 engineering apprentices supported through supply chains and trade associations which would represent a 12.5% growth on 2009–10 starts.

35. NAS is complementing the investment secured by Semta from the Employer Investment Fund to double the number of SMEs recruiting apprentices (from 11% to 20% by 2016) by:

(a) Collaborating on an Apprenticeship Employers Champions Group chaired by Arthur Connelly, Semta Board member from Rolls-Royce, to the benefit of advanced engineering Apprenticeships.

(b) Providing funding for the expansion of Advanced and Higher Apprenticeship hubs for the manufacturing and engineering industries to meet SME and supply chain needs. The proposal is for the prime or large and significant engineering/automotive companies to act as training hubs or *academies* for smaller local companies with Apprenticeships at the core of the offer. Two routes will be established: the use of current overspill of high quality applications to major advanced manufacturing and engineering companies for placements in the smaller supply chain companies and a bespoke recruitment service for SMEs that typically require flexible and diverse models for Apprenticeship delivery including extended full-time training provision and access to foundation elements.

36. NAS' sales force is very focused on promoting STEM related frameworks to employers and individual learners. In 2010, every engineering and manufacturing employer in England was approached offering support for taking on apprentices and the new AGE wage incentive for 16–24 year old apprenticeships is aimed at these sectors specifically.

Increasing WorldSkills UK Success

37. NAS is committed to driving up the profile and reputation of Apprenticeships through national and international competition success. By competing in international skills competitions, the UK is able to showcase the high level of performance that can be achieved by individuals and organisations through high quality training including Apprenticeships.

38. One third of all the skills competitions at WorldSkills are engineering based (not including automotive related skills), equating to approximately 15 skill areas.

39. During WorldSkills London 2011, the UK achieved its first ever medals in the engineering skills of Mechanical Design CAD and Welding (Bronze) and a Medallion for Excellence in Mechatronics—achievements which had not been realised for 20 years.

(a) The UK however consistently fails to get in the top half of the scores in engineering skills such as CNC Milling, CNC Turning, Manufacturing Team Challenge, Electronics, Aircraft Maintenance and Mobile Robotics and we accept that engineering skills success at WorldSkills is currently dominated by countries such as Japan, South Korea, Brazil and Switzerland.

(b) Nevertheless, the UK has a good reputation for excellence in Advanced Engineering.

40. The UK has also not entered, or not entered for some time, in skill areas such as Polymechanics, Industrial Controls, Construction Metal Work and Sheet Metal Work, and Mould Making. The National Apprenticeship Service recognises that it is important the UK is able to demonstrate at WorldSkills the high level of skill being taught to our young people in these engineering areas. This would help indicate that the UK has a solid base of highly skilled labour to support investment decisions in the UK as a manufacturing base.

41. NAS is launching a series of study visits to countries such as South Korea, Brazil and Switzerland to understand how they have become successful at WorldSkills in these engineering skills.

(a) Visits to Switzerland and South Korea have already been undertaken and companies such as Samsung, Hyundai and Hamilton Company have shared their understanding of how to increase the level of skills to bring about success at WorldSkills competitions which NAS is looking to harness.

(b) The Swiss Apprenticeship system uses a skills competition "like" based assessment format to assure skills competence at years two and years four of their programme and we are exploring the main advantages of the Swiss Vocational Education and Training system and how it supports WorldSkills competition success.

42. NAS works closely with Semta as its skills competition partner who coordinates a portfolio of engineering competitions UK wide. This portfolio has increased from only two engineering competitions in 2006 to now servicing ten during 2012.

(a) For Team UK to be successful at the full range of engineering skills they require far greater engagement from leading UK engineering based organisations. In addition to the regular support given by Rolls-Royce (Engines), Bentley Motors, BAE Systems and CarnaudMetalbox, NAS is working directly with relevant large employers to promote company involvement and secure active support for skills competition to drive up expertise in Apprenticeships and skills.

Conclusion

43. NAS is transforming the culture and practice of Apprenticeship delivery and as such provide a suitable platform for promoting the take-up of vocational learning in STEM Apprenticeships at all levels. Indeed, STEM Apprenticeships are often discussed as part of the national STEM narrative and we are determined to focus on those sectors where the demand and need for a high quality Apprenticeship solution is demonstrable by deploying a proven model of Apprenticeship framework development in support of employers, universities, further education colleges, private providers and other partners.

June 2012

Written evidence submitted by Oxford Cambridge and RSA Examinations (OCR)

Introduction

1. As one of the largest UK awarding bodies, OCR designs, produces and assesses qualifications, particularly GCSEs, and A Levels. We provide a wide range of vocational qualifications including the Diploma in Engineering. We meet the needs of learners of all ages, working with 13,000 schools, colleges and other institutions. These close links with curriculum and learning have made us very aware of the impact of changes on the curriculum choices being offered to young people.

2. OCR has a particular interest in the Engineering and STEM agenda:

- we work closely with University Technical Colleges in the Engineering sector to develop a curriculum which meets the needs of learners and reflects best practice within the sector; and
- we have subject consultative forums in respect of Science, Mathematics and IT & Computing in which representatives of Higher Education, employers and sector experts provide advice to inform our qualification development.

3. Our submission is based upon evidence that we have gained from:

- our survey *Key Principles of Engineering*;
- recording comments from school, colleges and University Technical Colleges who have worked with us since the Engineering Diploma/Principal Learning became available in September 2008, and schools and colleges that deliver our GCSEs in Product Design, Engineering and Manufacturing; and
- discussions with engineering employer partners and members of our STEM subject consultative forums.

Results of OCR Survey—Key Principles of Engineering

4. In association with The Royal Academy of Engineering, in 2011 OCR undertook a survey of 50 key influencers within the engineering sector, to establish their view of what constituted the key principles of engineering. This work was undertaken in the context of policy changes in respect of government support for the Diploma and the decision to implement the recommendations of *The Wolf Review of Vocational Education* in full.

5. The survey was informed by the curriculum activity that OCR had carried out with The JCB Academy and The Black Country UTC, both of which offer a curriculum with Engineering as a specialism. The survey targeted four sectors,

- Manufacturing/Production Engineering.
- Maintenance Engineering.
- Electrical/Electronic Engineering.
- Chemical Engineering.

The survey sought to identify employers' views on current provision and what they felt future engineering and manufacturing qualifications should contain.

6. The key findings that emerged were:

6.1 Current Provision

All respondents felt that the Principal Learning for Engineering qualification was respected by the engineering community and was providing the right blend of learning and experience to allow learners to progress within Engineering. Respondents were keen to ensure that the qualification was not broken into chunks (linked qualifications) as it would lose the depth that was providing learners with the engineering skills required by employers.

6.2 Curriculum Offer 14–16

Respondents identified the importance of developing learners' skills and abilities in core curriculum areas emphasising the importance within engineering of understanding and mastery of:

(i) Mathematical techniques and applications.

(ii) Scientific principles and applications.

(iii) Application of computers for problem solving, diagnostics, maintenance and process control.

This reflects concerns already expressed across the education community in respect of the wider STEM agenda.

In contrast to the recommendations set out in the Wolf Review, for 14–16 curriculum, respondents felt learners should be provided with a large amount of authentic and current hands on practical experience with related employer industry input.

6.3 Review Group Views

The review group made up of RAE, Imeche, (the engineering council), MEI and Brighton University all felt that common underlying general principles across all engineering sectors should be the basis of any future engineering qualifications and this should be reflected in future developments at 14–16 in particular.

It was felt that Principal Learning in Engineering provided a platform for the further development of engineering qualifications. Any new qualifications developed needed to provide:

— schools with the flexibility they require; and

— UTCs with the ability to deliver the greater depth engineering employers are seeking.

Concerns expressed by schools, colleges and UTCs delivering the Diploma, Principal Learning in Engineering and GCSEs in Product Design, Engineering Manufacturing and Applied Science in the light the introduction of the E-Bacc and other performance measures

7. OCR has received face to face feedback from 10 current or planned UTCs in respect of this submission and has also received feedback from schools and colleges delivering the Diploma or Principal Learning in Engineering. The key issues emerging are:

7.1 Curriculum Time and the Impact of "Headline" Performance Measures

As approximately 40% of the school curriculum time is required to deliver Principal Learning, the decision by the DfE to count this achievement as the equivalent of one GCSE in the headline performance measure is creating a strong disincentive to continue delivering the qualification.

Schools, and UTCs in particular, have reported that the Principal Learning for Engineering provides the right balance of academic and technical study. However, as a key measure of a school's/UTC's performance is through qualification outcomes set out in the headline measure, it is unlikely that they will be able allocate the necessary amount of curriculum time to its delivery.

7.2 Cost of Delivery

Schools and UTCs have expressed concern about the recent funding changes that have withdrawn the additional financial support required to deliver this type of qualification properly. The unintended consequence of this could be to encourage schools and colleges to concentrate provision on qualifications with lower overhead delivery costs reducing learner access to engineering qualifications.

7.3 Approach to Learning and Assessment

The Principal Learning specification is designed for students who respond well to a kinaesthetic, practical style of learning. The syllabus requires learners to demonstrate mastery of practical skills and requires internal assessment to support this method of delivery. There is concern that the move towards terminal, exam based assessment at the end of Key Stage 4 will disadvantage these learners and reduce their opportunity to progress to employment or further learning.

7.4 Breadth of Offer at GCSE

There is evidence of schools switching large numbers of students away from Product Design, Engineering, Manufacturing and Applied Science GCSEs, including examples of this happening when students are already six months into these programmes. It would appear that decisions are being made to increase the number of students following the portfolio of E-Bacc subjects. A number of schools reported that this was beginning to affect uptake at A Level and may in the longer term lead to a decline in the take up of Engineering degrees.

Discussions With Engineering Employer Partners

8. Below are comments received from a number of engineering employers about the potential loss of the Engineering Diploma (Principal Learning).

> "I think there are problems we need to overcome urgently. This isn't ultimately about qualifications, it's about learning in the right way to go into careers. Engineering is increasingly disappearing from schools' option forms after years of going in the right direction. The Dyson Foundation wants more home grown engineers and the Diploma was the best way forward for school students to engage with the subject." *Dyson Foundation*
>
> "The Diploma in Engineering has now become known as the industry standard. To break this up or get rid of a name that we now recognise and respect would simply be ludicrous" *Siemens UK*
>
> "For many years, we have been encouraged to support the delivery of engineering within schools. We are at a stage where we are now working with schools more closely than ever because we believe the Diploma equips learners with the right skills. Our engagement will be very different if this qualification does not exist". *Tata Steel*

Issues Arising From OCR's HE Engagement Strategy

9. During the past two years OCR has implemented a wide-ranging Higher Education engagement programme. The programme consists of a Higher Education (HE) Consultative Forum, together with a number of subject consultative forums including science, mathematics, IT & Computing. Some 100 representatives from learned societies, professional associations, schools and colleges, employers and education charities have attended these forums. Feedback from all three forums has consistently emphasised the importance of learners being enabled to demonstrate:

- strong command of the core subject knowledge, principles and practice;
- ability to demonstrate problem solving approach; and
- ability to work independently to develop own learning.

10. All forums have recognised the importance of engineering and have underlined the "shared agenda" across the STEM subjects. There is a strong view that the current revision of A levels should be used to promote the academic core which will best support learner progression to employment or entry to HE.

OCR's View

11. The introduction of the English Baccalaureate was welcomed by OCR as a "wholly appropriate means of rewarding young people who have succeeded across a number of strong academic subjects". The inclusion of Maths and all three sciences within this measure provides a strong grounding for future academic study that will support the development of engineering skills within the workplace and further and higher education. Without command of these core subjects, future progression will be at risk.

12. However the implementation of the recommendations of the *Wolf Review* has had significant consequences for emerging approaches to promoting the delivery of engineering skills within the school curriculum.

13. Firstly the guidance that between 14 and 16 no more than 20% of curriculum time should be spent on subjects outside of the academic core will cause many schools, colleges and UTCs to withdraw from delivering qualifications, like the Principal Learning in Engineering, because they require more than this ceiling suggests.

14. This is further exacerbated by the criteria that vocational qualifications have to meet to be included within the revised headline measure from 2014. All qualifications must have a significant amount of external assessment and regardless of number of guided learning hours will only count as the equivalent of one GCSE. Both of these factors have already begun to drive schools, colleges and UTCs to offer bite size vocational learning at 14–16 rather than the more rounded holistic approach that is supported across the engineering sector.

15. Consideration should be given to how schools, colleges and UTCs can be supported to deliver a broader curriculum that develops and supports the acquisition of core engineering skills. The current arrangements provide strong support for those that will enter the sector by the traditional route of academic excellence in related STEM disciplines. However, the opportunity to deliver a more practical applied approach and to broaden the number of routes into an engineering career, require a less prescriptive interpretation of performance measures.

June 2012

Written evidence submitted by EADS UK

Introduction

A. EADS UK welcomes this opportunity to respond to the Science and Technology Select Committee's inquiry into engineering skills.

B. We would welcome the opportunity to contribute to any further work investigating a broader range of issues beyond the scope of this present inquiry.

About EADS

C. EADS is a global leader in aerospace, defence and related sectors. The EADS Group of companies includes Airbus, the leading manufacturer of commercial aircraft, Eurocopter, the world's largest helicopter supplier, Astrium, the European leader in space programmes from Ariane to Galileo, and Cassidian a leading provider of cryptography, border security and other security solutions. EADS is the second largest aerospace and defence company in the world and a major partner in many of Europe's largest aerospace projects, including Eurofighter Typhoon. EADS has a major industrial presence in the UK. Over 16,800 highly-skilled jobs are directly employed at EADS' 25 key UK sites, and a further 135,000 jobs are indirectly supported throughout the UK supply chain. EADS invests around £2.8 billion annually on research, of which £390 million is spent in the UK.

D. EADS is responsible for the supply of Eurofighter (with BAES and Finmeccanica), A400M, FSTA, Skynet 5, DII (Secure Network), Cormorant, crypto and (through MBDA) Storm Shadow, ASRAAM, FASGW and Brimstone.

1. *Does the current engineering skills base meet the needs of employers?*

Do employers in the engineering sector prefer an academic or a vocational profile?

1.1 The current engineering skills base covers a vast range of capabilities at differing depths and consequently meets our needs in some areas but not others. EADS's business units need both academic and vocational profiles and a lack of appropriate skills poses a significant risk to our business.

1.2 While industry as a whole needs employees with both academic and vocational backgrounds, the key is that the employee should be good at the role in which they were trained. The skill requirements brought about by changes in technology will be the key to the future economy in Advanced Manufacturing in both England and Wales. The workforce must be flexible and be in a position to react and respond to these changes when required.

1.3 Eurocopter and Airbus generally train our own engineers to a level acceptable for aircraft work. To progress beyond a basic shop floor level engineers are required to pass formal examinations including maths and science to "A" level. Oddly there are no exemptions from Civil Aviation Authority (CAA) exams for any academic qualifications, already obtained at school or college.

1.4 There should be confidence in qualifications that both employers and learning institutions value; they should meet the expected competency in a consistent way and be understood across both England and Wales. In addition, vocational courses must have sufficient academic structure underpinning them. Traditionally employers recognise academic qualifications such as GCSEs and A levels but when vocational qualifications are mixed with academic qualifications, eg in an apprenticeship framework, the qualification is boosted with added value and credence. Educational institutions need to be incentivised to vigorously liaise with industry so that their curriculum better suits the changing needs of the sector, whilst maintaining academic excellence. A much higher profile should also be given to courses accredited by the appropriate engineering institutions in order to provide a basic guarantee of competence from a source which has broad support and trust.

1.5 We have found that post graduates with degrees in aeronautical subjects have an optimistic view of their worth to aircraft companies and become disillusioned when they find that their hard earned degree gives them no exemptions from the industry required examinations. Colleges need to tailor their course so that they comply with industries regulations, and meet the aspirations of their students. Given that, even post graduates require five years of on aircraft work experience before they can apply for their licence, it means that they will be around 27 years of age before they get their AMEL and a higher level of salary.

1.6 A recommendation would be to embed an industrial placement year in all engineering/science degree courses so that graduates have vocational experience such as commercial awareness as well as the required academic knowledge before joining the UK workforce. This is where we are considerably weaker than in Europe. We do manage to recruit from the UK workforce/skills base, but we have a higher dependency on foreign nationals than other countries in Europe.

1.7 Arrangements like the Talent Retention Scheme are a useful means for industry and other Engineering organisations working together to provide a mechanism for retaining key skills within the sector.

1.8 Finally the standard of mathematics in this country must meet the international norms of competitor countries as these skills are a pre-requisite of all our higher level engineering skills. Poorly supported

mathematics translates to difficulties in pursuing numerate subjects, which will damage recruitment in both science and engineering which in turn affects industry.

2. *What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?*

2.1 The percentage of UK postgraduates on engineering courses has already collapsed. The decisions of government recently will only make this worse. In the past the UK has been able to keep many of the overseas postgraduates in order to strengthen the UK economy. However this will not be as simple in the future. For example China and India are rapidly improving the pay and conditions for their talented nationals and with the expansion of their high grade engineering capacity we should expect to see a corresponding drop in the availability of postdoctoral students to the UK as their country of origin becomes more attractive in the next decade.[26]

2.2 England has decided that qualifications such as the Engineering diploma will no longer be equivalent to five GCSEs.[27] A concern is that these changes are seen as a statement that engineering is not high value. Although we have not seen any impact of this change, it would have been better to improve the qualification rather than downgrade it.

2.3 Airbus and other large employers have mainly used Vocational subjects, such as the Engineering Diploma as an equivalent to one GCSE alongside English, Maths and Science. However, we would welcome more credence given to Engineering subjects and a legitimate comparison, where possible.

2.4 The changes will probably have a detrimental effect on the principle learning and the Engineering Diploma but will not adversely impact the very important STEM subjects. It should have little or no effect on the skills base needed by the engineering sector. There are concerns regarding the impact should there be a shortage of industry specific skills in the market.

2.5 True vocational courses that are built into apprenticeships such as the Performing Engineering Operations or Performing Manufacturing Operations at NVQ level 2 and NVQ level 3 have far more influence on the skill base of the Engineering Sector at technician level. These are competency based qualifications where individuals must carry out real activities with skills required by the industry and assessed to industry standards.

2.6 The Engineering "A" Level (Edexcel) must also be considered. The breadth and depth seems to be out of proportion with other "A" Levels, it needs to focus on what students will do next, ie engineering degree courses and the course structure amended accordingly. Greater support should be provided for schools to understand what is required of them and some re-branding may be necessary to make it clear what sort of student is likely to benefit. If this is aimed at students that will eventually become chartered engineers later in life the title "Professional Engineering" may be useful to distinguish it from more "craft" oriented courses. Similar comments could be made at GCSE level. Industry in general is very willing to support these courses. Practicing engineers in the RAEng and universities should be consulted on an improved syllabus with a view to increasing uptake, a focus higher quality and exciting students across the full spectrum of backgrounds.

2.7 Experience over the last five years has shown apprentices with GCSE's do not have the underpinning scientific and mathematical knowledge required to support the new information they receive at College or for the CAA examinations. GCSE modular examination allows individuals to discard the information once the module is passed. Those with 'A' levels go through the process of having to learn how to understand and retain the information in preparation for an overall final examination. There needs to be a radical shift in the way young people are taught if we are to be serious about preparing them for future employment in high tech industries that require good engineering skills, otherwise those who have only GSCE's, no matter how good the grade, will be left with low level jobs.

2.8 The change in tuition fees is also likely dictate change. Institutions that are not charging £9,000 per annum are likely to be under severe pressure to cut back on expensive courses (very relevant to four year STEM courses). In particular there is no relief on tuition fees for the brightest students taking shortage subjects that are crucial to the future economy. We believe a secondary threat, as more graduates accrue very large debts, will be the questioning of the value of such degrees. Due to increased cost implication, in England, there is a marked increase in applications for apprenticeships from candidates with qualifications that would have previously encouraged them into further education. Therefore, better qualified and more mature applicants who are more likely to succeed in passing all elements of the apprenticeship. A small silver lining of this is the apprentice will be 23 years of age or older before obtaining an Aircraft Maintenance Engineers Licence (AMEL) and a higher level of salary.

2.9 However, the negative consequence of this change is that in shortage areas UK industry needs engineering graduates and the UK needs the additional tax and jobs generated by such industry. So engineering degrees (shortage areas for capable students) are far more valuable to the UK economy than they are to the individuals and this should be reflected in incentives to take them.

[26] www.gemini.com.hk/assets/doc/survey_china.pdf

[27] Foundation Diploma was equivalent to 5 GCSEs at grades D to G. Higher Diploma , was equivalent to 7 GCSEs at grades A* to C

3. *How do the approaches taken by the Devolved Administrations to produce a technically skilled workforce differ to the current approach in England? What are the strengths/weakness of the different approaches?*

3.1 For economically important sectors, such as Advanced Manufacturing, the Welsh Government has developed the "*All Age Apprenticeship"* which supports new entry apprentices under 18 years of age, older apprentices who would like a second chance and existing employee apprenticeships. England is moving to a system where apprentices from 16 to 18 will be funded, post 18 will be financed and those over 23 will be eligible for loans similar to student loans. Large employers are also expected to have a further 25% reduction in the delivery funding.

3.2 Wales has a stronger social agenda than England. The English ability to expand beyond the usual cap on student numbers, in the case of highly qualified students, is not supported by the Welsh Government. Consequently successful departments at Welsh Universities, which are attracting top quality students, cannot expand in the same way as the top English universities. HEFCW recognised that allocation in shortage areas is a problem[28] and is trying to address some of the issues. Wales also has a strong focus on SMEs as they make up a disproportionately large percentage of the Welsh economy. Given that Wales relies heavily on public sector money, which is dwindling, it may be a mistake not to consider attracting and retaining large export driven companies as the priority. Certainly the emphasis should be on companies that bring money into Wales.

3.3 Wales allocates less funding to STEM subjects than England, causing a competitive disadvantage. This is worrying; at present Wales is doing well with one university in the top 10 UK engineering institutions and two in the top 20, this far exceeds other home nations. Clearly there are lessons to be learnt from Wales in terms of their top institution's ability to cope on smaller budgets but there is also a risk in further stressing a system that is working efficiently. We should be mindful of control factors such as small strategic initiatives that may have disproportionate effects (eg the Power Academy).

3.4 Finally the Welsh Baccalaureate has had a mixed response with some universities being dubious of its nominal 120 point score. England can learn from the strengths and weaknesses of the Welsh approach. It is imperative that if the students are going to spend time in this area the qualification can be trusted to deliver value.

4. *Could the Government and others do more to raise the status of technical subjects?*

4.1 Yes. It is important that Government encourages STEM subjects for all school children and where appropriate give vocational subjects the same credibility as academic subjects. There are several learning methods that could be considered and many learners benefit from having a range of subjects, pathways and modes of learning to suit different interests, capabilities, learning styles and career opportunities as possible. Choice should apply equally to learners whether they are academically or practically orientated. It is important that the Government helps challenge the (negative) perceptions of engineering. In addition EADS, like other organisations, supports the national objective to raise the profile of STEM subjects in the hope of encouraging more students to study these subjects post 16 and ultimately choose careers in STEM related fields.

4.2 There are a number of ways Government could do more to raise the status of technical subjects:

(a) Engineers should be presented as innovators rather than maintenance and repair technicians. The roots of the word "engineer" are "ingeniaire" (to devise)

(b) Where great inventions are created by engineers they should not be referred to as scientists but as engineers (or chartered engineers).

(c) Government bodies often have Chief Scientific Advisors who are actually providing engineering advice (invention, analysis and design) rather than scientific (discovery and models of the way the world works). This should be reflected in the title.

(d) Large primary and secondary schools should be incentivised to employ at least one teacher who has a good class of degree and enthusiasm for engineering as one means of encouraging more students to study technical skills at all levels. They should be supported by centrally produced material. Many schools use robot or electrically powered car building clubs to encourage young people to gain an interest in engineering, but it becomes little more than a fun adventure rather than having a useful purpose of teaching fundamental scientific and engineering principles. The Government should look at incentives to encourage Universities and students to pursue engineering careers and raise awareness of all STEM subjects.

(e) Companies should be incentivised to take a greater part in working with schools. Such social responsibility should be rewarded through official recognition (eg badge schemes) and greater access and influence on bodies that make decisions on the future of education and curricula. As a large employer we do not feel the Government offer support or incentives to large employers to be actively involved in promoting STEM projects and believe the Government do not have an awareness of the lengths employers are going to support STEM subjects.[29]

[28] Press Release "Reallocating student numbers in higher education." Thursday, 5 April 2012

[29] For example, Airbus, like many other employers have developed education liaison strategies which aim to initiate and support activities that raise education standards relevant to the national curriculum in science and engineering to ensure future intellectual industry needs. Airbus also seeks to support and develop initiatives to help equip school leavers with the relevant skills, capabilities and attitudes that today's working environment demands.

(f) The public services (including teaching) should make a point of supporting professional engineering bodies and individuals to become Chartered Engineers (and similar), to use the title and to recognise the status in the salary and reward structures. This requires a fundamental change in the mindset of teachers of students from the age of 12. To teach someone engineering skills requires a workshop and expensive resources, to teach someone a language is less expensive by far. Also engineering is a broad subject which requires an understanding of materials, processes and design. Changes in technology require the instructor to be regularly updated. Field trips to cutting edge industry will capture the imagination of students.

(g) Greater use should be made of the engineering institutions to provide relevant advice to Government and the value and use of such advice should be made more public. This includes the Royal Academy of Engineering and Engineering Council for general issues and the separate institutions (eg IMechE and IET) for more subject specific issues. Where broader regional issues are of concern then of course more general learned regional institutions are relevant (Royal Irish Academy, Royal Society of Edinburgh and The Learned Society of Wales).

(h) In relation to industry, Government should recognise where companies are acting as good corporate citizens in order to encourage the good work undertaken.[30,31,32]

(i) Government could do more to support or encourage more strategic approaches between industry and academia. A model for this may be the Power Academy (conferences.theiet.org/power-academy). This academy was brought together to address the devastating collapse in Electrical Engineering undergraduates.

(j) Government should look at best practice in other EU countries where the status of engineers is much higher with a view to transferring some of their methods to the UK.

4.3 Parents must be sold on the requirement for engineers and that it is a worthwhile and rewarding career for their children. Careers advice in schools and colleges remains woefully poor and virtually non-existent in engineering mainly due to the fact that few teachers understand it. Computing, design, sport, drama, art, media studies are personified as the Holy Grail. Teachers in secondary schools need training in engineering matters so that they can give a balanced picture to their students.

5. *What more should be done to attract and retain a more diverse technically skilled workforce?*

5.1 This is a very complex issue to address,[33] diversity is not a problem across all STEM subjects. Although there is a particular problem in relation to physics, computing and additional/further mathematics. Female

[30] In the case of Cassidian this includes STEM ambassadors who work with schools and colleges to promote STEM subjects as well as supporting wider work in the area such as via Techniquest and Dark Sky Wales. Cassidian has worked with the Welsh Government in this area.

[31] In the case of Airbus The activities with schools are tailored to particular age groups between 11 to 19 yrs and also aim to promote diversity. These activities include:

Robolab in schools (11–14 yrs)

In-company educational visits for Key Stage 4 students (14–16 yrs) or Key Stage 5 (16–18 yrs)—around 1,000 visitors.
A programme of Work Experience weeks (14–19 yrs) placing over 200 students.
School/College careers fairs / mock interviews.
In-school presentations to promote engineering and apprenticeship opportunities.
Airbus graduates and apprentices are encouraged to become STEM Ambassadors and gender role models. They run a number of activities such as Lessons in a box (11–14 yrs), interactive displays at external shows/fairs, school visits, amongst others.
Engineering Education Scheme projects—('A' level students).
Farnborough Airshow—interactive events for over 45 'A'Level Maths/Physics students.
Events include:

Airbus Flying Start Challenge—8 schools participate in a two-day event (14 to 16 years).
Theory of Flight—Chester Zoo/Airbus—30 students (14 to 16 years) participate in a two-day event.
Diversity—Girls into engineering events—60 students (14 to 16 yrs).

Additionally events are held to engage with the key influencers—teachers, careers advisors and parents in support of the STEM agenda. These include:

Mathematics/Physics Focussed Events for teachers and Careers Advisors' Events.
Airbus Apprenticeship Information Events (Broughton and Filton)—major on-site events largely aimed at GCSE and 'A' Level students, as well as parents (around 6,000 people attended these events at Airbus sites in 2011).

Airbus is also looking at opportunities to work with local university networks and schools to support them in promoting STEM subjects in particular through social media.
We believe that Airbus is seen by the general public and other key influencers to be offering excellent opportunities for development and progression and where appropriate apprenticeships that are a real alternative to University. The challenge is to ensure that other organisations across all sectors are seen to be offering the same high quality opportunities.

[32] Astrium created an education outreach scheme which allows employees to be able to support school visits and workshops held at our main UK sites or to visit local schools within a 30 mile radius and hold interactive activities. Astrium currently support four school visit requests a month. Astrium use the medium of Space as a way of promoting the study of STEM subjects within schools, it is hoped as a company we inspire and encourage the Scientists, Engineers and Mathematicians of the future.
Key figures:

Approx 110 employees are registered ambassadors across both main UK sites.
Involvement in around 150 events/activities (including extended projects and large events) during 2011 alone (similar levels in 2010 and 2009).
Direct interaction with ~10,000 students during 2011.
Outreach Budget = 3000 staff hours per year.

[33] UKRC publication "Statistics: Women and men in science engineering and technology: the UK statistics guide 2010". Detailed information can be found from the JCQ results (www.jcq.org.uk).

representation at "A" Level in computing, physics and mathematics is significantly low and continues to fall, this is coupled with an overall decline in numbers.[34] This then propagates into engineering as a whole as such "A" Levels are key feeder subjects to the best universities. Making funding available will increase the popularity of these subjects, specifically making them attractive to the brightest students. Academic work should be followed up with examples, "hands-on" work and demonstrations which should emphasise creativity and innovation.[35] Naturally the effectiveness of this material will depend on the quality of the presenter. Those which can prove their effectiveness in this area should have it recognised.

5.2 The percentage of women studying engineering at University is very poor, resulting in a low percentage pursuing engineering careers. Work needs to be done as early as possible in education to promote engineering as a career path to all, but particularly young women. We actively promote female engineers into the industry via online profiling and our STEM activities, but more needs to be done across industry and government. Organisations should be encouraged to support schemes like WISE (Women in Science and Engineering) and use female corporate ambassadors to introduce students to the work environment and the opportunities available

5.3 Industry should indirectly support diversity as an addition to the direct support from universities. It should be noted that the goal here is to get the best students from under-represented backgrounds into the right courses, not to use quotas to make the figures look correct by advancing less able students of the right ethnicity. Groups do exist which help, particularly in the STEM area such as EESW in Wales and wider groups like Athena Swan (supported by the Royal Society, Biochemical Society and the Department of Health) should be consulted. However these tend to focus on gender equality. Under-represented ethnic groups also need support. One of the issues that admission tutors face is that the statistical numbers can be so small that deriving statistically meaningful indicators on a particular course, which may have less than 50 students in total, is difficult.

5.4 Regional statistics that take into account qualifications leading to the degrees under scrutiny should be collected to determine where the issues arise. 2010–11 Department of Education statistics show percentages of pupils achieving 5+ GCSEs of A*-C grade including English and Mathematics vary between the ethnic groups (from 78.5% to 54.3%). This disparity continues into 'A' level. This is a strong indication that much earlier intervention is necessary than university level. Root cause analysis is required to support the under-represented groups, not actions to merely require the numbers to look correct.

5.5 In terms of the overall distribution of ethnic groups in engineering subjects, it should be noted that it is not unusual now to see over 30% of the intake from overseas and this rises to much greater proportions amongst postgraduates. So the student body as a whole is far more diverse than the UK population, except for gender. There are overwhelmingly varied and complex reasons for different groups to come to the UK, so establishing what is a reasonable spread of various groups in the overseas recruitment area is an intractable problem. The issue here is not so much about having a diverse student body as the opportunity (or lack of it) for different groups in UK society.

5.6 Airbus has developed its own Skills Strategy, to attract a diverse skilled workforce and provide a structured framework for investing in the skills of our workforce. The strategy has at its centre the apprenticeship model; although this is seen by some as being expensive. We feel that, providing there is government support for the delivery part of the programme, we can manage the remaining considerable employment and non-framework costs of the apprenticeship.

5.7 It is also important that employers are able to identify people that meet their internal business requirements, and where appropriate are able to recruit or develop a well-educated, vocationally competent, skilled workforce who are able to carry out a meaningful role within their business.

5.8 The Government makes available £16,000 of funding for each apprentice. Generally aircraft companies are not able to draw this funding down. It is only available to colleges or intermediate training organisations. Quite often this funding is spent on college courses which are of no value to the student whatsoever.

5.9 All this comes down to more investment in engineering and its associated subjects and fewer "easy option" subjects.

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[34] computing (7.5% and falling), physics (20.8% and falling) and mathematics (31.2% and falling)

[35] Universities UK publication "Supporting STEM in schools and colleges in England: The role of Research" December 2011 and from the Royal Academy of Engineering "Getting Girls into Engineering: A practical Guide" 2009.

Written evidence submitted by National Skills Academy Process Industries

The UK Government's Science and Technology Committee published its report Engineering in Government on 30 April 2012 with a request for written submissions on the following matters by 18 June 2012. This response has been prepared by the National Skills Academy Process Indusries, in collaboration with the North East of England Process Industry Cluster.

1. *Does the current engineering skills base meet the needs of employers?*

Do employers in the engineering sector prefer an academic or a vocational profile?

In the current recession the vocational skills base is more than capable to meet workload demand with some estimates of 30% unemployment of the engineering construction workforce. However, if construction levels return to previous levels (eg 2007) there would be a significant shortage of resources, perhaps as high as 20%. Vocational training generally satisfies employers' needs. In recent years surveys of employers have led to changes in qualification content and the establishment of competence verification schemes. Where gaps in training provision have been identified eg planning and supervision, courses have been developed and qualifications approved by national bodies.

Currently demand for experienced graduate/chartered engineers is outstripping supply in some disciplines, eg electrical, control and chemical engineers. If capital projects increase, the skills base shortfall would be acute. The applicability of graduate courses to industrial need have been criticised by employers and should be regularly reviewed by both academic institutions and the engineering institutes. In summary graduates who are involved in employer-led graduate training schemes do generally meet the needs of employers.

Employer preference for academic or vocational profiles is dependent upon the specific job role. Some companies will opt for academic graduates as they are able to achieve chartered status more quickly. However engineers with vocational qualifications up to foundation degree level are often perceived to be more "industry ready" after qualifying. For technician/planning roles vocational qualifications are usually preferred.

2. *What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?*

The uptake of STEM (science, technology, engineering & mathematics) subjects by young people is unlikely to be affected by recent changes relating to engineering qualifications in England. Initially it is highly unlikely that the new qualifications will be sufficiently understood in the education system or in industry, to have a positive impact on recruitment to the sector. However, in the longer term and provided sufficient and positive promotion is given, there is a chance that this could produce the desired impact.

The highly successful Children Challenging Industry Programme, managed by the Chemical Industry Education Centre at the University of York is an excellent example of engaging with children at an early age, together with teaching staff, to attract more people to study STEM subjects and take up careers in industry.[36] This programme should receive direct Government support.

3. *How do approaches taken by the Devolved Administrations to produce a technically skilled workforce differ to the approach in England? What are the strengths/weakness of the different approaches?*

The problems of attracting young people to study STEM subjects is UK-wide, although a report produced for the Welsh Assembly Government in January 2011 indicated that this was significantly worse than the rest of the UK. The recent appointment of a Chief Scientific Officer to oversee STEM education in Wales could have a positive impact.

Recent publications of Economic and Skills Strategies (March 2012) for Northern Ireland focussed on the need to increase the talent pool of scientists and technologists.

In Scotland a refreshed Skills Strategy was issued in 2011, again with the intention of high-lighting the need for highly skilled people, but recent college closures and a reduction in engineering places is cause for concern.

In summary, there does not appear to be any outstanding differences in the approaches taken in any of the four nations to address these issues.

4. *Could the Government and others do more to raise the status of technical subjects?*

Without doubt there is much that the Government could do to improve the perception of science and engineering and the amazing career opportunities available. Initiatives such as reduced tuition fees at University for such training and tax incentives for employers recruiting apprentices are options for consideration.

The hugely successful Tees Valley Apprenticeship Programme (TVAP) which ran from 2010 to 2012, and assisted engineering apprentices in the region, is an example of what can be achieved.[37] Future projects of this nature should be encouraged.

[36] www.ciec.org.uk
[37] www.nsa-tvap.co.uk

5. *What more should be done to attract and retain a more diverse technically skilled workforce?*

Perception of science and engineering careers remains low, and any programmes aimed at improving this should be encouraged and where possible receive additional funding from Government. The aforementioned CIEC activity is a prime example, together with the careers advice available through Cogent Sector Skills Council.[38]

June 2012

Written evidence submitted by Prospect

Introduction

1. Prospect is a trade union representing 120,000 scientific, technical, managerial and specialist staff in the Civil Service and related bodies and major companies. Prospect is the largest union for professional engineers, with significant membership in the energy, transport and defence sectors as well as in central government. Each of these sectors is currently facing different investment and skills scenarios, though there are also some common experiences and challenges.

Does the current engineering skills base meet the needs of employers? Do employers in the engineering sector prefer an academic or vocational qualification?

2. Although anecdotal, feedback from Prospect's membership suggests that there are challenges in some—but not all—engineering sectors. This may in part be due to the focus in recent years on management and operation of facilities rather than demand for new projects. Looking ahead, there are broader concerns about the skills pipeline.

3. Our sense is that the ideal qualification profile is still a blend of academic and vocational, delivered either through graduate recruitment schemes or via apprenticeships that provide progression pathways. Both routes have come under pressure due to budgetary constraints, and we are aware that for SMEs in particular apprenticeships can appear challenging to operate. Initiatives such as the Talent Retention Solution[39] provide a useful resource, with potential for further development. New Higher Apprenticeship frameworks should also help to dilute the silo mentality between academic and vocational routes providing that they can be developed on a sustainable basis.

What impact will recent changes to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?

4. A worrying factor emerging from our enquiries is the apparent lack of awareness of recent changes, suggesting that companies may not be well-prepared to deal with the consequences.

How do the approaches taken by the Devolved Administrations to produce a technically skilled workforce differ to the current approach in England? What are the strengths/weaknesses of different approaches?

5. We would suggest that an assessment should be made of the relative strengths and weaknesses arising from the operation of multiple engineering skills bodies, locally and nationally. On one hand it could be counter-productive to constrain specialist or local activity, particularly where this meets a real need. On the other hand, the existence of overlapping organisations can make it difficult even for large companies to make best use of what is available or even to understand what is most relevant to their business. It could be helpful for a body such as Engineering UK or the appropriate Sector Skills Council to play a stronger co-ordinating role. There is also scope for the UK Government and Devolved Administrations to lead more directly through their own procurement arrangements.

Could the Government and others do more to raise the status of technical subjects?

6. More could certainly be done to raise the status of technical subjects, though it should be noted that not all technical subjects suffer in this way. There is a related issue of how and where students choose to deploy their technical knowledge, and it is the case that some employment sectors do have challenges to address regarding their image. Also, as discussed below, there are longstanding challenges relating to gender segregation and under-representation of BME communities in engineering.

7. However, we do also think that this is an area in which key individuals can have a positive influence. Much has been made of the importance of celebrity role models—the so-called Brian Cox effect. Undoubtedly high profile role models are important, but it is striking that a recent Prospect survey completed by 2,000 our female members working in science and engineering showed that 26% had been inspired in their subject choice by teachers and 17% by a relative. This underlines the need for support and information to be targeted to these groups.

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[38] www.cogent-careers.com

[39] http://www.talentretention.biz/single.htm?ipg=12275

8. Similarly trade union members and representatives can play an important role, both locally and nationally. For example, Prospect has developed a World Skills UK environmental science competition to raise awareness of and encourage the development of excellence in a range of disciplines that contribute to mitigating climate change. Many Union Learning Reps engage beyond the workplace and into their communities and UnionLearn is working to promote wider access to good quality apprenticeships.

What more could be done to attract and retain a more diverse technically skilled workforce?

9. Women's under-representation in engineering is not a recent problem but, despite some slow progress in recent years, it remains pervasive. These issues have been explored extensively elsewhere[40], but our most recent survey identifies four main reasons why women are currently leaving science and engineering:

Family reasons—The difficulties faced by women in juggling a scientific or engineering career with raising children, including the cost of childcare. Lack of progression for part-time workers is key issue.

Not happy in role or field—Our survey identified frustrations both over the professional development of work, including lack of vision/strategy and an overwhelming focus on efficiency savings, and the workplace environment—with comments like "It is exhausting working in a world of men".

Funding/redundancy—Potential or actual redundancy or outsourcing is currently a major concern in the public sector. Issues of uncertainty of funding or contract renewal figure particularly strongly in the university and wider academic sectors.

Career development—This includes women making positive choices to enter managerial roles (though this raises a broader issue of why engineers and scientists are expected to jettison their specialist expertise to achieve career advancement). Equally, it includes a sizeable group who move due to lack of career development opportunities in their professional role.

10. At the very least, these responses challenge established career progression models and suggest that prioritising action to address the loss of value from failure to effectively use the skills and potential of part-time employees would reap immediate benefits to business.

June 2012

Written evidence submitted by the Stoke-on-Trent and Staffordshire Local Enterprise Partnership

INTRODUCTION

In Summer 2010 partnerships across the country submitted bids to Government to form regional LEPs. In October 2010, Government announced that Staffordshire and Stoke on Trent's bid had been successful. This new business promotion partnership will provide a solid local focus for economic regeneration, representing local businesses in pushing for a better business deal for the area. Given the strong presence of engineering companies within Stoke-on-Trent and Staffordshire, we believe that the collective views of our local employers in relation to engineering skills have particular weight.

SUMMARY OF THE MAIN POINTS

- The engineering skills base does not currently meet the need of our employers, and more needs to be done to increase the number of people studying technical and practical subjects. The lack of technical, practical and job specific skills is a particular problem for local employers.
- Most engineering employers tend to have a workforce that includes people from both academic and vocational backgrounds.
- There is a need to improve "employability" skills (management, team working and customer handling skills) to make sure that people are in the best position possible to take advantage of employment opportunities.
- One unintended consequence of recent changes relating to engineering qualifications has been the down grading of highly relevant, vocational qualifications leading providers to replace competency based qualifications with more generalist awards which provide a less "hand-on" learning experience.
- Until Chartered Engineers are afforded the same status as Doctors, Teachers and Lawyers then the engineering profession will continue to be perceived as a "second tier" profession and will not attract the most talented and able people.
- Better information from government agencies relating to the quality of training/learning provision.

[40] For example in "Unlocking potential—perspectives on women in science, engineering and technology" Smith Institute 2011.

Recommendations

— Increase the number of people studying for vocational qualifications in practical subjects, together with the introduction and expansion in the number of University Technical Colleges. Modest funding support would be able to foster partnership work in establishing 14–16 school and FE College links on a "day release" basis which could compliment the new technical colleges by offering another way to study for those unable to obtain a place at a UTC; students could then progress to further FE study or an apprenticeship with local engineering companies.

A clear progression route from apprenticeship to becoming a qualified engineer needs to be developed and explained to students, parents, IAG staff and teachers. Apprenticeship and career pathway's information should be available and used in schools early enough to inform choices of the qualifications that need to gained for a career in engineering. This information could be developed by Sector Skills Councils/Awarding bodies or commissioned by UKCES.

Review the curriculum content of STEM subjects at levels 2 and 3 to strengthen the assessment of how knowledge is applied practically to solve "real world" problems and challenges. Schools should be encouraged to allow businesses to design and implement practical projects that link with the curriculum and help in enthusing pupils while enabling them to see the relevance of their studies. FE Colleges could help to design an engineering award scheme for schools based on the needs of local employers but development of this idea may need local development funding.

Develop Science and Mathematics teachers links with local engineering and science industries to make mainstream curriculum more relevant to manufacturing and engineering. Businesses need to be encouraged to offer "open days" or job shadowing for teachers and careers advice professionals to improve knowledge and understanding of the skills needs and the career prospects within the company and the sector.

The government should support and promote a bigger campaign to change the perception of engineering today held by parents, guardians, and teachers. A campaign that uses highly successful role models, designers and inventors especially in the world of digital technology, aerospace and automotive engineering and promotes how important people with these skills are to the country.

— Local Enterprise Partnerships and other innovative local structures (Stoke-on-Trent and Staffordshire Education Trust[41]) could involve providers in establishing local delivery partnerships when they are currently delivering poor training and learning.

QUESTIONS

1. *Does the current engineering skills base meet the needs of employers? Do employers in the engineering sector prefer an academic or a vocational profile?*

1.1 The current engineering skills base does not meet the needs of employers within Stoke-on-Trent and Staffordshire. In a recent consultation with our local employers, many of which have some requirement of engineering type skills, around two fifths of respondents stated that they had job vacancies in the previous 12 months that they had found difficult to fill due to the quality of the candidates. Over three quarters of these respondents stated that this was due to candidates lacking the skills that they look for.

43% of employers have difficulty recruiting STEM skilled staff (CBI/EDI education and skills survey 2011). Employers report that due to the changed world finance situation they are now able to get an increasing amount of work competitively but may not have the skilled staff they need to complete it. A number of companies are now re-patriating from abroad eg JV Murcott, Tamworth.

The lack of technical, practical and job specific skills presents a particular problem for Stoke-on-Trent and Staffordshire employers. Over three quarters of respondents that had hard-to-fill job vacancies in the previous 12 months stated that applicants lacked technical, practical or job specific skills.

During the recession some companies managed to fill their skills gaps from the pool of workers made redundant by companies downsizing or going out of business; this is no longer the case and employers want to see some growth in the skills base to alleviate concern that new investment like the Jaguar Land Rover plant at the i54 Business Park may cause movement of personnel creating more skill shortages.

Engineering employers tell us that they need both an academic and a vocational profile as they add the different skill sets that are required if companies are to be innovative and produce reliable products and services at a profit. Most engineering employers tend to have a workforce that includes people from both academic and vocational backgrounds.

Graduate engineers have more of a research based and computer modelling approach initially whereas vocational route engineers have a better understanding of working with materials and production processes. Companies are now valuing the vocational route more highly to help meet their current business needs. To be competitive employers need engineers that can optimise processes and the use of technology. The wide range

[41] The Regional Education Trust is a partnership of senior leaders and stakeholders representing business, the community, and the education and skills sector from across the LEP area. It is positioned within the LEP structure as the key strategic vehicle for articulating, promoting and delivering the LEP's ambitions and vision for skills in our area.

of jobs found in major employers can require very different types of skills, and therefore a particular focus on academic or vocational qualifications should be avoided.

Leek College in Staffordshire has frequent contact with local engineering companies. A common view from local employers is that they require elements of both academic and vocational skills and knowledge. A good level of mathematical understanding and confident written and verbal communication skills are often cited as qualities missing from applicants.

Vocational skills are also valued. Over the past six years students progressing from the "day release" 14–16 school link programme in mechanical engineering have progressed to college then gained sought after apprenticeships in a local world class engineering company. By the age of 17 these students have spent three years experiencing training within an industry standard engineering workshop taught by skilled practitioners with recent substantial industrial experience. By the time they progress to the apprenticeship route they are "work ready", and have experience of key engineering processes.

The importance of employability skills should also not be understated. Employers would like engineering education to contain generic skills so that employees are equipped with additional skills to the specific technical and engineering science skills. These include communication skills, problem solving, decision making, analytical skills, and customer service. These softer types of skills are what most employers deem as necessary to make somebody "work ready".

Employers need to and should be encouraged to design their own training programmes to meet their company requirements. This would help employers to articulate their training needs to the FE colleges and training providers.

A view is that FE courses are good in meeting the needs for basic and generic engineering skills but often do not meet the specific training needs of individual companies. Decisions made in the past by FE colleges to withdraw from engineering provision are now proving to be difficult and expensive to reverse.

In-company training activity is varied: half of small engineering firms do not provide any training to their employees; and engineering employees at higher levels are more likely to receive training from their employers. The main barriers perceived by employers to providing more training are cost and access. Employers may need support in developing in-house training areas.

Staffordshire has some good practice regarding improved in-house training facilities and employers taking more ownership in the design and delivery of their apprenticeship programmes eg KMF in Newcastle under Lyme operate a successful programme working in a managing agent model as alone they would not have met the Skills Funding Agency's minimum apprenticeship contract value.

Engineering in Staffordshire has many contrasts in terms of size, sector and occupation patterns. Different engineering sectors are subject to different pressures, which in turn have implications for skills. Analyses of overall trends can mask important differences. Important key skills issues for engineering at a local level will vary according to the company therefore increasing the difficulty of meeting skills needs as a one size fits all approach may not work.

While the supply of engineering qualified people has been growing, there is still a failure in attracting enough quality young people studying engineering, partly due to: a poor image, a declining interest in taking Maths and physics at "A" level, continuing low take-up by women on engineering courses, attractions of alternative options (especially studying IT), more encouragement given to young people to stay on at school than follow vocational routes which involve workplace training.

Although a number of changes have been introduced to improve engineering education more could be done to improve work placement opportunities. However, an issue identified as having a negative effect on the quality of higher education is the difficulty many universities face in recruiting young engineering staff.

This has clear implications for publicly funded education and training and for providers. However, the industry itself needs to respond—for example, by improving work placement opportunities, by improving in-company training (particularly in small firms) and by continuing to work on improving the attractiveness of the industry.

Better information is needed from government agencies relating to the quality of training/learning provision can have a lag of 12 months plus, therefore up to date information regarding poor quality provision is not available.

2. *What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?*

The wholesale "downgrading" of the value of vocational qualifications addresses the issue of schools manipulating their league table standing through "enriching" the curriculum with vocational qualifications of dubious merit. However, one unintended consequence has been the down grading of highly relevant, vocational qualifications leading providers to replace competency based qualifications with more generalist awards which provide a less "hand-on" learning experience. Colleges changing highly successful level 1 Performing

Engineering Operations Qualification for Edexcel Diplomas, which has more classroom based learning, is proving to be less engaging for the 14–16 age group.

A number of UTCs (JCB Academy) had based their curriculum around delivering the engineering diploma and a number of other schools were teaching the BTEC first certificate and diploma; for some this will not be the case from September 2012 and they will not be replacing them with other specific engineering based courses.

In order for schools to continue to support students the particular tarif for any particular qualification is paramount especially now that schools must use their own core funding to pay the College for delivery.

Some aspects of the English Baccalaureate will be welcomed by engineering employers, particularly the emphasis upon raising the standard of Mathematics English and Science. Confidence in these subjects is fundamental and underpins the successful acquisition of engineering skills.

Schools are also offering triple science and the English Baccalaureate which has the effect of reducing the ability to offer more subjects to give breadth of experience. Increasing the numbers taking triple science appears to be a positive move, allowing pupils to experience physics and chemistry in more depth but students do not then get the opportunity to see how science is applied. This is one reason for the current lack of STEM skilled people at the right level for employers.

Another aspect for work in STEM industries is the extent core subjects such as Maths and Science GCSE and 'A' Level encourage students to develop an understanding of how the theoretical knowledge gained is applied within industry.

Funding through the Learning and Skills Improvement Service (LSIS) can help develop innovative partnerships. In 2010–11 the Engineering Change in Staffordshire Moorlands project, which in 2010–11 brought schools, Staffordshire University, Leek College and local engineering employers together to raise awareness of engineering as a career route.

The relationship between the implementation of the QCF and changes to the funding methodology is an issue. QCF introduced greater flexibility and opportunities to customise provision more closely to employer needs. However, this flexibility is constrained by what appears to be arbitrary funding values being assigned to qualifications eg the level 2 Performing Engineering Operations guided learning hours reduced from 2011–12 from 540 to 214. Flexibility has not increased through picking and mixing units within a single qualification. A situation now exists where a range of qualifications are delivered to cover all the competencies required by employers. Changes have become a driver for curriculum design not employer or individual need. Flexibilities offered within the new UKCES "Employer Ownership of Skills" pilots should be extended.

3. *How do the approaches taken by the Devolved Administrations to produce a technically skilled workforce differ to the current approach in England? What are the strengths/weakness of the different approaches?*

3.1 We are not aware of how different approaches taken by the Devolved Administrations have necessarily been more effective, and we would suspect that similar systemic challenges are faced across the UK.

4. *Could the Government and others do more to raise the status of technical subjects?*

43% of employers have difficulty recruiting STEM skilled staff (CBI/EDI education and skills survey 2011). Employers report that due to the changed world finance situation they are now able to get an increasing amount of work competitively but may not have the skilled staff they need to complete it. A number of companies are now re-patriating from abroad eg JV Murcott, Tamworth.

Vocational education has often suffered from being viewed unfavorably and any reforms should not exacerbate the vocational/academic divide.

Some employers would like to see schools encouraging more students to follow engineering vocational routes, after completion of Maths and Science academic qualifications, which would involve workplace training. This should be viewed by students and parents as high status learning with clear routes to higher education, high earnings and good job prospects.

A clear progression route from apprenticeship to becoming a qualified engineer needs to be developed and explained to young people, parents, IAG staff and teachers.

IAG advisers sometimes hold a stereotypical view that if you are not academically bright you can become an engineer. Support and encouragement should be given to employers to encourage more working with schools in setting projects that relate to their business and give a real insight to the company or the sector.

More specific action should be taken to encourage and incentivise young people to follow a Science route at School, College and University with capital grant money targeted to create STEM Centres of Excellence at a district level co-designed by educationalists and local employers. The current position of Design & Technology and the National curriculum review needs to be made clearer. Leading engineers such as James Dyson and Sir Jonathan Ive (a Staffordshire pupil for a number of years) support the place of Design & Technology but it is recognised that the subject does need to change.

Young people may not have an accurate understanding of employment and career progression in Engineering and High Value Manufacturing. Statistics show people earn some of the best salaries in engineering and manufacturing compared to many other degree study areas. Starting salaries are 16% higher than average, research by BIS shows that the undergraduate premium for someone with two "A" levels is 33% higher if they study engineering. The problem is how many GCSE and "A" level students know that and more importantly the staff giving them independent careers advice and guidance?

5. *What more should be done to attract and retain a more diverse technically skilled workforce?*

We are concerned that engineering is not always promoted as a worthwhile, challenging and exciting career option, and advocate that it feature more prominently in the provision of careers advice at schools. Worryingly, a recent report by Engineering UK found that 21% of teachers would not recommend engineering as a suitable career to their students.

Until Chartered Engineers are afforded the same status as Doctors, Teachers and Lawyers then the engineering profession will continue to be perceived as a "second tier" profession and will not attract and retain the most talented and able people to remain globally competitive as a nation.

It remains important to challenge stereotypes and encourage more females and ethnic minorities into the sector; employers believe that this needs to be done at an early stage.

June 2012

Written evidence submitted by Cogent Sector Skills Council

Cogent is the Sector Skills Council for the Process, Nuclear and Life Science Industries. We have contributed to several previous Government and Parliamentary calls for evidence and ideas on STEM skills. We are an employer led body licensed by Government to ensure that employers and employees in the science-based industries have the skills needed to operate safely, effectively and competitively in a global market.

1. *Does the current engineering skills base meet the needs of employers? Do employers in the engineering sector prefer an academic or a vocational profile?*

1.1 Background: In the Cogent science-based sector (process, nuclear and life sciences), 74% of employers report that Professional Scientists and Engineer positions were hard to fill (Cogent Oracle research 2011). The main reasons employers cited for hard to fill vacancies were lack of suitable work experience to meet company requirements and few applicants with the required skills. Employers report that graduates tend to need upskilling in leadership and management skills, industry awareness and problem solving and similar behavioural skills.

1.2 Employer feed-back shows core engineering skills can only be effectively delivered with a combination of academic and vocational learning. Theory underpinned by practical hands-on experience is preferred. Some employers report they struggle to find good engineers and have to pay premium salaries to retain them.

1.3 Many employers are still not aware of the apprenticeship and qualifications options available. But more employers in the engineering sector are showing interest in vocational routes and developing employees *within* a business rather than taking on graduates with little work or people experience. Employers who would once never entertain the idea are now considering the Apprenticeship route for engineering vacancies and contacting Cogent's Technical Apprenticeship Service (TAS) for advice and to place apprentices.

1.4 Cogent has worked with the nuclear industry to determine the practical and employability skills required for the UK's new nuclear build programme. Using Cogent as a conduit we have networked employers with providers (universities and FE colleges) in the delivery of the Nuclear Island programme. This has also increased engagement between engineering disciplines and academics and increased collaboration through nationwide delivery of a well-established programme.

The engineering sector now recognises and value this program which has attracted significant media interest and substantial employer funding.

2. *What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base need by the engineering sector?*

2.1 Over recent years Cogent has worked with The Royal Academy of Engineering (RAE) on a number of programmes dedicated to understanding the existing qualifications in the FE STEM sector, the English Baccalaureat and the Diploma in Engineering. Our activity with employers is in full alignment with the recommendation that the RAE has put forward.

Cogent also works with the Engineering Council Gateway to the Professions programme and the Technicians Council to look at widening participation in the engineering field.

2.2 Other factors affecting uptake may come from increased HE fees and the high profile promotion of non-graduate routes. Whilst we are seeing more interest from some employers in recruiting apprentices, in the majority of cases, employers requiring high level skills prefer graduates from particular Universities and particular courses. As a consequence many engineering companies across the sector engage with university industry advisory boards to ensure that those student have the complete portfolio of practical and employability skills required. Professionalism is embedded onto the courses.

3. *How do approaches taken by the Devolved Administrations to produce a technically skilled workforce differ to the approach in England? What are the strengths/weaknesses of the different approaches?*

3.1 Different funding mechanisms to support skills development exist across the Devolved Administrations with some being UK wide, some England only. Some of this linked to the different educational systems in each nation.

Cogent has been fortunate to have been supported by DA project funding (mainly in Wales and Northern Ireland) focusing on specific technical issues.

3.2 The UK Commission for Employment and Skills (UKCES), has been extremely supportive and selective in its backing of science/manufacturing skills development programmes, with an emphasis on encouraging employment co-investment in technical workforce development.

Sector Skills Councils such as Cogent have successfully made the case for developing better and more accessible information about STEM career and training options, and on continuous professional development for employees and benchmarking to industry designed standards- such as the Cogent Gold Standard.

3.3 The strength of the UKCES approach is that it is *employers*—with their Sector Skills Council—who are leading the approach to identifying problem areas and skills development solutions. Cogent SSC's employer board members have been instrumental in creating our STEM skills project bids into EIF and GIF funds, and in the oversight and governance of projects.

3.4 However, we often hear that what is lacking is a coherent, UK wide careers information and education system. Web-based information is therefore important for UK-wide access.

4. *Could the Government and others do more to raise the status of technical subjects?*

4.1 Our nationwide survey of employers (2005) and of young people 14–16 at regional careers and skills events (up to 2010) showed students had low awareness *of* and interest *in* technical career opportunities. This was compounded by low industry knowledge by teachers and careers advisers. That was the motivation for Cogent's online career website (www.cogent-careers .com) which is being revised in 2012 to provide a more user-centred career progression and training/qualification information service.

4.2 The huge investment in apprenticeship promotion by the previous and current administrations is increasing awareness and interest in non-graduate route STEM careers. Interest in professional technical occupations from students with strong STEM A levels and equivalents appears to remain strong, but more will need to be done to make widening access to these professions more than just an ambition. Cogent has been working with the Engineering Council to widen participation through the Gateway to the Professions programme, and we are pleased to say that employers are utilising this route.

4.3 Some employers and advisers suggest that the development of new technical qualifications needs to be informed by skills requirements from industry to ensure a competitive engineering sector can be created. Core skills such as hand-based engineering are being lost through retirement and the skills to deliver engineering training are being lost

4.4 Other suggestions include incentives for schools and colleges to raise the knowledge and understanding of technical subjects and how these are going to effect and link with the future growth of the economy. Some employers are eager to have closer links to schools, and some already operate work experience and favour local recruitment. For the process, nuclear and pharmaceuticals industries Cogent's Skills Oracle (2011) showed 50% of skilled people being recruited locally, 31% regionally, 14 nationally and 5% internationally.

5. *What more should be done to attract and retain a more diverse technically skilled workforce?*

5.1 Cogent believes it is essential to work with employers and stakeholders to understand the specific technical needs of the industries and delivering pathways to the professions.

Cogent is working with the Nuclear Island programme at *all* vocational *and* academic levels to embed the right skills across the industry.

It is essential that those people providing advice in schools and job centres have sufficient knowledge about the breadth of technical opportunities, and access to recent case studies of role models that challenge conventional industry gender and ethnicity stereotypes.

Parents are still key influencers and any information campaigns need to target them as well as young people.

5.2 To ensure wider access to technical and professional roles, communication and advertising needs to address a diverse audience and not perpetuate the status quo.

Women only or girls only open days are very effective in recruitment campaigns and need to be encouraged and supported. Women in Leadership programmes are effective for retention—within individual companies or through a network of senior women across a number of organisations. Mentoring and schemes work well at entry level and apprenticeships.

Organisational "workplace champions" are effective in driving things forward. Diversity traditionally sits with HR in larger companie but experience shows they are not necessarily the most passionate people in the organisation.

5.3 The collection and monitoring (and sharing) of recruitment and employment data is essential to identify trend. For example, there may be a particular test in the recruitment process that females fail in bigger numbers than males. Or retention may be an issue in a certain department for a particular minority group.

5.4 Cogent's new web-based career and training pathways and our apprenticeship frameworks are part a wider move to help establish effective mechanisms to engage school leavers in technical and engineering careers. Students and their advisers need to understand employer expectations and what the planned or existing qualifications can lead to, as well as other personal attributes and behaviours. Where employers and professional bodies have close links to schools, colleges and HEIs the transition from theory to the workplace is more successful and sustainable.

June 2012

Written evidence submitted by Bentley Motors Ltd

1. Background Information—Bentley Motors

1.1 Bentley Motors is one of the world's leading producers of high luxury vehicles. Designed, engineered and manufactured in Crewe, England and exported directly to over 50 markets globally, Bentley cars are amongst the desirable in the world, a symbol of British manufacturing excellence and synonymous with luxury, craftsmanship, quality and engineering excellence.

1.2 Crewe is home to ALL operations. This includes styling, engineering, production (assembly, wood and leather production, engine manufacture), quality, sales and marketing, finance, personnel etc. Bentley employs around 4,000 people in Crewe with a further 15,000 jobs in service and supply areas as well as local businesses dependent on our success and continued levels of employment.

1.3 Bentley is the third largest investor in R&D in the UK automotive sector and in the top 20 of all companies investing in R&D in the UK (Department for Business scorecard 2011). Given the nature of our product and the commitment we have to engineering, we employ over 900 qualified engineers and have a further 500 or so employees directly involved in engineering-related work.

1.4 Since 1998, Bentley has been part of the Volkswagen Group and the investment and capital provided by Volkswagen has been transformational. Over the decade to 2008, Volkswagen invested over £1 billion in the site in Crewe, upgrading facilities and bringing forward new products. This investment helps maintain one of the most highly skilled automotive workforces in the country and expand the range such that we now exports around 80% of what we produce, contributing nearly £1 billion to the UK's balance of trade every year.

2. Bentley And Engineering Skills Development

2.1 Bentley has always been strongly committed to skills development and apprenticeships and actively promotes careers in the automotive industry. We believe the apprentice system as a way of encouraging young people into the business and developing specific skills through on-the-job training. Bentley also offers adult apprenticeship programmes, available to existing employees seeking to develop their skill set further and progress within the Company. At any given time, approximately 100 apprentices are employed in Crewe.

2.2 In addition, there are always 40 or more graduate trainees participating in a two-year programme and Bentley welcomes around 90 industrial/summer placements and internships each year alongside 150 work experience places.

2.3 Apprentices are seen as future experts. The wood shop apprentice will be a veneer specialist when fully qualified, and will help source the veneers used in our cars from around the world. We also have apprentices in the styling studio, engineering, electrical engineering, press & special, acoustics, quality, trim development, sales & marketing events and public relations, to name a few.

2.4 The company's commitment to apprenticeships has been widely recognised and rewarded. In 2011 Bentley was named Apprentice Employer of the Year for the North West and finished in the top five places at a national level. Furthermore, the individual success of the apprentices is significant. One of our female apprentices won the Total People Advanced Apprentice of the Year Award and received in December 2010 the

Mary George Memorial Prize for Apprentices 2010 awarded by the Institute of Engineering and Technology (IET) honouring the best female apprentice engineers working in the UK today.

3 Terms of Reference

Does the current engineering skills base meet the needs of employers? Do employers in the engineering sector prefer an academic or a vocational profile?

3.1 There needs to be a balanced approach. From an apprentice perspective, vocational skills are more relevant to our needs. As we require each individual to undertake a practical approach underpinned with theoretical knowledge. This follows with our graduate intake where we look for theoretical engineering skills but with complimentary practical skills.

3.2 Bentley, like other automotive manufacturers, finds it very difficult to recruit in some specific engineering disciplines, particularly (but not exclusively) Electrical/Electronic where there is a real shortage of graduate and experienced engineers. The quality of applicants is frequently poor. We find many graduates lacked a basic understanding of electronic fundamentals. For instance, a simple test we use for all applicants is to draw and explain a very simple transistor switch circuit. The pass rate at this elementary test is generally only 50%. Given the fundamental nature of the test this is a poor reflection of the output of academic institutions.

3.3 Vocational qualifications can offer a clear route to meet these needs as the practical experience is an essential part of an engineer's acumen. With a very competitive job market, we are becoming ever more reliant on "growing our own"; some of our best Engineers have come through the vocational Apprentice route first, picking up the academic later—this model works well and should be encouraged.

3.4 The increased take-up of more specific Automotive Engineering degrees helps, however their emphasis tends to be more mechanical and powertrain/chassis focussed rather than broader skills such as electrical. Added to this is the fact that, in our experience, graduates have often been guided towards favouring project management—or business skills—over technical skills. These abilities are important aspects of engineering but they are of little or no value if individuals cannot engineer a marketable product

What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?

3.5 There is a danger that technical subjects such as design and technology will no longer be taught due to the baccalaureate. This will mean that individuals will have a more generic base of knowledge but no specific skill set. For engineering apprenticeships we recognise that those who have taken practical, technical skills are far more competent in the craft skills we require.

3.6 UTC's specialising in technical and engineering subjects could provide us with the skill set we need, however UTC's which deliver diplomas may find less uptake if the decision is made to downgrade diplomas to be equivalent to one GCSE rather than four.

3.7 Furthermore, the downgrading of the relative importance of qualifications like the Engineering Diploma and BTEC goes entirely against the required trend, and could certainly harm the recent (slow) trend towards greater uptake of STEM subjects in schools.

3.8 On a more fundamental level, however, the subjects taught at secondary schools within the curriculum do not necessarily inspire children to careers in engineering. In many instances, the content has not changed significantly in a generation. Business and industry—and therefore society in general—needs more engineers and it is school children—from primary school onwards that must be attracted into this career from an early age. Technical subject teaching does not currently do this as it is too removed from the engineering work typically found in today's advanced manufacturing workplaces.

How do the approaches taken by the Devolved Administrations to produce a technically skilled workforce differ to the current approach in England? What are the strengths/weakness of the different approaches?

3.9 We do not see any specific differences in output as a result of the different approaches taken by the devolved administrations although it must be said that Wales does seem to be able to access/secure more funding for training particularly around apprenticeship training. Their Alliance sector skills model seems to be the strong driving force behind the skills agenda which seems to be more straightforward to understand than the models available in England.

3.10 A broader point about nationality is that we are seeing reduced number of applications for engineering vacancies from British nationals. We receive increasing numbers of high quality applications from Indian and Chinese nationals—often trained in the best UK Universities.

Could the Government and others do more to raise the status of technical subjects?

3.11 The Government can and should do more to raise the status of technical subjects. The shift in emphasis towards the service industry at the expense of manufacturing in the UK in recent years has led to a decline in the numbers of those considering engineering and manufacturing as a career. Many employers—including

Bentley—try to address this with a variety of outreach programmes designed to encourage younger children into considering a career in engineering and manufacturing.

3.12 However, the Government needs to do more to address this problem; to increase the uptake up of STEM subjects in schools and Engineering subjects at University. Many young people still think an "Engineer" is the technician who comes to fix their washing machine, and the rich heritage in the field in the UK is occasionally celebrated, but in truth largely forgotten. The Government therefore needs to raise the profile of Engineering as a worthwhile occupation first, and clearly distinguish it from the more vocational (although clearly no less vital) Technician career route.

3.13 The industry itself could do more. Despite the best efforts of the various professional institutions (IMechE, IET, etc), engineering does not have the profile in this country that it enjoys in Europe, particularly Germany where engineers are regarded as highly as solicitors and doctors are in the UK. Indeed many engineers go on to achieve the highest positions in Companies, positions that tend to be the preserve of finance of management experts in the UK

3.14 Furthermore, the industry must address the leakage of engineering graduates to other sectors especially banking. The high initial salaries offered and potential future remuneration is undoubtedly attractive but Government and industry should work together to promote engineering careers as fulfilling options which offer long term career paths.

3.15 On a more insular note, there are a multitude of professional institutions which represent "engineering". IMechE, IET, IEE etc all do much to promote their discipline and membership. However, the very fact that there are a multitude of organisations is a weakness. The Committee and the Government would do well to encourage a more joined up approach such that the voice of engineering was louder and clearer.

3.16 By working closely with employers to understand their needs, the Government can ensure we maintain an engineering and manufacturing presence in the UK. Universities have seen smaller class sizes in certain engineering subjects eg electrical so more needs to be done to make these subjects appealing to students. The National Careers Service needs to promote technical skills at school level to ensure young people are aware of the choices and careers open to them

What more should be done to attract and retain a more diverse technically skilled workforce?

3.17 More visibility of careers and progression routes available to students considering undertaking technical subjects should be a priority. In addition, more support for businesses offering apprenticeships and graduate opportunities in technical areas would benefit the employment opportunities for budding engineers. This means financial support for *all* businesses, to encourage growth, not just SME's or businesses taking on their first trainee eg Youth contract funding.

3.18 Universities and Government should also work to develop improved degree courses that focus more on the advanced electronic technologies, while still retaining the more traditional "mechanical" ones. The government could also help by facilitating/encouraging sandwich courses or year-out placements in industry during the engineering degree course.

3.19 The "See Inside Manufacturing" initiative—an idea generated by industry and Government to raise awareness of engineering and manufacturing careers has been successful. A number of automotive manufacturers "opened their doors" to students and careers advisors so that they could see some of the skills and work environments typical of modern manufacturing. Such experiences for young people are essential if the UK is to attract and develop the best and brightest into careers in engineering.

June 2012

Written evidence submitted by E4E—Education for Engineering

Does the current engineering skills base meet the needs of employers?

1. This is a challenging question as engineering skills are highly valued across many sectors, not just those directly or indirectly involved in engineering. They also exist across many qualifications levels so the picture is complex.

2. The Technician Council reports a shortage of 450,000 level 3+ technicians by 2020[42] while the Royal Academy of Engineering in its recent analysis[43] estimates that 820,000 *SET professionals* will be required by 2020 with 80% of these required in engineering.

3. The engineering community has worked hard to better understand the potential supply of and demand for labour for engineering and technology roles. However, we are hampered by lack of disaggregation of engineering from "SET" in high-level SOC category estimates of demand and, in estimating supply, there is a

[42] *Professional Technician: The Future.* Technician Council 2012.

[43] The Royal Academy of Engineering analysis used a combination of UKCES predictions for 2010–2020 (UKCES Working Futures 2010–2020) and LFS occupational population data for 2009. This estimate is based on a 7:1 ratio of replacement demand to expansion demand.

lack of interconnectedness of datasets from schools through FE to HE and on, at all phases, to the workplace. There is a particular need to improve the collection of data on employment by discipline and degree class following higher education. Current data gives scant information on which to base policy. We would urge the Committee to examine the case for matching datasets of learners throughout the education and training system and for improving data collection of employment of graduates.

4. At Appendix 1, we provide a snapshot of data on engineering-related qualification achievements in England.

5. Supply and demand is discussed in Section 5 of the recently published report *Science, Engineering and Technology (SET) Technicians in the UK Economy.*[44] This study throws light on a range of important data and issues, not least that "level of certification" and "skills" and "occupations" cannot be simplistically aligned. For example, in some SET skilled trades (technician roles) the graduate share of jobs is now as high as 15%—and 27% in some associate professional roles[45] (also technician roles). This may or not reflect requirement of the jobs and may be building up problems as full-time engineering undergraduates are not trained to be productive in these employer-specific practical and commercial roles.[46]

6. Regarding the current situation (SET technicians), Mason (2012:33) comments:

> "There are currently just over 1.5 million SET (science, engineering and technology) technicians in employment in the UK, about 30% of whom are in associate professional occupations while 70% are in skilled trades occupations. In 2010 almost three quarters (73%) of SET technicians were employed in SET production, construction and service sectors with a further 17% in non-SET private sector activities and 10% in the public sector. A key characteristic of the SET technician workforce is that it is ageing fast, with as many as 31% of SET skilled trades workers and 23% of SET associate professionals aged 50 or older in 2010."

7. From January 2012 the Talent Retention Solution (TRS) became entirely industry funded[47]. TTRS continues to support skills and jobs retention in the Advanced Manufacturing and Engineering (AME) sector through proactive redeployment of people "at risk" of redundancy into other skilled jobs. Through this approach the intention is to provide a UK wide platform to maintain and enhance the AME skills-base across the UK. Initiatives like this are welcome.

Do employers in the engineering sector prefer an academic or a vocational profile?

8. The distinction between academic and vocational is not useful and we are concerned that undue focus on this is a distraction. The concern should be with whether a qualification and experience profile is fit for purpose.

9. Engineering employers require a broad range of skills, from technician level roles (QCF level 3) to post-doctoral specialism (QCF level 8).

10. Employers want *competent* engineers and technicians. In the UK engineers and engineering and ICT technicians cannot be registered until they have *sufficient working experience* to demonstrate competence. Competence is developed through doing the job, underpinned by theory ("academic" or "vocational" learning though not necessarily certificated). It is this *integrated* learning which develops competence.

11. To become registered as Chartered Engineer, Incorporated Engineer, Engineering Technician or ICT Technician the applicant has to demonstrate *competence* at or above a threshold level defined by the UK Standard for Professional Engineering Competence (UK-SPEC). Registrants must also commit to continual professional development. The Engineering Council Registrant Survey 2010 indicates that 57% of registrants have their subscription and registration fees paid by their employer.[48] It could therefore be inferred that at least 57% of employers value competent engineers very highly. This has, however, a hierarchical skew in that Chartered Engineers are more likely to have their fees paid (61%) than Incorporated Engineers (51%) and Engineering Technicians (43%)—and Technicians often earn least.

12. Paths taken to professional engineering include:

- Work-located training—eg Advanced Apprenticeships—an *integrated* vocational and work-located learning path.
- FE college-based vocational education/training—vocational learning path—which may be classroom based learning only—plus working experience.
- University-based education—general or "academic" path—which may include a "sandwich" working placement—plus working experience.
- Non-formal and Informal learning;.
- A combination of the above over a working lifetime.

[44] Mason, G. (2012). *Science, Engineering and Technology Technicians in the UK Economy.* London: Gatsby Charitable Trust.
[45] Ibid.
[46] *Ibid.*
[47] TRS was started by BIS in 2011. It comprises a governing council known as the Skills and Jobs Retention Group and strategic operating board of senior employers from sponsor companies: Rolls-Royce, Siemens, Airbus, NISSAN, EDF Energy, Shell and BAE Systems.
[48] 2010 Survey of Registered Engineers—http://www.engc.org.uk/about-us/publications

13. Alongside there are also integrated opportunities such as the flexible work-based route to professional qualification, *Engineering Gateways.*[49]

14. Periodically, the Engineering Council surveys employers to ascertain if UK-SPEC remains in line with employers' needs. The most recent survey in 2007 involved 830 employers. These employers were selected as representative across engineering sectors, size and so forth from 8,755 firms in the filter phase. The report concludes:[50]

> "5.1 The most valuable finding from this study was that UK-SPEC largely reflected employer competence needs, the additional competences identified as desirable being mentioned by only small percentages of employers (the highest being 7% for IT skills).
>
> 5.2 Organisations with registered staff tended to require higher standards than those without registered staff at the same level, suggesting that the presence of registrants "raises the bar" in terms of valuing areas of competence. This was particularly true at Engineering Technician level."

15. The Royal Academy of Engineering has undertaken a number of major studies into how best to prepare engineering undergraduates for industry. The reports[51,52] highlight the importance of providing students with real-life problems to solve and to develop greater links with industry for the teaching of engineering at university. Initiatives such as the Academy's Visiting Professors scheme where industrialists lecture to students at university and explain current practice and the challenges being faced by engineering companies have been shown to add real value to undergraduate provision.

What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?

16. E4E members (Appendix B) have been consistent in not encouraging pre-16 pupils to specialise. A broad and balanced general education is necessary for the formation of engineers and technicians. E4E puts emphasis on the importance of mathematics and on making learning links across technical subjects—mathematics, sciences, D&T and computing. Art & design, the humanities and performing arts and languages are also important formative components for many engineering disciplines.

17. E4E welcomed much of Professor Wolf's report, particularly as it considered 14–19 as a raised-participation-age phase where the vast majority would be expected to achieve mathematics at QCF Level 2 by the age of 19. This would open the door to Advanced Apprenticeship entry (in engineering, construction, IT etc.) for many more individuals. Progression in engineering is highly unlikely without a reasonable level of mathematical ability.

18. E4E supports the shift towards seeing 14–19 as a phase and post-16 as a more appropriate point for young people to take up full time vocational courses, combine general and vocational learning or to start out on an Intermediate-Level or Advanced/Modern Apprenticeship in employment.

19. The Government's implementation of Prof Wolf's recommendations has contributed to demise of the 14–19 Diploma as a "programme". However, we welcome John Hayes MP taking a lead in addressing the future of the Principal Learning component. On behalf of Baker-Dearing Trust, the RAEng and UTC representatives are now examining how to split the single Principal Learning qualification into smaller qualifications, each with a size value similar to one GCSE.[53]

20. The recent changes to engineering qualifications are not a new or surprising phenomenon. However, our concern is that qualifications continue to be changed without due regard for lessons learned from evaluation of the past and often without piloting of new qualifications. Tracing the detail of some engineering qualifications even from the pre-2000 is nigh impossible (the Register of Regulated Qualifications only goes back to around 2002 and the AFO Archive to only relatively recent frameworks).

21. Qualification development and regular revision is however important if we are to keep pace with what might be valuable learning for the individual, employers and the economy. The QCF is very helpful in this respect because it enables unit revision, deletion or addition without necessarily changing the overall integrity or title of a qualification. QCF ensures titles and purpose categories are consistent and are more likely to describe what is in the qualification.

22. E4E welcomes the introduction of University Technical Colleges (UTCs). They can act as a means of demonstrating deep employer engagement—important for an authentic engineering experience. If a high quality experience of technical areas is provided in UTCs then this will be a good outcome for future engineering skills supply as well as for other progression paths.

23. The revised and more transparent FE post 19 funding system (England) may help to encourage learners to strive to reach QCF Level 3 by age 24. New post-16 qualification suites are appearing in the market and

[49] Engineering Gateways—www.engineeringgateways.co.uk
[50] UK-SPEC Baseline Project 2007. Engineering Council http://www.engc.org.uk/about-us/publications
[51] *Educating Engineers for the 21st Century.* The Royal Academy of Engineering. www.raeng.org.uk
[52] *Engineering Graduates for Industry.* The Royal Academy of Engineering. www.raeng.org.uk
[53] The Royal Academy of Engineering is working with EDGE Foundation and the Baker Dearing Trust.

parental and learner appreciation that there are traditional and well-respected alternative roads to higher level learning and skills in engineering appears to be regaining traction.

24. The BTEC suites are regularly reviewed by Pearson/Edexcel with stakeholder consultations which include professional bodies and we are usually happy with how they operate. BTECs have represented a degree of continuity—ONC (now in the form of BTEC Level 3 (QCF)) has been around since 1921. The qualifications are well understood by employers in our sectors and evolve over time and in response to changing skills needs.

25. However, we are very concerned about reports that the revised "Next Generation" BTEC at Level 3 will be an NQF, not QCF, model—designed for schools, more like an A level—no credit, and not occupationally-grounded. Currently, BTEC Level 3 (QCF) is the only stand-alone qualification exemplified in the Engineering Technician section of UK-SPEC. It is also the qualification most usually used by the Engineering Council to exemplify meeting the qualification requirement of the Dublin Accord[54] (Technician level mobility). The European Credit Transfer System for Vocational Education and Training (ECVET) requires a credit system (as does the SCQF).

26. The BTEC Level 3 (QCF) is also a component of many SASE/W compliant Advanced Apprenticeship frameworks in the engineering and construction & built environment sectors.

27. The potential loss of the BTEC Level 3 (*QCF*) qualification may therefore have a range of undesirable impacts.

28. We also have concern about the impact of the English Baccalaureate on general technical qualifications. The introduction of the E-Bac has caused many schools to reduce subject options for pupils and the Design and Technology Association reports that schools are cutting back on D&T provision. We are pleased that DfE have proposed that D&T should remain a requirement in the Primary curriculum, but it must also remain a requirement at Secondary phase. D&T is the most popular non-compulsory GCSE with some 250,000 entries in 2011 although we expect the introduction of the E-Bac to significantly affect entries in 2012.

29. Yet D&T is an important subject at A level for engineering. UCAS data[55] shows that the engineering subject group[56] was the second most popular destination for pupils with D&T A levels, accounting for 15% of the total of applicants with D&T A level—Creative Arts and Design[57] being the highest with 25% of the total. D&T has been identified by Russell Group universities as a "useful" A level and around a quarter of students accepted onto engineering degree courses in the UK had an A level in D&T. This was across universities from all mission groups. In some subjects it was significantly higher, eg 74% of students accepted onto Production and Manufacturing Engineering degree programmes had D&T A level.

30. E4E welcomed the Education Secretary's announcement to disapply the ICT curriculum from September 2012 as it may have been discouraging pupils from progressing in computing. We welcome also that ICT will remain in the national curriculum for all key stages with new statutory Programmes of Study.[58] We support the work of the Computing at School group and their curriculum for Computer Science at school. BCS, the Chartered Institute for IT (an E4E member) has been pressing the case with government to include Computer Science as a fourth science GCSE in the E-Bac. Enabling subjects such as D&T also help to broaden the scope of computing in schools through D&T systems and control and electronics. It is in D&T that pupils can most readily develop real-life applications and embed computing into products and systems.

Could the Government and others do more to raise the status of technical subjects?

31. The Government has an ambition for growth which rebalances the economy in favour of productive industries. All government policy should be supportive of that ambition.

32. We support the Technician Council and the establishment of the new Registered Technician register for Science. We ask government continue to promote the value of professional registration.

Schools

33. The Education Secretary should make public his support for high-quality technical education in schools, in the way he did for Music. His announcement should include D&T, ICT with emphasis on Computer Science and engineering-related qualifications valued and respected by employers which lead to progression to further learning and employment.

34. Engineering suffers from a lack of visibility in the classroom. Better careers guidance would help in this regard. Schools' duty to provide careers IAG for young people should be extended to year 8 and to post-16 provision. We will watch with interest the development of the National Careers Service and welcome the newly

[54] Dublin Accord—http://www.washingtonaccord.org/dublin/.
[55] Data extracted from 2010 UCAS Applications.
[56] Engineering subject group—Joint Admissions Coding System (JACS) code H.
[57] Creative Arts and Design—Joint Admissions Coding System (JACS) code W.
[58] Summary of Results for consultation on Regulations for removing the duty on maintained schools to follow the Information and communication technology (ICT) National Curriculum Programmes of Study, Attainment Targets and statutory assessment arrangements http://www.education.gov.uk/consultations/

formed National Council for Careers. We ask that government view STEM careers initiatives like the Big Bang as a key contribution to building skills for growth rather than "marketing".

Post 16 Education

35. There has been significant improvement in FE in the last few years. Increases in high-quality Apprenticeships across all sectors are welcome, as is the intervention of John Hayes MP to ensure all Apprenticeships are minimum 12-month duration.

36. Some major engineering employers have suggested to us that Apprenticeship funding should go directly to the work-based trainers (employers, GTAs etc).

37. To incentivise technician supply, the FE sector funding revisions will need to ensure there is sufficient weighting given to "strategically important" yet high-cost technician training. A much higher cost is associated with training in engineering, construction & built environment Apprenticeships, over and above other Apprenticeships. Attracting expert training staff and the cost and maintenance of up-to-date equipment/ materials—as well as the longer training periods usually involved—can be very high.

38. We are concerned that post-16 funding and the Academy-conversion process encourages schools to set up sixth forms, which will primarily focus on delivering classroom-based subjects, and that this is already affecting FE vocational qualification enrolments. We have also noticed a marked decline in part-time achievements at level 3[59] and would welcome more discipline specific information. Experience tells us that once workshops and plant are lost, they do not reappear.

39. We are unsure how the revised FE sector funding/loans arrangements (post age-24) will impact. While it is clear that employers and individuals should contribute beyond the level 2 threshold, it currently seems that if a learner were required to fund a VRQ plus NVQ programme themselves, the cost to them could be around £21,000.[60] Given the much lower lifetime returns to individuals from vocational/occupational qualifications we suspect that individuals might feel more incentivised to take an HE route thus depleting the technician pool further.

Higher Education

40. We remain concerned about the future of engineering higher education in the wake of funding reforms. The best graduates are those who have *authentic* experience-led learning programmes and employer engagement. These programmes require significant additional resources.

41. We are also concerned that the new fees regime will discourage students from undertaking Integrated Master's Degree programmes because of the cost of the extra year of study and attendant cost of living.

42. We are concerned that Home Office policy on non-EU immigration may be discouraging many overseas students from applying to UK universities.

What more should be done to attract and retain a more diverse technically skilled workforce?

43. This is a hugely important issue and is worthy of an inquiry by the Committee in its own right. We feel unable to do justice to this issue here but highlight some key points:

44. Analysis of sciences and mathematics subjects at KS4 in England shows that a higher proportion of females achieve A*-C grades in at least two science GCSEs and in mathematics GCSE compared with males. Yet, only around 20% of the cohort for physics A level are female. At Higher Education, the proportion of women in engineering subjects falls to around 12%. The issue therefore appears to be one of interest rather than ability.

45. There is considerable variation in participation and attainment in sciences and mathematics at KS4 across different ethnic groups. For example, there is under-representation of Black pupils in high-attaining maths/ science cohorts at GCSE while there is substantial over-representation of Chinese/Asian pupils in high-attaining science and maths cohorts at GCSE.

46. Our analysis of DfE Data[61] shows that Socio-Economic-Status is the underlying driver for participation and achievement in sciences and mathematics, but it is not the only factor. And even where there is attainment, there is still a lack of progression to STEM post-16.

47. There are deeply embedded cultural factors at play here; public (and media) perceptions of what engineering is[62], early gendered role-stereotyping, a strongly class-based society.

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[59] SFR January 2012 Overall Education and Training (2003–04 to 2010–11) Participation by Level and Mode of Attendance—achievements (Level 3).

[60] Trial rates matrix—*A new streamlined funding system for adult skills*—SFA February 2012—http://skillsfundingagency.bis.gov.uk/providers/fundingrules/

[61] Data accessed through the DfE National Pupil Database.

[62] The 2011 Engineers and Engineering Brand Monitor. EngineeringUK www.engineeringuk.com

48. The answer to the problem is complex, multi-faceted and efforts to date have not made significant impact. However, it seems likely that the *culture* of education and training in engineering and in engineering workplaces and the lack of diverse representation provides little "pull". Additionally, lack of *retention* of engineers/technicians from diverse backgrounds that do make it to the workplace may indicate poor quality business practice in too many organisations that employ engineers and technicians.

49. The Royal Academy of Engineering is taking a lead for BIS for improving diversity in engineering. We welcome the opportunity to discuss the work being carried out by the RAEng and our Profession on this issue.

Appendix A

Supply of engineering skills

We provide data on STEM education and training in England to provide a snapshot of potential supply for engineering employers.

STEM in Schools

This data is from a forthcoming report[63] on participation and attainment in science and mathematics subjects at Key Stage 4 in England through analysis of the DfE National Pupil Database.

Science and Mathematics at the end of Key Stage 4:

The size of the cohort at the end of Key Stage 4 in 2009/10 in schools England was 633,500[64]. Of these:

- 16% (101,500) achieved A*–C Grade in Mathematics GCSE and A*–C Grade in Triple Science (individual Physics, Chemistry, Biology) GCSEs
- In total, 49% (313,500) achieved at least two science qualifications at A*–C Grade (or vocational qualifications at level 2, equivalent to two GCSEs) and Mathematics at A*–C Grade
- 23% of the cohort (145,000) achieved A*–C grade in Design and Technology GCSE

For Principal Learning qualifications, the following achievements were recorded for 2010 and 2011

Year	*2010*	*2011*
Engineering	1,550	2,600
Construction and Built Environment	700	1,000
Information Technology	1,200	2,000
Manufacturing & Product Design	0	100

A levels:

The cohort taking A levels in 2009–10 in schools was 407,000. Of these:

- 21,500 achieved a combination of mathematics and physics A level.
- 27,400 achieve three or more STEM A levels.
- 68,500 achieved Mathematics A level.
- 127,500 achieved STEM A levels.
- 280,000 achieved A levels not in STEM.

STEM subjects in Further Education

STEM Qualifications: This data is from the FE STEM data project[65]. FE Data is collected by qualifications achieved, not on learners. Learners are therefore estimated from FE STEM data analysis. In 2009–10:

- 943,000 STEM qualifications were completed by 16–18 year olds
  - 202,000 Engineering qualifications achieved
    - 121,200 qualifications at level 2 and below.
    - 80,800 qualifications at level 3 and above.
  - 235,000 Technology qualifications achieved
    - 164,500 qualifications at level 2 and below.
    - 70,500 qualifications at level 3 and above.
- The 934,000 STEM qualification achievements are estimated as:
  - 150,000 Level 2 STEM learners.
  - 75,000 Level 3 STEM learners.

[63] E4E report on science and mathematics attainment at key stage 4 to be published June 2012.
[64] All figures for Key Stage 4 data are rounded to nearest 500 pupils.
[65] FE STEM Data report undertaken by the Royal Academy of Engineering for BIS. July 2011. www.thedataservice.org.uk

— 33,000 Level 2 STEM apprenticeships completed.

— 29,000 Level 3 STEM apprenticeships completed.

Apprenticeships: Latest figures from the Data service show there were:

— 457,000 apprenticeship starts in 2010–10

— 49,000 Engineering and manufacturing technologies (29% increase on 2009–10).

— 28,000 Construction, Planning and Built Environment (11% increase on 2009–10).

— 19,500 ICT (55% increase on 2009–10).

— 10 Science and mathematics (no previous apprenticeships in 2009–10).

— 133,000 Business, administration and Law (75% increase on 2009–10).

— 102,000 Retail and commercial enterprise (67% increase on 2009–10).

For the above data, we are including all levels, while the engineering profession is predominantly focussed on levels 3 and above. The business and retail apprenticeships are included to provide comparison with engineering.

Engineering in Higher Education

Applications: Latest data on applications to HE from UCAS shows that as of 31 January 2012 there has been an 8.7% decrease in applications to all HE Institutions in the UK across all subjects. England suffered the worst decrease at—9.9%.

By subject groups the picture is more varied:

— Physical sciences subject group (JACS F) saw the smallest decrease at—0.60%.

— Engineering subjects (JACS H) saw the second smallest decrease at—1.3%.

— Technology subjects[66] (JACS J) exhibited a very large decline of—17.8% (albeit from a small baseline.

Trend analysis shows that engineering subjects have relatively flat growth over the seven years. However there have been significant variations across the different sub-disciplines. Civil Engineering and Chemical, Process and Energy Engineering have seen significant growth while Electrical and Electronic Engineering and Production and Manufacturing Engineering have seen substantial decline.

Subject	*2009–10 Achieves*	*Change over one year*	*Change over seven years*
General Engineering	1350	-4.9%	-21.1%
Civil Engineering	2640	5.0%	70.2%
Mechanical Engineering	2980	3.0%	13.1%
Aerospace Engineering	1000	-4.7%	-1.3%
Electrical and Electronic Engineering	2765	-0.1%	-29.9%
Production and Manufacturing Engineering	735	-2.5%	-41.2%
Chemical, Process and Energy Engineering	690	18.9%	29.2%
Total Engineering	12,165	1.5%	-3.8%

Engineering and Technology achievements alone make up 6% of all degrees. We included Physical sciences, Mathematics, Computing and Biological Sciences in the data as, like engineering graduates, people with these qualifications may use their skills and knowledge in a wide variety of sectors including engineering.

First degrees achieved. Figures for 2009–10 graduates are as follows:

— Engineering and technology—21,955.

— Physical sciences—13,795.

— Computer science—14,255 *STEM proportion of all degress—25.3%.*

— Mathematical sciences—13,795.

— Biological sciences—32,185.

— Total STEM—88,660.

— Total Degrees—350,860.

[66] JACS J group includes: Minerals, Mining, Quarrying, Metallurgy, Maritime Technology, Polymer Technology, BioTechnology etc.

Appendix B

About E4E

Education for Engineering (E4E) is the body through which the engineering profession offers coordinated advice on education & training to UK Government and the devolved Assemblies. It deals with all aspects of learning that underpin engineering.

It is hosted by The Royal Academy of Engineering with membership drawn from the professional engineering community including all 36 Professional Engineering Institutions, Engineering Council and EngineeringUK.

We trust that, in assessing submissions, you will ascribe appropriate weight to E4E's response in view of the wide range of contributing professional engineering institutions and organisations listed below.

BCS—The Chartered Institute for IT
British Institute of Non-Destructive Testing
Chartered Institution of Building Services Engineers
Chartered Institute of Plumbing and Heating Engineers
Chartered Institution of Water and Environmental Management
Chartered Institution of Institution of Highways and Transportation
Energy Institute
Engineering Council
Engineering Professors Council
Engineering UK
Institute of Acoustics
Institute of Cast Metals Engineers
Institute of Healthcare Engineering and Estate Management
Institute of Highways Engineers
Institute of Marine Engineering, Science and Technology
Institute of Mathematics and its Applications
Institute of Measurement and Control
Institute of the Motor Industry
Institute of Physics
Institute of Physics and Engineering in Medicine
Institution of Agricultural Engineers
Institution of Chemical Engineers
Institution of Civil Engineers
Institution of Engineering and Technology
Institution of Engineering Designers
Institution of Fire Engineers
Institution of Gas Engineers and Managers
Institution of Lighting Professionals
Institution of Materials, Minerals and Mining
Institution of Mechanical Engineers
Institution of Railway Signal Engineers
Institution of Royal Engineers
Institution of Structural Engineers
Institution of Water
Nuclear Institute
Royal Aeronautical Society
Royal Institution of Naval Architects
Society of Environmental Engineers
Society of Operations Engineers
The Royal Academy of Engineering
The Welding Institute

Written evidence submitted by the Engineering Professors' Council

The Engineering Professors' Council (EPC) represents the interests of engineering in higher education. It has over 1,600 members in virtually all of the UK universities that offer engineering. They are all either professors or senior managers. It has as its mission the promotion of excellence in engineering higher education teaching and research.

> "Britain's higher education is a major contributor to the economic success and social well being of the country. Higher education is a national asset, whose excellence in teaching and research is world recognised."

This quote from the Department of Business, Innovation and Skills web site has informed our responses to all of the questions.

> "The European Commission's commitment to the new skills for new jobs agenda. It is a sign of our belief that the employment and the education worlds must join forces. The two worlds must work closely together if we are to make a successful exit from the current economic crisis and provide inclusive, innovative growth in the decade ahead.
>
> The crisis has speeded up the pace of change in our economies and societies. And as the world changes, work is changing too. Some types of jobs are vanishing. Others are opening up, in the "green economy" for example, or in the health and care sector, as our population ages.

The skills needed are different too. Technical knowledge will always be essential. But equally important are the cross-cutting skills that enable people to cope with and develop new knowledge, while pursuing more flexible career paths. In the face of global competition, we need the skills to innovate."

This quote from Androulla Vassiliou, Member of the European Commission responsible for Education, Culture, Multilingualism and Youth in 2010 reinforced the view of BIS that education and research are essential to the economy and that agenda requires a focus in innovation and employability skills and gives an indication of the direction that higher education will take.

This response has been partly informed by the response from E4E but provides additional information based on the experience of the Engineering Professors' Council.

Does the current engineering skills base meet the needs of employers?

1. Based on the experience of members of EPC, industry finds it difficult to articulate the skills base it requires of graduates. This was an issue identified in the last Government's report Higher Ambitions. However, engineering skills are highly valued across many sectors, not just those directly or indirectly involved in engineering because of the inherent blend of numeracy, critical thinking and problem solving which characterise an engineer. This is encouraging for two reasons. Students entering tertiary education may not have reached a decision as to their choice of career and, since engineering skills are valued by a range of sectors, it is a suitable choice for those students yet to decide on their future. This deals with the individual student but there is also a much wider societal issue which is related to the need to understand engineering principles to cope with changes ahead. Increasing the number of engineers in all areas of society helps society to appreciate the challenges that we face and the decisions that will have to be taken to meet those challenges. Of course this also creates a corresponding challenge for the engineering industry to retain the best skilled graduates against competition from other sectors such as financial services.

2. It also has to be recognised that engineering covers many disciplines (eg the number of professional engineering institutions) and in each discipline there are numerous sub sets of engineering specialists. There is a range of skills generic to engineering and a significant number of combinations of skills sets for the different engineering disciplines in addition.

3. The formation of a professional engineer is a two-stage process. Most engineers complete tertiary education and then undergo a period of initial professional development to reach a level of competency set by the Engineering Council. This formation is a combination of education and training both formally and in the workplace with greater emphasis on education in further education (FE) and higher education (HE); and greater emphasis on training in the workplace. Those educational programmes that are accredited are audited by licensed professional engineering bodies against a set of guidelines produced by Engineering Council in consultation with academia and industry. Therefore the skills of graduates should meet employers' needs, provided they articulate what those needs are and are engaged in the auditing process. Industry should also accept its role in training the new graduates, as they train other types of recruits.

4. Data from various Government sources can be used to estimate the demand for engineers and the supply of graduate engineers. However, the demand-led data (eg Standard Occupational Classification (SOC) codes) is based on different criteria to the supply data (eg that collected by the Higher Education Statistics Agency—HESA). This reflects the fact that higher education focuses on the disciplines that underpin engineering sectors while Government is more interested in the jobs created. There is some alignment between the two descriptions but they cannot be assumed to be reliable. This is further complicated by the fact that people enter the engineering professions through a variety of routes (eg cognate degrees, apprenticeships). These were the findings of ConstructionSkills which has developed a demand-led model to predict the number of people that the construction industry needs and is currently developing a supply-led model to identify the training provision in the UK.

5. The Royal Academy of Engineering (RAEng) in its recent analysis[67] estimates that 820,000 SET professionals will be required by 2020 with 80% of these required in engineering. There is a further breakdown of those required within sectors from the relevant Sector Skills Councils (eg ConstructionSkills).

Do employers in the engineering sector prefer an academic or a vocational profile?

6. It is important to be clear that these terms are not necessarily mutually exclusive. Indeed this misconception may underlie some of the difficulties that the engineering sector has faced in attracting appropriately skilled and talented staff in recent years.

7. A key message from employers is that they prefer graduates who have some work experience. However, the decline in sandwich programmes and the reduction in opportunities for work placements mean that students are finding it increasingly difficult to gain work experience. Paid internships should be provided by most of industry as part of their commitment to securing the future skills base and their commitment to corporate social responsibility.

8. Engineering education has always contained a mix of education and training with a greater focus on education. This covers the underlying scientific and engineering principles creating graduates with a "habit of mind" that means that they can adapt to change. However, graduates will have experience of a variety of skills including the generic skills identified in the Dearing Report and the more specialist skills stated in the accreditation guidelines produced by Engineering Council. The recent focus on employability skills within tertiary education is leading to the development of new methods of teaching and learning some of which are funded by HE STEM, RAEng, Sector Skills Councils and Professional Engineering Institutions.

[67] The Royal Academy of Engineering analysis used a combination of UKCES predictions for 2010–20 (UKCES Working Futures 2010–2020) and LFS occupational population data for 2009. This estimate is based on a 7:1 ratio of replacement demand to expansion demand.

9. A challenge for leaders of tertiary education programmes is to balance the demands for change (eg management skills) with the demands for tradition (eg underlying scientific principles). This can create unnecessary stress within programmes creating a perception that they may not be fit for purpose. However, on the positive side, there is a diverse range of education and training found within tertiary education, which means that the engineering skills particular employers require can be found somewhere. This drives their recruitment policy which is often to focus on particular programmes at particular universities.

10. Employers want competent engineers and technicians. In the UK, engineers and engineering and ICT technicians cannot be registered until they have sufficient working experience to demonstrate competence. Competence is developed through doing the job, underpinned by theory ("academic" or "vocational" learning though not necessarily certificated). It is this integrated learning which develops competence. Industry needs to focus on the ongoing encouragement, development and support of its employees to achieve incorporated and chartered status, and not simply on the skills base of new graduates entering the profession.

11. Paths taken to professional engineering include:

- Work-located training—eg Advanced Apprenticeships—an integrated vocational and work-located learning path; accredited Further Learning programmes.
- FE college-based vocational education/training—vocational learning path—which may be classroom based learning only—plus working experience.
- University-based education—general or "academic" path—which may include a "sandwich" working placement—plus working experience.
- Non-formal and informal learning.
- Flexible work-based route to professional qualification, Engineering Gateways.[68]
- A combination of the above over a working lifetime.
- There should be an increased emphasis on apprenticeships at Levels 6 and 7 of the Higher Education framework.

12. Periodically, the Engineering Council surveys employers to ascertain if UK-SPEC remains in line with employers' needs. The most recent survey in 2007 involved 830 employers. These employers were selected as representative across engineering sectors, firm size etc from 8,755 firms in the filter phase. The report concludes:[69]

> "5.1 The most valuable finding from this study was that UK-SPEC largely reflected employer competence needs, the additional competences identified as desirable being mentioned by only small percentages of employers (the highest being 7% for IT skills).
>
> 5.2 Organisations with registered staff tended to require higher standards than those without registered staff at the same level, suggesting that the presence of registrants "raises the bar" in terms of valuing areas of competence. This was particularly true at Engineering Technician level."

13. The Royal Academy of Engineering has undertaken a number of major studies into how best to prepare engineering undergraduates for industry. The reports highlight the importance of providing students with real-life problems to solve and to develop greater links with industry for the teaching of engineering at university.[70][71] Initiatives such as the Academy's Visiting Professors scheme where industrialists lecture to students at university and explain current practice and the challenges being faced by engineering companies have been shown to add real value to undergraduate provision.

What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?

14. A broad and balanced general education is necessary for the formation of engineers and technicians. Mathematics and technical subjects—mathematics, sciences, design & technology and computing underpin the core engineering subjects. Art & design, the humanities and performing arts and languages are also important formative components for many professional engineering disciplines. This is especially the case in the emerging skills agenda which requires greater emphasis on the qualitative skills to deal with social aspects of engineering.

15. Entrants to higher education come from a variety of backgrounds and have a variety of qualifications. This has always been the case and makes for a rich learning experience within universities and colleges. However, it creates a challenge for higher education because there is a need to undertake remedial teaching, provide additional support and ensure that at the end of the first year students have a reached a common standard. This means that they can then go onto to complete their formal engineering education. Therefore any changes to engineering qualifications sub degree level will have to be accommodated as they always have been.

16. The introduction of engineering qualifications pre 19 is important, however, as it gives students an insight into engineering and the skills needed to become successful engineers.

[68] Engineering Gateways—www.engineeringgateways.co.uk
[69] UK-SPEC Baseline Project 2007. Engineering Council http://www.engc.org.uk/about-us/publications
[70] Educating Engineers for the 21st Century. The Royal Academy of Engineering. www.raeng.org.uk
[71] Engineering Graduates for Industry. The Royal Academy of Engineering. www.raeng.org.uk

Could the Government and others do more to raise the status of technical subjects?

17. The Government has an ambition for growth which rebalances the economy in favour of productive industries. All Government policy should be supportive of that ambition.

Schools

18. The Education Secretary should make public his support for high quality technical education in schools. His announcement should include Design & Technology, ICT with emphasis on Computer Science and engineering-related qualifications valued and respected by employers which lead to progression to further learning and employment.

Higher Education

19. The effect of the funding reforms on higher education is uncertain. A recent report by the EU suggests that the UK has moved to a commodity model for higher education. It is not certain whether students will choose engineering as a career, whether they will learn then earn or earn and learn, and whether employers will recognise this shift and how it will affect them.

20. The best graduates are those who have authentic experience-led learning programmes and employer engagement in offering placements and internships. These programmes require significant additional resources. There should be more financial incentives available to industry offering Level 6 and 7 apprenticeships and to engage in the design and delivery of undergraduate programmes

21. The integrated Masters Degree is recognised by the engineering sector as the premier route to an engineering career. It is also recognised across Europe as a 2nd cycle degree. It is possible that students following this programme will decline because of the funding placing greater emphasis on workplace learning. This may prove unacceptable as it could lead to a loss of higher skills normally found at Masters level.

22. The Home Office policy on non-EU immigration may be discouraging many overseas students from applying to UK universities. Fees from overseas students are an essential funding stream of the diverse sources of funds for engineering departments.

23. Increasingly European Universities are offering degrees in English reducing the competitive advantage the UK has had in the past.

24. There is evidence that European Universities are also encouraging UK students to study in Europe. This will create a problem for the professional engineering institutions because each graduate will have to go through the individual case procedure for Chartered Recognition as the European degrees are generally not accredited.

Public Sector

25. Engineering role models in the public sector are limited. There are no chief engineering advisors to Government; there are only three engineers in Parliament; engineering career paths in the Civil Service are limited. The ability of Government departments to take informed decisions on engineering-related matters is said to be constrained owing to the background and experience of civil servants.

What more should be done to attract and retain a more diverse technically skilled workforce?

26. Analysis of sciences and mathematics subjects at Key Stage 4 in England shows that a higher proportion of females achieve A*–C grades in at least two science GCSEs and in mathematics GCSE compared with males. Yet, only around 20% of the cohort for physics A level is female. In Higher Education, the proportion of women in engineering subjects falls to around 12%. The issue therefore appears to be one of interest rather than ability.

27. There is considerable variation in participation and attainment in sciences and mathematics at Key Stage 4 across different ethnic groups. For example, there is under-representation of black pupils in high attaining maths and science cohorts at GCSE while there is substantial over-representation of Chinese and Asian pupils in high attaining science and maths cohorts at GCSE.

28. Analysis of Department for Education National Pupil Data by the RAEng shows that socio-economic status is the underlying driver for participation and achievement in sciences and mathematics, but it is not the only factor. And even where there is attainment, there is still a lack of progression to study STEM subjects post-16.

29. There are deeply embedded cultural factors at play here; public (and media) perceptions of what engineering is, early gendered role-stereotyping, a strongly class-based society.[72]

30. The answer to the problem is complex, multi-faceted and all efforts to date have not made significant impact. However, it seems likely that the culture of education and training in engineering (all phases) and in engineering workplaces and the lack of diverse representation within them provide little "pull". Additionally,

[72] The 2011 Engineers and Engineering Brand Monitor. EngineeringUK www.engineeringuk.com

lack of retention of engineers and technicians from more diverse backgrounds that do make it to the engineering workplace may indicate gaps in staff development and retention practices in companies and organisations that employ engineers and technicians.

June 2012

Written evidence submitted by the Chemical Industries Association

1. The Chemical Industries Association is the organisation that represents chemical and pharmaceutical businesses across the UK. The Association is pleased to have the opportunity to make this submission on behalf of our members.

2. The chemical and pharmaceutical industry has the credentials to underpin economic, social and environmental progress for our country:

- Innovation drives growth. Chemical and pharmaceutical businesses spend more on research and development than anyone else—over £5 billion each year which is one third of the UK total amount. This generates growth. Chemistry facilitates other research in—new materials, adhesives, paints in aerospace and motors, key components of electronics and communications
- Every day our companies contribute £70 million to the UK economy, equivalent to £17 billion a year. This is reducing the deficit.
- We are major investors in capital equipment. Helping to sustain UK activity in construction. Even during the worst recession in a generation, we are still investing well over £1 billion a year in capital expenditure.
- The products and technologies of our companies are at the heart of the green economy. The energy saved by society in the lifetime of these products is twice that used in making them.
- We provide employment for over half a million people. Our highly skilled workforce perform quality jobs that pay 40% more than the average for the manufacturing industry. We develop workforce skills and encourage academic studies which reinforce the UK position as a competitive industrialised nation.

3. At the heart of this performance lies our engineering skill base. No such level of performance can be sustained without an effective level and supply of engineering skills.

4. Our member companies have considered the Committee's questions and offer the following views.

Does the current engineering skills base meet the needs of employers? Do employers in the engineering sector prefer an academic or a vocational profile?

5. Members feel that the current skills base is not meeting requirements. There are significant problems recruiting mechanical, electrical and instrumentation engineers, despite extremely competitive pay rates. There is a concern that the skill landscape is very narrow, so there are, for example, extremely good pipe-fitters or other specialisms but there is an insufficient range of skills. At graduate level members have mixed experiences. Recruitment runs have to take place two or three times before being successful. Here the education base is too random. Candidates could, for example, design a racing car or attempt to, but would not appreciate the underpinning technical knowledge such as materials of construction. Worryingly verbal and numerical assessments can be much lower than they should be. Europe's economic crisis is increasing the width of the market for recruitment.

What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?

6. We are optimistic that changes in education, training and qualifications will lead to more successful outcomes but we also have concerns. There needs to a stronger cultural appreciation that an important part of understanding is "getting your hands dirty". The skills of observation, of taking measurements should be done by physical presence rather than electronic monitoring. The industry can help with this by a review of student placements. The attitude of universities (and employers) is critical. The country needs a greater willingness to work together. Trade associations and similar bodies can help this process. A willingness to travel a short distance supporting students is not always present. Incentives could be widened to allow greater sponsorship of subjects in education, including engineering disciplines.

How do the approaches taken by the Devolved Administrations to produce a technically skilled workforce differ to the current approach in England? What are the strengths/weakness of the different approaches?

7. Our experience in Scotland is similar to England and Wales. Pressure on the existing skills base from projects in the north sea is leading to pay escalation and shortages.

Could the Government and others do more to raise the status of technical subjects?

8. Sometimes what is needed is political encouragement for technical career routes as well as professional. We are starting to see this, but it will take time.

What more should be done to attract and retain a more diverse technically skilled workforce?

9. There is a problem in attracting a diverse workforce. We believe there is scope to assess the value of further promotion of opportunities to specific sectors of society. This can be best done by early learning within schools.

DECLARATION OF INTERESTS

10. We are not aware of any conflicts of interest.

June 2012

Written evidence submitted by OPITO—Skills Body for the Oil and Gas Industry

BACKGROUND

OPITO is the industry owned skills body which develops a sustainable, safe and competent workforce for the oil and gas industry. Over half a million offshore oil and gas workers in 40 countries are trained to OPITO safety and competency standards and there are 127 OPITO-approved training centres around the world delivering OPITO's 103 industry standards.

In the UK, OPITO is the industry's focal point for skills and workforce development working across five key areas:

(1) Standards development.
(2) Education.
(3) Careers and attraction.
(4) Workforce development.
(5) Informing and influencing.

Competition for skills and talent are a major priority and concern for the UK's oil and gas sector. Over half the industry responses to a recent OPITO survey identified talent attraction and retention as their primary challenge, with professional engineers and engineers at the top of the list.

Does the current engineering skills base meet the needs of employers? Do employers in the engineering sector prefer an academic or vocational route?

Labour Market Intelligence (LMI) research, conducted by OPITO last year, suggests that the oil and gas industry will require an additional 10,000 staff over the next 4–5 years in order to deliver new oil and gas project plans that the industry has identified.

The OPITO report also suggests that 66% of contractors and 62% of operators are experiencing problems in recruiting suitable employees in particular occupations. Engineers: senior, project, design, control, mechanical, subsea; geologists, geosciences, reservoir; skilled craft and technicians (machinists, tool dressers, electrical, instrumentation and hydraulics technicians, fitters, offshore technicians and welder fabricators, liquid and gas flow metering staff. [73]

The oil and gas industry covers a broad spectrum from large multi-national operators down to small companies who form part of the extensive supply chain, including the hugely successful subsea sector which is regarded as the best in the world. In 2010 international sales in the supply chain were estimated at £6 billion. Employers in the oil and gas industry employ both graduates and engineers with a vocational profile with the preference varying between individual companies. In such a large and diverse industry engineers from both academic and vocational routes are required.

OPITO has run a successful modern apprenticeship scheme on behalf of the industry for over 12 years—with industry investing over £120 million to date. Selecting around 100 candidates each year, on behalf of a range of major companies OPITO oversees the three and a half year apprenticeship which involves 21 months at college and a further two years assigned to a specific company to develop their skills and gain workplace experience both on and offshore. The four disciplines in which the OPITO apprentices are trained include (1) Process Engineering Maintenance (2) Electrical Maintenance (3) Mechanical Maintenance and (4) Instrument and Control Maintenance.

The scheme has one of the best retention rates in the UK, with an average 94% of apprentices completing the course and securing employment.

[73] The full report can be found at: http://www.opito.com/uk/about-us/news/421-ground-breaking-labour-market-intelligence-survey-result-released.html

However, the offshore oil and gas industry faces a unique problem when trying to increase the number of apprentices it trains as it is limited by the number of available bed space on offshore installations. It has been suggested that there may be a possibility of increasing the number of OPITO apprentices recruited each year by using onshore sites for training with simulators (thus reducing the practical experience on an offshore installation) but this would require a large financial investment to place the correct equipment in the appropriate on-shore sites.

With security of energy supply becoming ever more important to the UK, the diversity of energy producers including the growing renewables sector and the likely replacement of old nuclear plant means that competition for engineers will be a big challenge for everyone involved in the energy sector in future.

What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?

It is difficult to say at present how the changes will affect the skills base but, without exception, the companies recruiting engineers into the oil and gas sector require candidates to have extremely good skills in the core subjects of mathematics, chemistry and physics. Nearly all the large companies provide additional and on-going training for their engineers throughout their careers but the importance of good strong core skills and understanding of mathematics cannot be over emphasised. Although the OPITO apprenticeship entry criteria asks for a C grade in GCSE mathematics, English and science, students who have a higher qualification than a C in maths will find the course much easier as a strong understanding of mathematics is key to their learning.

OPITO is keen to do all it can to promote the key STEM subjects in schools as possible and already works with organisations such as STEM NET. In addition, the PETROCHALLENGE competition we run with various schools encourages pupils to use their maths, chemistry, IT, business studies and geography skills and to work together in teams in a two day oil industry simulation challenge to learn about the industry and see how they can apply their academic learning in an industry context. The feedback from teachers, whose pupils participate in the PETROCHALLENGE, describe it as "the curriculum in a box" and this successful programme could be widened out to more schools if more funding was available.

The industry believes that the government should work with industry to encourage the importance of STEM subjects in schools from as early an age as possible. We believe this includes primary schools where only a small percentage of teachers have a mathematics or science background.

As part of its work with primary schools OPITO has provided 65 "*Hydrocarbons in Action*" kits to primary schools across Scotland and will be almost doubling the number available this year. The kits allow primary pupils to try a range of hands-on experiments designed to help them understand oil and gas exploration and production and help to encourage primary schools to introduce more science into their curriculum.

The kit, which was produced by OPITO and Young Engineers and Science Clubs with support from BP and the Scottish Oil Club, provide ready to use science experiments ranging from seismic exploration, core sampling and rock and mineral analysis through to crude oil testing and the building of a remotely operated underwater vehicle.

At the moment this scheme is only running in Scotland but could be expanded with additional support and funding.

In a future economy where technical and engineering skills are going to be in great demand, including the energy sector, we believe it is vital for government to ensure that all schools have good quality teachers in mathematics and science. It is often teachers in the early years of education who inspire pupils to go onto develop a love or aptitude for a particular subject and the importance of such role models should be recognised and encouraged.

How do the approaches taken by the Devolved Administrations to produce a technically skilled workforce differ to the current approach in England? What are the strengths/weakness of the different approaches?

The Scottish government recognises the importance of the industry to the economy and has shown a keen interest in ensuring there are enough skilled people to meet the needs of the oil and gas industry. As a result OPITO was invited to be a member of the Scottish Government's Energy Skills Council. The Council aims to drive forward industry led skills initiatives and secure support from the Energy Advisory Board and funding from the Energy Skills Investment Plan as needed.

OPITO continues to work closely with the Scottish government and organisations across Scotland and has received support for a number of positive initiatives including:

Scottish government co-sponsored the "Lab in a Lorry" through the Institute of Physics to inspire an interest in science which included oil and gas related experiments.

Wide support by Ministers, Education Scotland and local government education departments for industry education and careers branded products.

SQA are reviewing the National Qualifications in line with the Curriculum for Excellence and have asked OPITO to support the context of the STEM subjects by providing oil and gas content. This will enable pupils to understand how school subjects are relevant to the workplace and how they can become effective

contributors to society. This work is only relevant in Scotland and will be much harder to do in England because of the large number of examination bodies to deal with.

Work is underway with Universities Scotland to embed employability skills into HE graduates during their academic studies based on key industry sector needs.

Two transformation training programmes have been funded by Skills Development Scotland and the Scottish Funding Council. This initiative takes a competency based approach to re-skilling workers from other industries eg. the armed forces and resulted in the candidates gaining employment in the oil and gas sector.

OPITO would welcome a seat on relevant skills bodies in England to help raise the profile of the industry.

Could the Government and others do more to raise the status of technical subjects?

It is predicted that oil and gas will still provide 70% of the UK's primary energy needs in 2020 and OPITO believes that industry and government should work together to help raise the aspirations of young people to join the oil and gas industry.

In countries like Norway, the people and politicians take great pride in their oil and gas industry (Statoil is the state oil company) and understand and appreciate the importance to the economy and the benefits it brings from taxation revenue. The UK, in comparison, has little knowledge or understanding of the industry or of the amazing engineering feats that are undertaken to ensure the UK has a reliable and secure supply of both oil and gas extracted from one of the most hostile and difficult offshore environments.

Many of the companies in the oil and gas industry already understand the importance of linking with local schools, colleges and universities and many have developed great networks. OPITO also co-ordinates an Ambassador Scheme called "*It's Your Future*" which encourages and trains young industry professionals to visit schools, talk about their careers and help motivate young people to consider a career in the oil and gas industry. This initiative focuses on the variety of careers that are available in the industry.

At the beginning of the year OPITO launched a new careers website www.myoilandgascareer.com. The site features case studies and job profiles of engineers and other skilled professionals in the industry and provides information on the types of qualifications needed to enter into the profession as well as typical daily tasks and starting salaries.

It would be good to hear more UK politicians speak positively about the UK's oil and gas industry, the benefits it delivers to the UK economy and the job opportunities in the sector.

The recently launched all age Careers service in the UK may provide an opportunity to encourage more people to think about working in the energy sector and OPITO is already starting to receive approaches from various careers websites to collaborate..

What more could be done to attract and retain a more diverse technically skilled workforce?

The oil and gas industry is very keen to encourage more women into the industry. In the past only around three% of applicants for the popular OPITO modern apprenticeship scheme have been female and work is being done to try and improve this percentage.

In general the industry is less concerned about ethnic mix. Many of the companies in the industry work in areas all over the world and there is already a big mix of nationalities employed in the sector eg Schlumberger currently employs 140 different nationalities.

Any activity that the government could undertake or support to encourage more women to consider a career in engineering would be welcomed by the industry but we believe that collaborative efforts with government and industry would be most effective.

June 2012

Written evidence submitted by Engineering UK

We are delighted to make this submission to your enquiry, which we hope you find useful. We are in wholehearted support of our colleagues at E4E (Engineering for Education) and our submission is intended as a supporting document to their paper. We have specifically answered the questions within your enquiry remit where we have particular expertise.

Does the current engineering skills base meet the needs of employers?

In 2010, the engineering sector generated £1.15 trillion turnover, 25% of all UK turnover—three times the size of the financial services sector. Of the 2.1 million businesses in the UK, 550,000 are engineering businesses employing 5.6 million people—19% of the work force. The demand for skilled engineers and technicians is strong; for example, the Technician Council estimates there will be a demand for 450,000 technicians by 2020.

The industry-leading engineering firms that are part of our Business & Industry panel: Babcock, BAE Systems, Rolls-Royce, Jaguar Land Rover, Airbus, Centrica, Network Rail, National Grid, United Utilities, BT, TfL, and Atkins among many others lead the world in engineering. The government is aware of their input, but to the wider world, beyond name recognition, there is often little understanding of the breadth of jobs available if the right training and skills are developed.

These companies tell us that the industry is struggling to recruit engineers. McLaren and Microsoft, for example, have both told us recently that electrical engineers are hard to come by. They have to recruit them in from overseas. The industry, which recognises the benefits of a diverse workforce, also reports that diversity in the sector is a major issue, both in terms of female entrants and engineers from ethnic minorities.

Above all there is a strong feeling that the engineering sector needs clarity from the government. It needs a clear industrial policy to be established and a steer about the intended direction of travel. Engineers want to understand exactly what the government expects the economy to look like in 2015, 2020 and 2025. Longer term thinking is critical. The implications of a re-balancing of the economy and growth in GDP are that the £1.15 trillion turnover would need to increase by a double digit percentage over the next five years.

Do employers in the engineering sector prefer an academic or a vocational profile?

Our main challenge to government is to meet the conditions that need to be brought about to bring more young people into the engineering sector—to grow the total pool of potential engineers—and to prevent the flight of engineering graduates to other professions.

Our experience is that more companies are looking for qualified employees than are laying them off. Engineers are being traded around the sector, rather than being recruited from a growing pool.

To crack these challenges the government needs to:

- Establish a clear, unequivocal industrial policy—a direction of travel. Industry needs to know what shape the economy will be in and how government intends to deliver growth.
- Address the shortage of engineering graduates and apprenticeships across all disciplines to meet the shortfall that is consistently reported across the industry.
- Grow the pool of students who are studying Physics (as part of triple science) at GCSE.
- Increase the number of students who are studying Physics at A level.
- Provide better informed careers information at an earlier age.
- Build dialogue between the universities (who want depth of education) and industry (which wants a breadth of knowledge to be taught as well as softer skills, such as teamwork to be taught).
- Return to the issue of class based science and technology practicals as a way of locking in the excitement and enthusiasm we see at events like the Big Bang Fair.

Resolution to each (or any) of these challenges would have a significant effect on the number of students who choose an engineering discipline as a degree course. Industry has a major role to play in enticing these graduates into the profession and an A-Level "milk round" where promising students are funded through their degree courses may also support this approach.

Barriers to Progress

There are a lot of barriers in the way of success. Most of them are surmountable and, with the right co-ordination from BIS and the Department for Education, we could put in place a solid pipeline of graduates and apprentices perfectly placed to enter the engineering sector.

The key barriers, identified by our research, are:

- Insufficient numbers of students are taking triple science at GCSE level (specifically Physics). Pupils who study triple science are three times more likely to study Physics at A Level; and actively increasing the supply of young people studying A level Physics is the best possible way to improve the number of engineering degree entrants.
- Universities constantly push for depth of subject study, but companies are asking for breadth. They also need graduates, and apprentices, to have people skills, communication skills, enthusiasm and the ability to work as part of a team.
- Careers information, advice and guidance. This has to improve and should also be targeted at a younger age group so that early interest in science and engineering can be captured and channelled. Our research shows that while primary school children enjoy science and engineering, there is a notable drop-off by Year 8. Enjoyment of a subject is a key determinant in a young person's decision to pursue that subject further and increased practical activity in classes would help to solidify interest and excitement.
- Increasing the number of specialist science teaching staff is critical if children are to reach their potential within STEM subjects and ultimately pursue engineering careers.

— The fate of the engineering diploma. In our view this qualification had gained traction in the industry and was proving popular among students. We need to see this replaced urgently and industry will need to be shown that the new qualification is on a stable political platform.

There are also some significant positives emerging from new government policy, but more needs to be done to support these fledgling ideas. Specifically:

— We need to build understanding of "Wolf compliant" technical qualifications for 14–16 year olds. The industry supports these qualifications but agrees that they need to be positively promoted into schools and colleges who in turn are given the appropriate support so that they can deliver these essential qualifications.

— The University Technical College model is popular in the sector but results need to be monitored to show that they will indeed provide the skilled technical engineers that the sector needs.

— DfE and BIS consequently need to ensure that academies and free schools are suitably motivated or incentivised towards supporting the UK engineering and manufacturing agenda.

— Use the existing innovation framework as another route into the problem. The Technology Strategy Board has already shown its effectiveness here and Catapult Centres look set to do similar.

Could the Government and others do more to raise the status of technical subjects?

If we were in government and had the power to change things at a fundamental level for engineering we would work to improve the following core areas:

1. Bridge the gap for employers and show younger people that there are significant career opportunities in engineering.

   One in five employers (21%) has difficulty finding graduates with STEM skills, and this proportion rises to one in three employers (33%) in the science, engineering and IT sectors. We need to make the case to young people now that there are wide ranging and well-paid jobs to be had in engineering. Enable a tax efficient route for employers to fund retraining for able graduates who want to change career track.

2. Provide an incentivised mechanism to link students into the sector working alongside employers.

   Develop a combined university application process that includes both student and employer. Employers could be encouraged to support engineers through their studies and build relationships with students. A student-centred agreement should be created drawn up between student, university and future employer. This agreement would ensure that the student was taught and trained in the best way for the sponsoring company, as well as providing the depth of knowledge required by the university. The same process could work to identify potential apprentices.

3. Help change young people's (and their influencers') perceptions of engineering so that they appreciate, understand and aspire to work in the sector. Industry values BIS's *Make it in Great Britain* campaign highlighting modern manufacturing but we need a longer term, high level government-backed communications programme, match funded by industry, and delivered by the third sector to show clear commitment.

4. Boost the knowledge of STEM teachers and bring practicals back into the classroom.

   Three fifths of the general public view a career in engineering as desirable, seeing it as being a "good profession/career", "challenging" and "well paid". However, amazingly, our research shows that 21% of STEM teachers say that a career in engineering is undesirable for their students. This is especially worrying when nine out of ten STEM teachers see providing careers information, advice and guidance as being part of their role, and eight out of 10 answer the pupils questions based on their own knowledge and experience. We have to be able to educate and, crucially, update STEM teachers, with the right careers information to ensure that students are being shown the potential of a career in sector. Extend engineering work experience opportunities to teachers so that they see modern engineering for themselves.

   We also have to bottle the enthusiasm of primary school children and carry it deep into secondary schools. This can only be achieved by lesson practicals, enrichment and enhancement activity such as Tomorrow's Engineers and creative sessions like the Big Bang Fair.

5. Instigate change through procurement processes.

   Our feedback from business is that government and business working together could do so much more to support skills development or innovation. Terry Morgan at CrossRail is a great example of an engineering industry leader actively using procurement methods to support skills development with great success.

6. Prioritise tax incentives for R&D for the engineering sector to drive technological innovation. Of the top 25 UK companies by R&D spend; eight are from the manufacturing sector.

The Industry Wish-List

What is clear overall is that industry has a supply problem. There is work out there—there just are not enough graduates and apprentices to fill the places available. That is driving UK companies to look abroad where they are finding out-of-the-box graduates with a positive and enthusiastic attitude.

The UK has these in abundance—a visit to a Big Bang Fair will show you that the potential pipeline is there. Working together we have to keep young people excited and interested in engineering.

June 2012

Written evidence submitted by The British Standards Institution (BSI)

Summary

1. Standards and standardization have a significant impact on the UK economy, specifically in the engineering sector. Ensuring students are educated about the effects processes of standardization will positively increase that impact.

2. International competitors have invested in education about standardization to increase the awareness and knowledge of standardization within their engineering sectors. If the UK were to follow suit, increased knowledge about standardization would improve the sector's contribution to the UK GDP.

3. University Technical Colleges will have a positive impact, however other changes—coupled with those changes to the UK higher education sector—could impact the uptake of technical qualifications in the UK.

4. A public/private scholarship initiative, linking training and participation in standards-making could have a positive impact on the uptake of technical qualifications and the effects of standardization and the engineering sector on the UK economy.

About us

5. This submission has been prepared on behalf of the British Standards Institution by the External Policy Department and Consumer Policy Unit.

6. BSI is the UK's National Standards Body, incorporated by Royal Charter and responsible independently for preparing British Standards and related publications. BSI has 111 years of experience in serving the interest of a wide range of stakeholders including government, business and society.

7. BSI presents the UK view on standards in Europe (to CEN and CENELEC) and internationally (to ISO and IEC). BSI has a globally recognized reputation for independence, integrity and innovation ensuring standards are useful, relevant and authoritative.

8. A BSI (as well as CEN/CENELEC, ISO/IEC) standard is a document defining best practice, established by consensus. Each standard is kept current through a process of maintenance and reviewed whereby it is updated, revised or withdrawn as necessary.

9. Standards are designed to set out clear and unambiguous provisions and objectives. Although standards are voluntary and separate from legal and regulatory systems, they can be used to support or complement legislation.

10. Standards are developed when there is a defined market need through consultation with stakeholders and a rigorous development process. National committee members represent their communities in order to develop standards and related documents by consensus. They include representatives from a range of bodies, including government, business, consumers, academic institutions, social interests, regulators and trade unions.

Factual Information

11. Research from Swann in 2010 showed standards to contribute £2.5 billion to UK GDP annually.[74]

12. In a 1996 report, Swann, Temple, & Shurmer believed UK standards increased both UK exports and UK imports; however standards had a stronger positive effect on imports.[75]

13. The same report stated UK standards appear to have a stronger positive effect than internationally equivalent standards.

14. A 2010 article from Henry stated standards simplified business to business trade, improved production efficiency and reduced inventory costs.[76]

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[74] Swann, G. M. (2010). The Economics of Standardization: an update. London: Department of Business, Innovation and Skills.

[75] Swann, G. M., Temple, P., & Shurmer, M. (1996, September). Standards and Trade Performance: The UK Experience. The Economic Journal, pp. 1297–1313.

[76] Henry, J. (2010). Economic Impacts—Micro Perspective. In D.-G. Choi, Standardization: Fundamentals, Impact and Business Strategy (pp. 115–134). Seoul: Asia Pacific Economic Cooperation Secretariat.

15. Williams, in 2010, stated measurement standards were vital to researchers converting strategic research into applied research.[77]

16. The CEN/CENELEC/ETSI Joint Working Group for Education about Standardization has created model curricula for both higher education[78] and vocational education[79] to "facilitate the provision of information about standards and standardization" as specified in their Policy on Education about Standardization.[80]

Recommendations

17. BSI recognizes that there is value to academic and vocational profiles, depending on the specific roles being performed by the individual. However, the levels of awareness and understanding of standards and standardization in both profiles is far lower than our competitors. Korea, China and Germany have all, with government support, built programmes which have taught and educated students on the effects of standardization. We recommend the UK follows suit, exploring methods of encouraging the provision and teaching of information about standards and standardization to students.

18. We draw your attention to the public/private scholarship initiative recommended on page 27 of our report, "Higher Education and Standardization: Knowledge Management between Generations".[81] This initiative could encourage students to study technical subjects and add to the skills base needed by the engineering sector and could be adapted/mirrored for vocational education.

June 2012

Written evidence submitted by University of Cumbria

Engineering skills Today the Science and Technology Committee publishes its report Engineering in Government, a short follow-up to the 2009 report Engineering: Turning ideas into reality. The Committee recognises the importance of engineering to society and as part of its continuing scrutiny of engineering, has agreed to conduct an inquiry on engineering skills.

Age 14 and above is an important period in education as students are asked to make decisions influencing the career path they will follow. In England, there have been three key developments:

- the introduction of the English Baccalaureate as a performance measure in 2010 provided an incentive for schools to prioritise performance in "traditional" academic subjects at GCSE-level/Key Stage 4 over more technical qualifications such as Design and Technology;
- the introduction of 13 new University Technical Colleges for students aged 14–19 to study technical subjects such as engineering and construction; and
- from 2014, many vocational qualifications in practical subjects, including engineering, will be downgraded from their previous status as GCSE-equivalent qualifications, including the Engineering Diploma, which would in future be equivalent to one GCSE rather than four.

There have also been changes among the devolved administrations. In Scotland for example, the Standard Grade examination will be replaced in 2013.

The Committee seeks to gain an understanding of how changes in qualifications and education structures will impact on the acquisition of engineering skills across the whole of the UK.

Terms of Reference

The Committee seeks written submissions on the following matters:

1. *Does the current engineering skills base meet the needs of employers? Do employers in the engineering sector prefer an academic or a vocational profile?*

We need to recognise that there is a need for both practical hands on engineers, a route traditionally taken through apprenticeships and the more academically focused skills needed by professional engineers where a strong grounding in mathematics and physics or chemistry is needed. It is not a matter of what do employers prefer as both types of "engineer", are required. It is unfortunate that the term "engineer" in the UK has a very unclear definition.

For young people it means ensuring they receive the necessary grounding, through applied learning to become highly motivated technically competent young people, who can meet the demands of the engineering sector in terms of technical competence and delivering problem based solutions based on academic principles.

[77] Williams, G. (2010). Standards for Statistical Methods, Tools and Techniques. Teddington: National Physics Laboratory.
[78] ftp://ftp.cencenelec.eu/CEN/Services/Education/Education/ModelCurriculumForEaS.pdf
[79] http://www.cencenelec.eu/standards/Education/JointWorkingGroup/Documents/ModelCurriculumForVocatio nalTraining.pdf
[80] ftp://ftp.cencenelec.eu/CEN/Services/Education/Education/PolicyonEducationaboutStandardization.pdf
[81] BSI. (2012). Higher Education and Standardization: Knowledge Management between Generations.Chiswick: BSI.

Within the existing engineering workforce we need to ensure that they develop the skills required to keep pace with technological developments in engineering. And in particular in the areas of specialism, for example Energy and Renewables. Locally employers have indicated a need to have a workforce of skilled craft technicians with hands on experience, at levels 4 and 5, HND and HNC levels.

2. *What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?*

It really depends on which sector we are talking about. A more academic subject focus for example the A Level—University route will help those student wanting to progress to study at degree level and beyond. This knowledge and skills is required to support innovation in the engineering sector, and is strongly favoured by engineering employers. There also follows opportunities for post graduate research to support industrial needs and the development of world class skills.

The UTCs will help those who wish to follow this academic route and will also provide them with the technical skills to progress within the industry at appropriate levels. The UTC's will also have a more practical aptitude but the current number nationally for UTCs seems a very low number.

The main negative impact on the changes may be for those students who wish to progress through to an apprenticeship as they may be turned off by the Governments more academic focus from 14, with insufficient practical application of skills being offered at age 14 in schools, with the exception of the UTC.

— How do the approaches taken by the Devolved Administrations to produce a technically skilled workforce differ to the current approach in England? What are the strengths/weakness of the different approaches?

— Could the Government and others do more to raise the status of technical subjects?

Yes we need to raise the status of engineers in general. There is a great opportunity following the financial sector debacle to make sure engineering is a sought after career. The government focus and that of the city needs to plan for an increase in the contribution of manufacturing to the country's GDP.

It is widely recognised that qualification in engineering enhance an individuals employment opportunities at 18 years old and also again after successful completion of engineering degree programmes

3. *What more should be done to attract and retain a more diverse technically skilled workforce?*

Increased pay and respect for the engineering profession and those involved in teaching. Ensure that mathematics and other STEM subjects are taught by well-paid enthusiastic teachers who can engage and enthuse about their subject areas. Increased exposure of technical subjects through media.

Within the UTC, the government to support employers who engage and contribute in the training of young people to enable them to become motivated and achieve STEM and engineering qualifications.

June 2012

Written evidence submitted by the Design Council

Background

1. The Design Council is an enterprising charity. We enable people to use design to transform communities, business and the environment for the better. Our work places design at the heart of creating value by stimulating innovation in business and public services, improving our built environment and tackling complex social issues. We have long worked with schools, colleges and universities—delivering design-led multidisciplinary projects which promote the use of design—and with industry to support development of professional skills. We generate income through our programmes and services as well as receiving grants from the Department for Business, Innovation and Skills and the Department for Communities and Local Government.

Summary

2. Design processes and design skills are an integral part of the engineering ecosystem. User-centered design innovation increases the commercial viability of our engineering outputs by making products and services better fit the needs of users and discovering new unfulfilled needs—design is therefore a fundamental part of the engineering sector. Engineering requires a broad base of skills—practical, technical and academic. Design & Technology (D&T) is the only curriculum subject that can deliver these in an applied way—whilst encompassing relevant knowledge and skills for engineering careers.

3. Therefore, the most important driver for enhancing the engineering skills base should be firstly to ensure D&T remains in the National Curriculum through to the end of Key Stage 3. If the subject is secured we then need to develop a revised and streamlined programme of study jointly across the design and engineering communities, supported by non-statutory guidance for schools, supported by increased investment in professional development for teachers and stronger links with industry. (A set of fundamental principles for

Design & Technology is provided in Appendix A which we have prepared in conjunction with a wide range of partners.)

Introduction

4. The Design Council welcomes the opportunity to contribute to the Science and Technology Committee inquiry and our comments draw on evidence from both our programmes and our year-long inquiry in 2011 into design education and growth as part of the Design Commission. Our evidence specifically covers:

- The extent to which the current engineering skills base meets the needs of employers and whether they prefer an academic or vocational profile.
- Impact of recent changes to engineering qualifications in England on uptake of technical subjects and henceforth impact on the skills base required by the engineering sector.
- How the Government and others could do more to raise the status of technical subjects.
- What more can be done to attract and retain a more diverse technically skilled workforce.

5. Sir George Cox, former Design Council Chairman, described design in The Cox Review as that which "*links creativity and innovation. It shapes ideas to become practical and attractive propositions for users or customers. Design may be described as creativity deployed to a specific end.*" [82]

6. Design processes and design skills are an integral part of the engineering ecosystem. The discipline of Engineering Design is a multi-step process that includes research, conceptualization, feasibility assessment, establishing design requirements, preliminary design, detailed design, production planning and tool design, and production.[83]

7. As evidenced by our own work[84] and recognised by the European Commission—companies that invest in design tend to be more innovative, more profitable and grow faster than those who do not.[85] User-centered design innovation increases the commercial viability of our engineering outputs—design is therefore a fundamental part of the engineering sector and the bedrock of engineering skills.

8. The UK's leading engineering/manufacturing sectors of high tech, aerospace, energy, automotive, chemical and food production rely on engineering design, design skills and other design disciplines to develop ideas pre-production and to successfully take products to market. . These include interaction design, system design, automotive design, sustainable design, retail design, product design, service design, graphic design.

9. The position of Design & Technology as a foundation subject in the National Curriculum Review is the underpinning for the supply and development of these skills. As part of the National Curriculum Review this is now at risk in the secondary education sector and we urge the committee to request the Secretary of State for Education secures the position of Design & Technology within the Secondary curriculum.

Does the current engineering skills base meet the needs of employers?

10. The engineering sector requires a range of skills sets across a range of job roles—many of which are not yet realised or known. Therefore the skills base for engineering, whilst requiring a solid grounding in mathematics and physics, necessitates a range of transferable skills. Andreas Schleicher of the OECD, responsible for the influential Programme for International Student Assessment (PISA), notes that:

> "Educational success is no longer about reproducing content knowledge, but about extrapolating from what we know and applying that knowledge to novel situations. Education today is much more about ways of thinking which involve creative and critical approaches to problem solving and decision-making.[86]"

11. The Design Council believe it is important to look beyond mathematics and physics to ensure the capability of adopting different "*ways of thinking*" is safeguarded as part of the engineering skills base. Other organisations such as SEMTA, and EEF through their three-year employer skills survey (reporting back in November 2012), are best placed to respond to the specific skills needs in more detail.

Do employers in the engineering sector prefer an academic or a vocational profile?

12. The range of job roles in the engineering sector is wide-ranging and diverse. Some require an academic profile (eg Chartered Engineer) some require a vocational profile (eg Technician)—but increasingly the sector requires a combination of both. The nature of engineering, and specifically engineering design, means students need a combination of science and arts aptitudes, both academic and practical.

13. Design & Technology is the only subject in the curriculum that proactively supports the development of innovation, creativity and entrepreneurship—providing a pivotal connection between art and science, and

[82] Sir George Cox. *The Cox Review of Creativity in Business.* 2005 http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/coxreview_index.htm

[83] Ertas, A. & Jones, J. (1996). The Engineering Design Process. 2nd ed. New York, N.Y., John Wiley & Sons, Inc.

[84] Design Council website http://www.designcouncil.org.uk/our-work/leadership/Designing-Demand/What-is-Designing-Demand/

[85] Commission of the European Communities. *Commission Staff Working Document: Design as a driver of user-centred innovation.* Brussels, 7.4.2009 SEC(2009)501 final.

[86] Source: Restarting Britain: Design Education and Growth. A report by the Design Commission, December 2011.

producing the rounded learner with the ability to challenge existing "*ways of thinking*". This is because of its focus on the practical as well as the theoretical, which requires intelligent thinking alongside intelligent making.

In a recent OECD blog post Charles Fadel—Founder & chairman of the Center for Curriculum Redesign and Vice Chair of the OECD Education Committee—states:

> "There is a profound need to rethink the significance and applicability of what is taught, and to strike a far better balance between the conceptual and the practical."[87]

14. In particular we need to develop our capacity to innovate. As Dr David Grant, Vice President of The Royal Academy of Engineering states in its recent report—*Educating engineers to drive the innovation economy*:

> "We believe the best way for the UK to achieve this long-term financial prosperity is to increase our capability and capacity for innovation. The UK remains home to some of the very best designers and engineers in the world, but an incomplete understanding or application of innovation processes means that many of their good ideas will go no further than the drawing board or the computer screen."[88]

15. The Design Council's Innovate for Universities[89] programme, recommended in the Department for Business, Innovation & Skills' *Innovation & Research Strategy for Growth*, shows how the design process can be used to turn research and ideas into commercial propositions. Educational pathways that cater to this need should be developed. The programme taught Technology Transfer Managers a number of things including:

- Using design methods to solve problems.
- Taking a user-centred approach to technology development.
- Finding new markets and applications for technologies.
- Managing design projects to develop products, communications and brands.
- Developing products, communications and brands.

What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?

16. Recent significant changes include: the introduction of the English Baccalaureate, University Technical Colleges and Studio Schools; downgrading of vocational qualifications; and the potential removal of Design & Technology from the Secondary National Curriculum.

17. There is a significant risk in syphoning off and separating out what are perceived to be purely academic (EBacc) from what are perceived purely practical (UTC) approaches through the systems and structures that inform the way we teach and learn. There is almost universal agreement from industry, academia and government that a broad and balanced curriculum—till at least aged 16—is crucial to developing the future workforce. However, due to geographical location, as few as 1% of students will have access to the new University Technical Colleges. This lack of equal access and the push for early specialisation will also impact on the diversity of the workforce, particularly if D&T is no longer formally part of the Secondary National Curriculum and no longer an entitlement that provides an inspiring pathway for a range of different types of learners to pursue a career in engineering.

18. The EBacc provides little space for students to take additional subjects beyond a prescribed core. The Design Council endorses the view taken by the Design Commission, the Henley Review of Cultural Education and the Creative Industries Council (Skills Group) that an additional "creative" subject, such as D&T or Art & Design, should form part of the performance measure the EBacc is aligned too.

19. The current threat to the place of Design & Technology in the National Curriculum could potentially cause most harm. Design & Technology should remain a National Curriculum foundation subject from 5 to 14 with updated, streamlined programmes of study for key stages 1, 2 and 3 based on a coherent body of knowledge—both technical and conceptual. This must build on the Design and Technology that children will experience as a statutory part of the new Early Years Foundation Stage framework from September 2012.

20. The UK was the first country to introduce Design and Technology in the National Curriculum for all pupils from five to 16 (subsequently reduced to 14), this helped to secure our position as a leading design nation, and other countries strive to emulate practice in our primary and secondary schools and look to us for leadership. It is vital that we maintain this lead internationally by ensuring that children continue to be taught knowledge and skills in Design and Technology progressively, starting in primary and continuing into secondary.

Could the Government and others do more to raise the status of technical subjects?

21. The Government should do more to promote multidisciplinary approaches such as the Design Council's Design Challenges for Schools[90] model which relates technical skills to academic skills and links them to real

[87] http://oecdeducationtoday.blogspot.fr/2012/05/what-should-students-learn-in-21st.html
[88] http://www.raeng.org.uk/news/publications/list/reports/Innovation_Economy_2012.pdf
[89] http://www.designcouncil.org.uk/our-work/leadership/Innovate-for-Universities/
[90] http://www.designcouncil.org.uk/our-work/challenges/Schools/

life issues—an approach that resonates with students and parents alike. The Government needs to provide organisations delivering this type of learning an access point into schools. Through non-statutory guidance to schools the Government should promote the work of organisations that highlight the different range of engineering careers available (beyond traditional blue collar roles) such as Creative & Cultural Skills soon to launch "Get into Design" website and accompanying careers guidance programme which delivers live career experiences. The Government should provide additional promotion and support for these events to enable parents and teachers, as well as young people, to take part in the opportunities.

What more could be done to attract and retain a more diverse technically skilled workforce?

22. We have taken this question to cover two potential areas of diversity—gender/race/age/background and skills within the workforce.

23. The key issue in terms of diversity of the workforce is the minority of women represented in the engineering sector. Through our Design Challenges for Schools programme we promoted STEM subjects through design-led projects that tackled big issues in a local context, such as reducing our environmental impact or enhancing quality of life for older adults. This approach engaged a significantly higher proportion of girls than these same schools do through their STEM clubs. (See paragraph 12 above for further suggestions/ issues with diversity.)

24. Ensuring a diversity of skills within the workforce requires a similar approach. By recruiting a more diverse intake a more diverse set of skills emerge within the workforce. It is however important to recognize the value different skill-sets, beyond the traditional technical skills, offer to the engineering sector.

25. Kick-started as a result of the Cox Review recommendation for Centres of Excellence, and with Design Council support, Imperial College and Royal College of Art came together in 2007 to create *Design London*. As well as introducing MBA students to design thinking and design approaches, Design London selects MEng and postgraduate students from the Faculty of Engineering, Imperial College London and students, Research Associates and recent graduates from the Royal College of Art through its Fellowship scheme. Design London delivers teaching programmes to MBA, MEng, MSc, PhD and MA students in both institutions. Central to this is the provision of design-led innovation modules on four MBA courses at Imperial Business School under the heading of Innovation Design Engineering (IDE).

26. We commend this approach as one way forward in providing an interdisciplinary experience. The IDE programme is a leading-edge, creative product development course that involves experimentation, design, engineering and enterprise activities. In multidisciplinary teams or as individuals, participants work at the centre of complex, demanding projects with an emphasis on prototyping and proving propositions. The programme requires that a wide range of design skills and thinking are utilised (industrial design techniques, manufacturing, mechanical engineering, design research, user-centred design and sustainability, among others). It is external facing and encourages all to tackle important real-world issues involving advanced technical, design and social parameters. This approach is the future for our engineering sector and this is the skills base we need to prepare for.

June 2012

Appendix A

New fundamental principles for Design & Technology

To develop a design literate society by:

- Enabling children and young people to be critical consumers, users, commissioners and creators of design.
- Helping them attain an understanding of the world through promotion of critiquing skills and knowledge of the key contexts for design (for example, socio-cultural, historical, economic, technological, environmental, health, emotional and industrial).
- Demonstrating how *all* fields can benefit from using and being knowledgeable about design.

To build design and technology capability in its own right and to act as a bridge between arts, science, and business by:

- Enabling children and young people to be creative, innovative and entrepreneurial.
- Establishing a link to the arts through exploration and iteration of creative ideas and aesthetic appreciation applied for a purpose.
- Establishing a link to science by turning new and existing knowledge into innovative products, services and commercial opportunities.
- Establishing a link to business through the application of skills used in professional design practice such as team work, user-research, pitching, project management, financial management and marketing—in the classroom.
- Delivering learning through multi-disciplinary design-led projects.

To place human-centred-design approaches, methodologies and processes at the heart of learning by:

— Enabling children and young people to develop skills of ethnography, observation, envisioning, empathy, analytical thinking, co-design, usability testing.

— Understanding the role of sustainability and ethics in human centred-design.

— Empowering young people to be active citizens and agents of change for social as well as economic growth, which provides insight and understanding of the role of design in improving quality of life.

To focus on technical skills which relate to design processes in three-dimensional, digital and visual communication of information and ideas by:

— Developing knowledge of the emergent and current means of production, manufacturing and digital technologies.

— Developing skills that enable learners to translate their ideas into material form. For example: early stage proto-typing, key facets of interaction design and drawing for design.

To embed design and technology within an academic and cultural framework by:

— Establishing a relationship between theoretical approaches taught within design at Higher Education level and classroom practice to provide rigour and support progression.

— Grounding an understanding of contemporary design and technology within our domestic design heritage, historical and international design practice.

— Using museum design collections and exhibitions as a key resource.

To forge strong links with industry and the cultural sector to inspire future designers, engineers, technologists and manufacturers; and introduce cutting-edge practice to the classroom by:

— Bringing professionals into the classroom.

— Developing knowledge and insight of new genres, practices and careers in design (eg service design, behavioural economics, bio-mimicry).

— Delivering learning through case studies and live briefs related to a real world context.

These principles are endorsed by the following bodies:

— Council for Higher Education in Art & Design.

— Creative & Cultural Skills.

— Creative Industries Council Skills Group.

— D&AD.

— Design Business Association.

— Design Council.

— Design & Technology Association.

— Design Commission.

— Design Museum.

— Institute of Practitioners in Advertising.

— Royal Society for the encouragement of Arts, Manufactures and Commerce.

— Victoria & Albert Museum.

Currently under review by:

— Royal Academy of Engineering.

— EEF.

— E4E.

Written evidence submitted by EDF Energy

Introduction to EDF Energy

1. EDF Energy welcomes the opportunity to contribute to the Science and Technology Select Committee's inquiry into Engineering Skills. EDF Energy is part of EDF Group, one of Europe's largest power companies. The company employs around 15,000 people at locations across the UK.

2. As the largest producer of low-carbon electricity, EDF Energy produces around one-sixth of the nation's electricity from its nuclear power stations, wind farms, coal and gas power stations. The company supplies gas and electricity to more than 5.5 million business and residential customer accounts and is the biggest supplier of electricity by volume in Great Britain.

OVERVIEW

3. Ensuring there is a skilled, productive engineering workforce is a major area of focus for EDF Energy. Research by Government and independent skills bodies is consistent in finding that the skills gap within the energy sector could begin to be felt most keenly between 2015 and 2025. This is a crucial time for maintaining secure, affordable and low carbon energy supplies within the UK as older nuclear and fossil fuel plants are decommissioned and taken off line.

4. Building, maintaining and operating power stations requires a diverse range of engineering skills. Nuclear power stations in particular are some of the largest and most complex engineering systems in the world, and provide employment for engineers at technician and professional engineer level from all the main engineering disciplines. These include civil, mechanical and electrical engineering, materials technology, instrumentation and control, chemical engineering and others. Engineering-related roles account for approximately three quarters of EDF Energy's 3,000 nuclear sector jobs that need to be filled by the end of 2015.

5. EDF Energy faces two main challenges over this timeframe: the age profile of the existing workforce; and the need to build the pipeline for future workers as we embark upon major, multi-billion pound investments in UK's energy infrastructure. EDF Energy also faces the challenge of its future supply chain's skills capacity and capability as similar issues will be affecting these companies. All of these are compounded by the complex funding landscape. Simplified, flexible employer-owned funding will allow investment in the right areas at the right time to support the needs of nuclear new build in the UK.

Age profile of existing workforce

6. Engineering UK (2011) advises that nearly half of those currently employed within the engineering sector are over 45, resulting in more than 500,000 posts becoming vacant over the period to 2017. In addition, the Gibson Review (2009) has warned of a predicted shortage of 300,000 skilled workers within the engineering industry by 2014. It will take time for organisations such as EDF Energy to transfer the specialist skills and implicit knowledge held by those approaching retirement to the current and future workforce. With an ageing workforce, a major challenge facing our industry now is ensuring effort is made to attract, develop and retain sufficient numbers of talented people.

Building the engineering skills pipeline for our investments

7. The other main challenge is to secure skilled, motivated engineering workers and an engaged supply chain. This is a critical part of being able to deliver EDF Energy's plans for new nuclear build on time and on budget. With our partner, Centrica, we are progressing with a strong and credible new nuclear project at Hinkley Point in Somerset. Our proposed two European Pressurised Reactors will generate low carbon electricity for around 5 million homes (6% of the UK's electricity) saving 12 million tonnes of CO_2 emissions a year

8. As the company leads the way for other investors in nuclear, the following new nuclear programme envisaged under the Government's National Policy Statements for Energy Infrastructure, is expected to generate tens of thousands of jobs across the industry. It is expected to provide an annual boost to GDP of 0.34% for 15 years,[91] equivalent to £5.1 billion annually, and develop strong export capability. It is projected that this will increase from £700 million annually, to between £1.1 billion and £1.6 billion per year by 2030.

9. With unprecedented levels of investment into the UK's energy infrastructure forecast over the next two decades, there will be a major opportunity for levels of engineering skills to contribute to the success of the UK economy. We are also taking the steps necessary to ensure we proactively tackle the productivity challenge faced by the UK.

10. This response addresses in turn the questions raised in the Committee's call for evidence.

Does the current engineering skills base meet the needs of employers? Do employers in the engineering sector prefer an academic or a vocational profile?

11. The UK has a very strong engineering tradition, and established courses provide a sound basis to build upon to meet future requirements. Both academic and vocational routes to qualification provide important and valuable routes in to engineering. However, it is not clear that enough is being done in a coordinated way by Government to address future needs. Demand for apprenticeships currently outstrips supply. There is also a need, particularly in the construction industry, to ensure that sufficient numbers of people with the right combination of skills are developed in order to take on first line supervisory roles. These staff require not only vocational or technical qualifications (not necessarily to graduate level), but also management and leadership skills.

12. We welcome the recent announcement from BIS that the minimum duration of apprenticeships will increase to one year. This step to help establish minimum standards for apprenticeships will help attract, develop and retain sufficient levels of talented people. We also welcome the launch of the Richard Review of Apprenticeships, which provides an opportunity to support the rebalancing the UK's workforce towards sustainable growth areas in manufacturing, construction and the low carbon economy.

[91] Research undertaken by the IPPR on behalf of EDF Energy, full results to be published in June 2012.

13. To ensure that the engineering skills base is best suited to meet the company's needs as a significant employer in the energy sector, EDF Energy takes a proactive approach to engaging with learners at all stages.

14. School engagement programmes are aimed at inspiring and enthusing children aged between five and 19 years old, to encourage the take up of STEM (Science, Technology, Engineering and Mathematics) subjects. These subjects form the basis of a career in engineering, and will help build children's awareness of careers that are available in the energy industry. All activity is supported by STEM ambassadors that act as role models for the industry.

15. As part of their development, all new graduates to EDF Energy are encouraged to join our UK-wide network of over 260 STEM Ambassadors. These Ambassadors visit schools and colleges to encourage engagement in STEM subjects. EDF Energy is working with the Smallpiece Trust, a charity dedicated to encouraging young people into engineering, to develop a bespoke training programme to support our STEM Ambassadors.

16. Since 2008, our Pod programme to encourage sustainability in schools has helped to engage children in energy issues. The programme aims to help schools across the UK make a real and measurable difference to their energy usage and carbon output. The Pod now has over 15,800 registered schools and since the programme was launched it has engaged an estimated 6 million young people in sustainability.

17. For students aged between 15 and 17, EDF Energy offers work experience, Year in Industry courses, as well as routes into engineering apprenticeships. Our Nuclear Apprentice scheme lasts four years and upon successful completion, results in a nationally recognised qualification, the Advanced Modern Apprenticeship Certificate in Engineering.

18. We are also developing other routes into our engineering apprenticeships. The company's Pathway to Apprenticeship scheme is launching in September this year. Delivered by three colleges, the scheme is aimed at school leavers. It will provide an opportunity to gain key skills, especially employability skills, without having to have gained a required number of GCSEs at school. The scheme will help to strengthen candidates who may wish to apply for the Apprenticeship Scheme. It leads to a recognised City & Guild Level 2 in Engineering, and after successful completion of the one year course, there is an opportunity for an interview for EDF Energy's Apprenticeship Scheme.

19. For students aged 18 and over, summer internship schemes, industrial placements and scholarships aim to recruit students for the EDF Energy Technical Expertise schemes in nuclear science and engineering. These typically last for one year.

Partnership working

20. EDF Energy works closely with industry bodies to develop the engineering skills base needed to meet the twin challenges outlined above. The company's main skills partnerships are with the National Skills Academy for Nuclear, the EDT, STEMNET, the Smallpeice Trust, Jobcentre Plus, Business in the Community, Arrival Education, ECITB, CITB and the National Skills Academy for Construction.

21. EDF Energy has strong links with a number of key educational establishments and at all levels of the educational sector. Within Higher Education, the company has identified 13 UK universities of strategic importance in the attraction of highly talented and skilled graduates to our Graduate Programmes. Through a partnership programme for intensive engagement with students at these universities, EDF Energy has been highly successful in preparing students for careers within the company. The 13 universities have proven to be highly successful with 65% of their graduates passing the final interview.

The need for both academic and vocational profiles

22. EDF Energy considers both academic and vocational profiles as equally valuable in developing the company's future skills pipeline. We need to draw skilled candidates from a range of professions and sectors, with diverse sets of experiences and qualifications to ensure that the complex engineering challenges we face in the future benefit from a multitude of perspectives and problem solving approaches.

23. In addition to working with Government departments on specific policy levers to support engineering skills, we believe that there is a role for local authorities to work more closely with schools and colleges. This would help ensure that local education providers are aligned to delivering what is needed for the local employment market, now and into the future.

24. To support this, the company is making its own investments in the engineering skills base in the UK. In April this year EDF Energy announced a further investment of £1.6 million in West Somerset's Community College to support training in specific skills and apprenticeships. This will be complemented by the £15 million investment the company is making to establish a world class industry training centre in partnership with Bridgwater College.

25. EDF Energy is also keen to look across the engineering sector into areas such as manufacturing and aerospace. Many common skills reside within the engineering capacity that, with appropriate upskilling, could

well serve EDF Energy's future skills needs. EDF Energy's plans for new nuclear build will also require additional engineering skills for the development and construction of the next generation of reactors.

What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?

26. The downgrading of GCSE equivalence for the engineering diplomas in the sector can only be seen as detrimental to the recruitment of young people into the sector. Devaluing a respected diploma seen as "robust and attractive" by the engineering sector will only make it harder for young people to be attracted to the sector if the principal focus is taken away from engineering.

27. We welcome the proposed changes to fund 14 to 16 year old education in Further Education colleges in England. We anticipate that this will go some way to mitigate against the changes above.

How do the approaches taken by the Devolved Administrations to produce a technically skilled workforce differ to the current approach in England? What are the strengths/weakness of the different approaches?

28. We are not in a position to comment on this issue.

Could the Government and others do more to raise the status of technical subjects?

29. EDF Energy believes that more could be done by Government to raise the status and attractiveness of technical subjects. The age at which learners start to disengage with STEM subjects can be seen in very young learners. In addition, the proportion of students taking STEM degrees has declined over the last decade. A Centrica study in 2010 of 2,000 A-Level and University students across all subjects, shows that 55% are not considering a career in science, technology or energy. In the South West of England, local to EDF Energy's proposed new nuclear build, the challenges in particular include low aspiration among local young people, reduced employment opportunities in the wider economy, inconsistent career advice and guidance, poor school performance and low take up in STEM subjects.

30. To tackle these challenges, EDF Energy proactively engages with the Department for Education and other Government Departments to address the steps needed to raise the status of technical subjects.

31. EDF Energy's school engagement programmes provide tools and resources to encourage and maintain a wider interest in STEM at all stages of the curriculum in the United Kingdom. The company also works with children and students to increase awareness of career paths and entry paths within the energy industry.

What more should be done to attract and retain a more diverse technically skilled workforce?

32. EDF Energy is committed to diversity and inclusion, and the company's Sustainability Commitments states that the company will "*have obtained a gold standard from independent experts for our approach*" in diversity and inclusion by 2012. We are on track to achieve this important commitment. Diversity Works For London Gold Standard's Framework has been chosen as the benchmarking tool as a first step towards further embedding diversity and inclusion within our business.

33. We have been pioneering approaches to widen our talent pools at the early stages of learners' lives. Our educational programmes start at the grassroots level to encourage a stronger and more diverse pipeline for the future. Our current activity also includes opening up our work placement opportunities to those who may traditionally not have taken up these positions. We have also been working with our partner universities to support students from diverse backgrounds who may wish to apply for our programmes. Our future planning includes programmes to help our current managerial population to be better equipped to integrate talent from diverse backgrounds.

June 2012

Written evidence submitted by Pearson

SUMMARY

With a growing proportion of the UK economy based on the science, technology, engineering and manufacturing (STEM) sectors, Pearson recognises the importance of a sufficient supply of young people with the right skills to work in these sectors.

We agree that the study of STEM subjects from age 14 onwards is an important period in young people's educational lives as they are asked to make decisions influencing the career path they will follow. We think the Committee is correct to highlight that recent policy developments including the introduction of the English Baccalaureate (EBacc) and downgrading the importance of vocational qualifications in the accountability system could discourage the study of vocational qualifications, including engineering.

This paper sets out the clear need for support and attention to be given to students wishing to study STEM subjects at each stage as they progress through their post-14 education to ensure the UK's engineering skills needs are met now and in the future.

Pearson Approach

BTEC Levels 1–6—Pearson's internationally renowned suite of BTEC qualifications is widely recognised by employers and universities as the gold standard in vocational learning. Established for over 25 years, BTECs were the first qualifications to acknowledge that, in addition to purely academic learning on the one hand, and the work-based "apprenticeship" learning on the other, there was a legitimate "middle way" whereby students could learn about a particular career area or employment sector—gaining all the necessary industry-endorsed knowledge, skills and understanding they would need to gain employment or advancement in that sector—but taught and assessed within a full-time education setting.

These principles of school/college-based, teacher-assessed vocational learning, created through deep employer engagement, and nationally accredited with rigorous quality assurance, remain synonymous with the BTEC brand and qualification specifications today.

BTECs offer a complete vocational progression pathway within all sectors from Levels 1–5—and are studied by learners aged 14–19 as full-time school or college programmes, and part-time by adults. BTECs also form the Technical Certificate knowledge component of the BTEC Apprenticeship. Additionally we have recently developed a new suite of Level 6 Diploma qualifications in Mechanical, Electrical & Electronic, Manufacturing and Aeronautical Engineering, giving routes through to both Incorporated Engineering (IEng) and Chartered Engineering (CEng) status.

A core element of all BTEC developments remains significant employer/industry engagement. Within Engineering we have worked closely with the key SSCs (Cogent, E-skills and SEMTA) and their employer networks on the development of our BTEC and Apprenticeship qualifications. We are also working with Engineering UK and The Engineering Council on the design of our Next Generation BTECs and new Apprenticeship frameworks, and all the key professional engineering institutions regulated by the Engineering Council endorse the BTEC provision.

There are over 1.3 million BTEC registrations in the UK each year; the most popular courses are the Level 2 "First" programmes (490,000 learners, predominantly in schools) and Level 3 "National" programmes (245,000 learners, predominantly in FE Colleges). BTECs are widely recognised as a route into the engineering industry via further study at degree level; in 2009–10 over 7,500 BTEC learners went on to HE to study Engineering disciplines.

BTEC Apprenticeships—In 2010 Pearson launched its new BTEC Apprenticeships. BTEC Apprenticeships seek to combine the value of the Apprenticeship opportunity with the additional benefits of Pearson's own BTEC offer, including:

- Available across 23 different sectors with over 235 career paths to choose from.
- Built on core BTEC values of quality, flexibility, employability and progression.
- Offer learners unique progression opportunities via other BTEC programmes.
- Included value-added product surround to give learners a richer Apprenticeship experience including optional BTEC Workskills qualification, workbooks, and online e-learning.

A particularly relevant example is the new suite of Higher Apprenticeships currently in development, which includes frameworks for Engineering (Advanced Manufacturing, covering new and existing technology areas, such as Aerospace, Electrical/Electronics and Wind Generation), Life Sciences (Professional Science Technicians), and IT (Software, Web and Telecom Professionals).

GCSE and A-Level—Edexcel currently offers Design & Technology (D&T) GCSEs in five subjects: Electronic Products, Food Technology, Graphic Products, Resistant Materials, and Textiles Technology, as well as GCE A-Levels in Food technology and Product Design. We believe that the government's English Baccalaureate initiative and National Curriculum Review both stand to have an impact on the amount of D& T learning done in schools:

- We expect the EBacc to lead to a reduction in the take-up of GCSE D&T as some schools direct their more able students towards EBacc subjects.
- The National Curriculum review recommends that D&T is reclassified as a Basic Curriculum subject. While this change would make the subject compulsory at KS4, schools would be able to determine the nature of the provision, and anecdotal evidence suggests that some might seek to meet the requirement by offering as little as a day a term rather than a weekly timetabled D&T lesson.
- This will have a knock on effect on the GCSE entries as students won't be covering everything they need for the GCSE.
- Additionally there is a risk that schools with small numbers of D&T GCSE entries might stop offering the qualification altogether.

Diploma—Since the inception of the 14–19 Diploma, Pearson has actively embraced this qualification, launching in 13 lines of learning at three levels and winning an 80% share of the Diploma market:

- We worked closely with the Diploma Delivery Partnerships (DDPs) on the design of each new Diploma qualification, and in particular the new Principal Learning qualification.
- However the Coalition government's lack of support for the Diploma has necessitated the withdrawal by Pearson of all of its aggregated Diploma programmes (last registration cohort 2011–12); we will continue to take registrations for the Principal Learning qualifications as standalones until their accreditation expires in August 2013.
- We are currently engaging with UTCs as well as employers and professional bodies within the engineering sector to gauge whether there would be an appetite for us to extend or redevelop the Engineering Principal Learning (eg as a suite of smaller nested qualifications at Level 2 building up to the largest five GCSE size).
- Much of what we learned in designing the Level 2 Principle Learning in Engineering was carried across to the Next Generation Level 2 BTEC.

Pearson and the University Technical Colleges (UTCs)—Pearson is working closely with UTCs across the UK supporting and helping to shape their vision to devise a project-based curriculum led and informed by the needs of employers, industry and universities. UTCs are united in their "hands-on learning" approach and Pearson has committed to mapping both academic and vocational qualifications to real-world projects and challenges devised by those who know—that is, employers, industry and universities. These projects are undertaken in real work environments with real time constraints, thereby ensuring students have a meaningful learning experience of the world of work.

Pearson is also the co-sponsor of Harlow UTC specialising in environmental engineering and medical technology.

Pearson Recommendations

1. *BTECs to be appropriately recognised in school performance measures*—For a large proportion of 14–19 year olds, full-time vocational courses such as BTECs will remain the most appropriate route to a STEM career, taken alongside GCSEs or A-Levels as part of a broad and balanced curriculum as advocated by Alison Wolf. BTECs are widely understood and regarded by HE and employers alike, and have a critical role to play in providing the next generation of STEM technicians with the required underpinning knowledge to progress in their careers. We believe that every learner for whom a BTEC is the right qualification to maximise progression chances, or who wants to do a BTEC, should be able to do a BTEC. But the DfE's EBacc measure and recent school league table reforms could mean that BTECs in subjects like Engineering cease to be offered in some schools. The following two things will help ensure this doesn't happen:

- The Next Generation Level 2 BTEC Firsts in Engineering (being developed for first teaching in September 2012) need to be included on the DfE's 2015 list of "non-GCSE" qualifications eligible for Headline Measures recognition.
- Non-GCSE qualifications such as BTECs need to be recognised in Headline Measures and other school performance indicators such as "Best 8" at an appropriate equivalence (rather than every qualification counting as one subject irrespective of its size in glh terms); we recommend:
  - 120glh qualifications = 1 GCSE equivalence.
  - 240glh qualifications = 2 GCSE equivalence.
  - 360glh qualifications = 3 GCSE equivalence.

2. *NQF qualifications to be made eligible for inclusion in Apprenticeship frameworks*—Pearson develops many 100s of vocational qualifications, each one designed in consultation with relevant stakeholders (employers, SSCs, professional bodies, HE etc.) to maximise progression opportunities for learners.

3. For some qualifications the Qualifications and Credit Framework (QCF) is the most appropriate framework eg for learners who want to undertake bite-sized chunks of learning, with the opportunity over time to build up to a full programme. For others the National Qualifications Framework (NQF) is the most appropriate framework eg for full-time learners where a qualification of substantial size is required and there is value in a synoptic element to draw together the different units.

4. Our Next Generation of BTEC qualifications are being designed on the NQF at Level 2, and probably also at Level 3, as this is the most fit-for-purpose framework. These Next Generation qualifications will, in time, replace the current suite of QCF BTECs, many of which are firmly established as the technical certificate component of Apprenticeships. Currently only qualifications developed on the QCF are eligible for inclusion in Apprenticeship frameworks. This is arbitrary and fails to recognise the complexities of appropriate qualification design.

5. We recommend that BIS are proactively lobbied to get an amendment to the Specification of Apprenticeship Standards for England (SASE) to allow the inclusion of NQF qualifications.

6. *NQF qualifications to be funded post-19*—Through its BTEC qualifications Pearson offers a complete framework of qualifications across the STEM industries that enables vocational learning aligned to industry requirements from level 1 to level 6. This employer-led provision is designed to be delivered in a flexible manner either in the workplace or through learning institutions such as FE colleges and Private Training Providers.

7. We believe that the decision to fund only QCF qualifications post-19 is not in the interests of older learners as it prevents them from pursuing the next generation of A level equivalent programmes, many of which are being developed on the NQF. Qualifications on the NQF are accredited by Ofqual and funded for pre-19 study. They should be funded for post-19 study too.

8. *High quality IAG in schools*—It is widely reported that the Science, Engineering and Technology (SET) Technician workforce is facing challenges including an ageing workforce and the need to recruit a further 450,000 roles by 2020. Yet there is a lack of awareness among young people of Technician roles: a recent Ipsos/MORI survey showed that 63% of young people know nothing about Technician careers, and 73% wouldn't want to work as a Technician. This can mean that learners of this age make choices at 14 and at 16 which effectively close down these opportunities to them. This is compounded by the incentives mentioned above for schools not to offer the relevant technical qualifications at KS4. We regard it as critical that high quality information, advice and guidance is given to school pupils throughout their 14–19 education, and particularly in Year 9 and Year 11.

9. *Clarity of government messaging*—Government needs to be clearer in its communications that the English Baccalaureate is only one of a number of educational pathways, and that—in line with the recommendations of the Wolf Review—a broad and balanced curriculum at Key Stage 4 including an appropriate balance of "academic" and high quality vocational qualifications is as highly valued

June 2012

Written evidence submitted by the Environment Agency

1 Summary

1.1 The Environment Agency welcomes the opportunity to contribute to this Inquiry. We rely on engineers to provide a broad range of outcomes including flood and coastal risk management and the regulation of nuclear sites in England and Wales. We employ mainly civil engineers, but also electrical, chemical, mechanical and other engineers, both directly and through consultants and contractors.

1.2 The Flood and Water Management Act (FWMA) 2010 established new roles and responsibilities for the Environment Agency, Local Authorities and others involved in flood and coastal risk management. The Environment Agency has been working with Defra, Welsh Government, Lead Local Flood Risk Authorities and other risk management authorities to understand the skills and capacity that will be required to implement the FWMA, including managing flood risk from all sources.

1.3 We have established a successful River and Coastal Engineering Foundation Degree and provide a structured development Programme for graduate engineers. We have provided training to 174 Local Authorities through over 70 workshops on the FWMA.

1.4 We are mindful that when the economy improves there may be consequences for staff retention and our technical resilience. The recent resurgence of the nuclear sector has had a marked impact on our ability to recruit experienced staff. We have addressed this though a strategic workforce plan which is addressing measures to recruit staff from a wider range of backgrounds, as well as measures to improve staff retention.

1.5 The Environment Agency has various Statutory Duties. For example the Reservoirs Act 1975 exists to ensure that large raised reservoirs are safely constructed and maintained to prevent dam and reservoir failures, and the catastrophic flooding that could result. The Act requires the Undertaker (owner and operator) of a large raised reservoir to employ a qualified civil engineer (QCE). The Defra Secretary of State appoints QCEs to certain engineering panels, following an application and interview process managed by the Institution of Civil Engineers. The main two panels are the Inspecting Engineers (IE) and Supervising Engineers (SE).

1.6 In the UK, there are currently 42 Inspecting Engineers and 164 Supervising Engineers. We estimate that a core of 40 Inspecting Engineers and up to 300 Supervising Engineers are needed. The number of Supervising Engineers has dropped from 400 in 1987 (following the implementation of the Reservoirs Act 1975) to 164. Although there are now more opportunities for potential Supervising Engineers to gain the necessary experience, many employers (especially large, foreign-owned consultancies) see reservoir work as being high risk and low return. The age profile of these specialists is of concern as the majority of QCEs are over 55 years of age. The geographical distribution of QCEs also limits the availability of these engineers in some areas.

2 The Environment Agency

2.1 The Environment Agency was set up under the Environment Act 1995 and is the leading public body for protecting and improving the environment in England and Wales. We employ around 11,500 people and have an annual budget of about £1.1 billion.

2.2 One of our roles is to protect people, property and the environment from flooding in accordance with overall policy and funding agreed with Defra and/or the Welsh Government. Our work includes the provision, maintenance and operation of inland and coastal flood defences, which range from earthen floodbanks to complex engineering structures like the Thames Barrier. We have been given a strategic overview role for flood and coastal risk. We are reliant upon the services of engineers within the Environment Agency, and also the consultant and contracting industries that we employ.

2.3 Another of our roles related to engineering is in our regulation of nuclear sites. Our assessors and regulators include graduate engineers and scientists from a variety of disciplines (eg chemical, mechanical and nuclear). They play an important role in ensuring that the environmental impacts from nuclear facilities are minimised and that radioactive waste is safely disposed of. In addition to existing sites we have been working with the Office for Nuclear Regulation on the assessment of new reactor designs.

3. Information For The Committee

3.1 *Does the current engineering skills base meet the needs of employers?*

3.1.1 The Environment Agency, Lead Local Flood Authorities, Internal Drainage Boards and other organisations within the flood risk management sector currently draw their engineering skills from a broad range of development routes. These include civil, mechanical, electrical, structural and drainage engineering.

3.1.2 Since 2004 the Environment Agency has developed a suite of further education courses in river and coastal engineering in partnership with the University of West of England. This programme of bespoke further education courses was developed to ensure resilience in key technical posts which were difficult to recruit to through conventional recruitment activities.

3.1.3 Access to these courses was extended to Lead Local Flood Authorities in 2009 through the Defra Capacity Building Strategy to address capacity issues arising from the introduction of the Flood and Water Management Act 2010. Each LLFA which benefits from the programme contributes funding towards the costs of a trainee. The core programme is funded by a Defra grant.

3.1.4 There are three further education courses in the current programme:

- Foundation Degree (FdSc)—Two years full time for students;
- BSc "top-up" course building on the FdSc to provide a BSc level qualification (three years part time for existing employees);
- Graduate Diploma aimed at numerate graduates with a non-engineering degree to acquire technical knowledge and skills required in flood and coastal risk management (four years part time for existing employees).

3.1.5 The Foundation Degree has produced 126 graduates between 2004 and 2011 for the Environment Agency. Since it was made available to LLFAs there have been a further 19 trainees who have graduated and joined local authorities. Within the next two years a total of 65 students are due to graduate, 50 working within LLFAs and 15 within the Environment Agency. Over 70% of the graduates having gained employment within the Environment Agency or LLFAs.

3.2 *Do employers in the engineering sector prefer an academic or a vocational profile?*

Flood Risk Management

3.2.1 The Environment Agency requires both backgrounds depending on the type of jobs needed to achieve our objectives. At the entry level for technician engineers we have had most success adopting a work-based learning approach supported by local mentors integrated with a university delivered academic course. This has resulted in graduates "ready to work", easier transition to employment, lower drop out rates than comparable university courses and high retention rates following graduation.

3.2.2 At the conventional university intake level for engineering graduates the Environment Agency runs structured professional development schemes, accredited by either the Institution of Civil Engineers (ICE) or the Chartered Institution of Water and Environmental Management (CIWEM). The Environment Agency has doubled the number of professional engineers we employ in key flood and coastal risk management posts from 76 in 2005 to 152 in 2011.

3.2.3 As part of their professional development, recruits from both the academic and vocational routes are encouraged to take up the role of a Science, Technology, Engineering and Mathematics ambassador for a period of time, to work with local schools to encourage the next generation of engineers and scientists.

Nuclear

3.2.4 In our nuclear work we use staff from an academic background. We have responded to the shortage of engineers and other technical staff we need for nuclear regulation by diversifying our recruitment activity. Traditionally we recruited experienced staff directly from the nuclear industry but we now:

— recruit some regulators from other regulatory disciplines, developing their nuclear expertise in house;

— contribute to bursaries and provide placements to students through Viridian Partnership's Empower scheme (which provides MSc students with exposure to the Nuclear Sector through research project placements, lecture days, visits and networking opportunities); and

— sponsor students through the nuclear industry's "nuclear graduates" scheme.

June 2012

Written evidence submitted by The Engineering and Machinery Alliance (eama)

The Engineering and Machinery Alliance represents circa 1,700 firms from 12 different trade associations (please see the masthead), mostly SMEs in the mechanical engineering sector with sales of some £8.5 billion.

They account for a quarter of the UK's mechanical engineering output, and according to HM Customs' data, sector exports account for about 70% of sector sales.

Typically, our companies supply 'enabling technologies' to other sectors (eg automotive, aerospace, medical, power, printing and food industries) in the form of machinery or packages combining services and products.

1. *Does the current engineering skills base meet the needs of employers? Do employers in the engineering sector prefer an academic or a vocational profile?*

The industry has a problematic skills profile because of the decline in the numbers of new entrants over the last three decades.

In a recent EAMA survey, skills were rated the second most important issue after finding new customers—just as they were in 2007 before the economic downturn. Forty-two per cent of firms said they don't expect to recruit new full time staff with the skills they are missing. Ninety-five per cent said they will have to train existing staff or apprentices to fill those gaps.

Anecdotally we hear how a lack of skilled workers is stopping many firms expanding their business. So the base isn't meeting employers' needs. And the sector skills council estimates that manufacturers will need to recruit 82,000 engineers, technologists and scientists between now and 2016. Meanwhile, apparently only 15% of sector firms recruit apprentices.

Through our membership of the European engineering federation Orgalime, we also know the UK isn't alone in this. The lack of skilled workers is a major issue for companies in many other Member States including Germany, Denmark, Sweden and The Netherlands. However, although others share the same problem, their situation is generally thought to be more favourable than the UK's.

Many employers have a need for entrants from both the academic and the vocational route. In fact, in practice the routes are merging, or at least the cast iron demarcations of previous decades are nearly a thing of the past. For example, one firm in EAMA's membership progresses as many as 70% of its technical apprentices to higher education. But to get to the reality it's important to contextualise these sorts of observations. Clearly, company skills and training requirements are specific, eg are we talking about big or small companies, higher or intermediate skills, general engineering or high precision.

When it comes to SMEs for example, company pay profiles can lead to very different perceptions about recruitment in pretty much the same market. But also to a very different perception about how to go about resolving the skills shortage (training to fill a particular gap/need) as compared to a large company (working with a well identified skills framework).

2. *What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?*

The recent changes introduced by the Department for Education reduce the options open to young people. As much as engineering companies welcome the more rigorous demands on English and Maths, they are very disappointed by the downgrading of the Engineering Diploma from the equivalent of five GCSEs to one.

Industry had participated in the design of the Diploma, which was considered to be a really good vocational qualification preparing young people for a successful long term career with excellent earning potential.

Industry also has some concerns that the current changes could reinforce the bias that's observable in some secondary schools against supporting pupils who decide they are better suited to a vocational route than an academic one for their future development. (Please see the evidence given to the BIS select committee by a

group of apprentices on 6 March www.publications.parliament.uk/pa/cm201213/cmselect/cmbis/83/120306.htm)

3. *How do the approaches taken by the Devolved Administrations to produce a technically skilled workforce differ to the current approach in England? What are the strengths/weaknesses of the different approaches?*

Employers find it easier to get to see a Minister in the devolved administrations than in England. As a result the concerns of SME engineering firms may well appear to be much better understood than in England.

For example, in 2008 as the broader impact of the economic crisis on skilled workers became more apparent, the Welsh Assembly Government introduced a £48 million scheme to help firms support short time working so that they could keep skilled workers on their payroll rather than be forced to let some of them go to protect the long term viability of the company as a whole.

In fact more than that, companies were encouraged to use the lull in business to upskill their workforce in preparation for new business opportunities once more normal times returned.

4. *Could the Government and others do more to raise the status of technical subjects?*

There seems to be a dichotomy between BIS and DfE on the importance of technology and related subjects. It will be much better for the country and for young people going through the educational system when there's a clearly settled approach and the two departments pull in the same direction.

A key element for all approaching the world of work is receiving timely, meaningful and practical information, advice and above all guidance about career paths and opportunities tailored to the individual. There are just too many examples of schools not handling this aspect well as most parents will probably attest from their own experience.

Please also see reference to the Engineering Diploma above (2).

5. *What more should be done to attract and retain a more diverse technically skilled workforce*

A key competitive consideration is that UK firms must have the freedom to recruit the specialist skills they need if they are unable to recruit them locally.

Our internationally competitive high-tech companies need top class engineers in their chosen disciplines as well as a raft of supportive technicians.

For example, Germany and Japan lead the world in control systems. Unsurprisingly, those countries also produce the best control engineers. Stopping UK companies recruiting from Japan means that UK companies aren't going to be cutting edge leaders in their chosen field. Hobbling them in this way therefore makes them less competitive and reduces their export potential. The top cryogenics companies worldwide recruit from Russia etc.

It's vital that business is able to recruit from the best worldwide to help raise UK standards in further education, research establishments and of course in the companies themselves.

Foreigners studying for second degrees here should be encouraged rather than constrained from working here as a rapid way to fill the gaps the UK education system has thrown up in STEM subjects at advanced levels.

(Please refer to ProAct in Wales as a means of sustaining and even developing skills during the current downturn 3 above).

Government setting the parameters for a potential UK solution for short time working, perhaps adapting the framework of the German insurance based scheme and by involving experts from the UK insurance industry, major manufacturers and some supply chain SMEs for a practical solution could be a useful start to the approach in England. (Note: A well designed practical scheme could also have an important impact on young people's career decisions if it helps create a more stable employment environment.)

November 2013

Written evidence submitted by British Airways

Introduction

British Airways welcomes the opportunity to contribute to the Science and Technology Select Committee's inquiry into UK Engineering Skills.

British Airways is one of the world's leading global premium airlines and the UK's largest international scheduled airline, carrying approximately 35 million passengers worldwide annually, on around 800 daily flights. The airline employs around 40,000 people, the vast majority of these at its sites throughout the UK, and has an annual turnover of £8.5 billion.

The airline's two main operating bases are London's Heathrow and Gatwick airports, with a smaller base at London City airport serving New York and European business destinations. From these three, British Airways flies 279 aircraft, to 173 destinations, in more than 80 countries. In addition to passengers, the airline also transports cargo—more than 785,000 tonnes of cargo are carried around the globe each year.

In 2010, the airline completed its merger with Iberia of Spain to create the International Airlines Group (IAG). Our combined business offers flights to 205 destinations throughout the world on a fleet of 415 aircraft. It also commenced a joint business agreement with American Airlines, which further extends benefits for its customers. The combined network of British Airways, Iberia and American Airlines serves 453 destinations in more than 105 countries with over 5,180 daily departures.

In April of this year IAG completed its purchase of British Midland Limited (bmi) from Lufthansa. The bmi mainline business has been integrated into the British Airways business. This acquisition will provide British Airways with the opportunity to expand its network and provide major improvements for customers.

Summary

- British Airways believes there is a gap in the workforce skill set, in our view due to the fundamental lack of focus on manufacturing, engineering and technical skills in recent years when academic subjects have been more of the focus.
- The Government's introduction of University Technical Colleges (UTCs) is a positive development because they provide an effective model to develop the skills needed in engineering. We welcome any initiative that encourages the uptake of technical subjects and especially encourages more women to enter into the world of engineering.
- The Welsh Government have been hugely supportive in producing a technically skilled workforce. The Scottish Government recognises the importance of the engineering and manufacturing sectors in Scotland, and is improving its long-standing support for business. In the future we hope the Westminster Government's policy on engineering skills will broaden its focus and provide more support for larger employers in England.
- British Airways believes that the Government urgently needs to ensure that children are made aware of technical subjects as early as possible in their school life.
- Engineering should be promoted as a valid and valuable career path across schools, further education establishments, in the adult career service, in the media and throughout Government. The old clichés about the industry need to be set aside and the industry presented as a new, modern forward-thinking sector.

Background

British Airways is one of only two UK airlines to undertake its major maintenance checks in-house in the UK, the other being Monarch Airlines. The Engineering team is critical to delivering the airline's operation of 800 daily flights across the world safely, and for looking after many other airlines' aircraft at our key global bases.

British Airways Engineering is a £900 million business employing more than 5,200 engineers in a broad range of highly-skilled and technical roles across facilities in the South East of England, South Wales and Scotland. There are three operations in South Wales—B747 and B777 aircraft heavy maintenance at Cardiff Airport (employing almost 900 engineers and support teams); Avionics overhaul and repair at Llantrisant (250 employees) and Interiors maintenance at Blackwood (almost 250 people). British Airways Maintenance Glasgow, based at Glasgow Airport with a smaller operation at Prestwick, undertakes heavy maintenance on Airbus and B737 aircraft and employs 300 engineers.

In 2010, we introduced two apprenticeship schemes in Engineering in London after a gap of 16 years as we restructured our mainstream business. These are run in partnership with four colleges in the South East—Brooklands, Farnborough, Kingston and Uxbridge.

Also in 2010, the Industrial Apprentice programme began with an intake of 90 students. This has since risen to 120 in both 2011 and 2012. The Business Support scheme, where students learn and develop knowledge of areas such as inventory, planning, commercial, safety, quality, Human resources, communications etc, has grown from an initial intake of 15 in 2010 to 20 in both 2011 and 2012.

We also run apprenticeship programmes in South Wales and in Glasgow to support our heavy maintenance facilities. The schemes at both sites pre-date those run at Heathrow Airport. In addition, we have an Engineering graduate programme for 10 graduates each year.

In 2012, British Airways Engineering will have recruited almost 600 people—more than 250 mechanics and licensed aircraft engineers; 155 engineering colleagues from bmi; 140 apprentices; 10 graduates and 30 others from across the business and externally into other technical and general roles.

1. *Does the current engineering skills base meet the needs of employers? Do employers in the engineering sector prefer an academic or a vocational profile?*

1.1 The applicants and intake for industrial apprentices are of a high standard academically. However, they lack hand skills and airmanship, by which we mean an understanding of working in an industrial area and of safety and regulatory requirements in an engineering situation. There is also a significant lack of awareness of the impact that poor standards of airmanship can have.

1.2 Business apprentices often seem to have a better awareness, although many are still unprepared for life in a working environment.

1.3 Generally, there are problems recruiting technical instructors and aircraft qualified people. Around British Airways key maintenance bases there is no engineering base or "cluster" in West London, which makes recruitment difficult. In South Wales the situation is easier, and in Scotland, we struggle to find qualified engineers.

1.4 There is a gap in the workforce skill set, due we believe, to the fundamental lack of focus on manufacturing, engineering and technical skills in recent years when academic subjects have been more of the focus.

1.5 British Airways does not have a preference between a more vocational or academic profile. There are advantages to both vocational and academic, depending on the role. All our apprentices require five GCSEs at C grade or above, including Maths and English, and they will learn valuable skills and experience on the job.

2. *What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills base needed by the engineering sector?*

2.1 The Government's introduction of University Technical Colleges (UTCs) is a positive development because they provide an effective model to develop the skills needed in engineering. British Airways announced earlier this year that we will be partnering one of the first 15 UTCs to be created. We welcome any initiative that encourages the uptake of technical subjects and especially encourages women to enter into the world of engineering.

2.2 Only 4–5% of our industrial apprentices are female, reflecting accurately the proportion of applicants. Our experience is that at 16 years of age, females entering engineering are often more focused and determined than males of a similar age.

2.3 The business support scheme is more balanced, with a 50–50% gender split.

3. *How do the approaches taken by the Devolved Administrations to produce a technically skilled workforce differ to the current approach in England? What are the strengths/weaknesses of the different approaches?*

3.1 In Wales, the Welsh Government and its pre-devolution Welsh Development Agency have been hugely supportive in producing a technically skilled workforce. The support extends across apprenticeship, training and development programmes, and has encouraged us to make conscious training decisions to move facilities to Wales. For example, we are currently considering an option to base a new composites facility that will require new skills and technology in South Wales, with a satellite at London Heathrow, based on the support available locally to undertake this specialist training and development.

3.2 British Airways has also entered into a partnership with the University of Glamorgan to offer a BSc in Aircraft Maintenance Engineering, under the auspices of our Civil Aviation Authority Part 147 designation as an approved training organisation. This course combines the airline's technical training with the university's degree programme. In September 2012, 61 students enrolled on the three year course, of which the vast majority are expected to enter into industry with an academic qualification and having completed the industry standard European Aviation Safety Agency (EASA) part 66 training, awarded under British Airways' licence. The Aircraft Maintenance Engineering course will benefit not just British Airways, but the aviation industry more widely in the UK, as a "regeneration of the gene pool" for the industry.

3.3 The need "for regeneration of the gene pool" is similar to the situation experienced in the 1980s and 1990s, when British Airways last ran its apprenticeship programmes. The knock-on effect at that time was a network of small and medium sized aviation and engineering businesses in West London and in the Heathrow area. These SMEs relied on large businesses such as British Airways to train apprentices and develop them into engineers, many of whom then moved into the SMEs to impart their skills and knowledge.

3.4 The Scottish Government recognises the importance of the engineering and manufacturing sectors in Scotland, and is improving its long-standing support for business. Although it currently lags behind the Welsh Government in its breadth and depth of support, it is attempting to close the gap and the signs are encouraging.

3.5 In the future we hope the Westminster Government's policy on engineering will broaden its focus and provide more support for larger employers in England. It is our experience that there is a lack of interest in supporting large employers, with the focus firmly centred on SMEs. However, this policy overlooks the key fact that it is the bigger businesses that undertake the greater investments in training and development; that

create more jobs, many aimed at 16–19 year olds; and whose activities have a positive knock-on effect for the SMEs as outlined above.

3.6 Aviation engineering suffers further from a lack of targeted support at the Department of Business, Innovation & Skills (BIS). Although the Department is to be commended for its support of the specialist aerospace and manufacturing sectors, aviation maintenance engineering, as undertaken by British Airways and other companies throughout the UK, does not fall into either sector as defined by BIS.

4. *Could the Government and others do more to raise the status of technical subjects?*

4.1 British Airways believes that the Government urgently needs to ensure that children are made aware of technical subjects as early as possible in their school life. Nursery and primary school education should promote science and engineering, and create a culture that values these subjects as much as English, Maths, Art, Music and Physical Education.

4.2 At the secondary school level, some schools are reluctant to open the door to engineering as an option for students, preferring instead to focus on academia and pushing students towards universities rather than practical roles and apprenticeships.

4.3 We believe there needs to be a review of what schools aim to achieve. Is their aim to maximise academic potential and pass exams, or is it to prepare children for a working life, and to maximise the potential of the individual in their chosen career?

4.4 Careers advisors should be recruited from, or at least supported by industry, under a revised joint business and Government approach to careers advice. We would encourage Government to work with the careers service in order to connect business, Local Employment Partnerships and schools.

4.5 Teachers and parents should be targeted in order to educate them of the value of engineering as a career, and Government and others should engage with employers to do this. We do not have a view as to whether Government actually carries out this role or simply provides funding or resources for businesses and employers to do so—but it is vital that it does happen.

5. *What more should be done to attract and retain a more diverse technically skilled workforce?*

5.1 Engineering should be promoted as a valid and valuable career path across schools, further education establishments, in the adult career service, in the media and throughout Government.

5.2 The old clichés about the industry need to be set aside and the industry presented as a new, modern forward-thinking sector. Much is discussed about the need to rebalance the economy—the same rebalancing should be applied to the employment market, with more encouragement and focus given to careers developing skills and technology.

5.3 Many engineering positions today are highly-technical roles that involve anticipating or solving problems, designing specialist technical systems, planning sophisticated modifications, etc, without the need for spanners, grease and dirty hands. It is also a challenging and evolving industry that rewards engineers with stimulation, job satisfaction and skills for life. Greater recognition of these personal benefits and the value of the sector generally to UK business is welcome, and would attract people to engineering.

November 2012

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