



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



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*Report, together with formal minutes, oral and
written evidence*

*Additional written evidence is contained in
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Science and Technology Committee

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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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Summary

Economic growth is a central ambition of the Government and crucial to the UK's global competitiveness and the Government considers engineering skills to be crucial to the Government's growth agenda. Unfortunately, there is a persistent shortfall in the numbers of engineers required to achieve economic growth, a situation that is likely to worsen unless radical action is taken.

We noted three key developments of interest in England: (i) the introduction of the English Baccalaureate as a performance measure in 2010; (ii) the introduction of University Technical Colleges; and (iii) reforms to vocational qualifications, particularly affecting the engineering Diploma.

We welcome the EBac's focus on attainment of mathematics and science GCSEs, which are important precursors for further study and careers leading to engineering. However, we are concerned that important subjects such as Design and Technology (D&T) are being adversely affected as schools focus on the EBac. Although the EBac leaves curriculum time to study other subjects, schools are likely to focus more on the subjects by which their performance is measured and less on non-EBac subjects. Therefore, the Government must consider how to reward schools and recognise performance in non-EBac subjects when it reviews the school accountability system. A Technical Baccalaureate (TechBac) is being designed that would combine technical qualifications with English, Maths and ICT at levels 2 and 3. We look forward to the Government's proposals for a Technical Baccalaureate with interest. If the TechBac is to be a success, the Government must endeavour to ensure that the TechBac does not suffer from the cultural misperception that plagues vocational education, namely that it is for less bright students. In addition, schools must be incentivised to focus on the TechBac. To achieve this, the TechBac must be equivalent to the EBac.

The Engineering Diploma was a qualification highly regarded by schools, employers and students, combining theoretical knowledge with hands-on practical skills. The Government's reforms to vocational education meant that Level 2 of the Engineering Diploma could not count as equivalent to more than one GCSE despite requiring curriculum time and effort equivalent to several GCSEs. The Engineering Diploma is currently being redesigned as four separate qualifications. The change in GCSE equivalence of the Engineering Diploma following vocational education reforms potentially sends a poor message from Government about the value of engineering education, which is at odds with the Government's frequently stated emphasis on the importance of engineering to the UK, and may lead to the Diploma being a less attractive qualification to schools.

University Technical Colleges (UTCs) are a welcome development and the limited evidence that is available suggests that they are effective providers of engineering education. However, the proposed network of UTCs will not provide nationwide coverage and thus the Government must also focus on good engineering education in schools and colleges. We have called for the Government to clarify its UTC targets, what it expects UTCs to achieve and how performance will be monitored. The lessons learned from

opening the first five UTCs must be shared with those involved in establishing new UTCs including engineering employers.

At first glance, recent educational reforms have the appearance of supporting engineering education. The rationalisation of vocational qualifications following the Wolf Review was generally welcomed, the EBac includes a focus on science and maths education and UTCs have met with approval from the engineering community. However, the devil is in the detail and some of the individual effects of such changes could be detrimental to engineering education, for example the recent changes to the Engineering Diploma following the Wolf Review. We consider that the Government's approach towards engineering education in some aspects has not been effective.

Our recommendation to the Department for Education (DfE), based on our experience during this inquiry, is that greater focus needs to be placed on evidence before future changes are made, and needs to leave sufficient time for evidence to be gathered on the effectiveness of its proposed changes before introducing further change.

We recommend that the DfE conducts a re-evaluation of its attitude towards the role of evidence in policy and decision-making.

1 Introduction

We want young people leaving school today to see engineering for the exciting, dynamic profession that it is, because in many ways, engineers are the real revolutionaries, the ones who take society forward, who create the technologies and the structures which carry us into new worlds.¹

Rt Hon David Cameron MP, Prime Minister, November 2011

1. The UK has a long tradition of producing engineers that change the world, from the civil engineers that facilitated the Industrial Revolution, to the electronic engineers that make today's digital world possible and the biomedical engineers pioneering tomorrow's life-saving technologies. The impact of engineering on our society is difficult to overstate. Successive Governments have recognised the importance of engineering in their rhetoric, focusing on the role of engineering and manufacturing in economic growth.² This report examines whether the Prime Minister's words match up to his Government's actions.

2. Select Committee inquiries in this Parliament and the last have been held on engineering. The Innovation, Universities, Science and Skills (IUSS) Committee published its Report on *Engineering: turning ideas into reality*³ in 2009, and produced *Putting Science and Engineering at the Heart of Government Policy* the same year.⁴ Both inquiries made recommendations to strengthen Government policy on engineering and the use of engineering in policy processes. In April 2012, this Committee published a short Report on *Engineering in Government: follow-up to the 2009 report Engineering: Turning ideas into reality* which found that much had improved in the relationship between engineering and Government, but warned that there was no room for complacency.⁵ But little select committee consideration has been given specifically to engineering education; the system through which our tradition of producing excellent engineers can be continued. Therefore, we agreed in June 2012 to conduct an inquiry into engineering education and skills. We invited written submissions from the public on the following questions:

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

¹ "Prime Minister's speech to launch Queen's Engineering Prize", Number 10, www.number10.gov.uk

² For example, "Oral statement: Manufacturing and Growth", Department for Business, Innovation and Skills, www.gov.uk, July 2011; and "£70 million boost for manufacturing", Engineering and Physical Sciences Research Council, www.epsrc.ac.uk, January 2010

³ Innovation, Universities, Science and Skills Committee, Fourth Report of Session 2008–09, *Engineering: Turning ideas into reality*, HC 50-I

⁴ Innovation, Universities, Science and Skills Committee, Eighth Report of Session 2008–09, *Putting Science and Engineering at the Heart of Government Policy*, HC 168-I

⁵ Science and Technology Committee, Fifteenth Report of Session 2010–12, *Engineering in Government: follow-up to the 2009 report Engineering: Turning ideas into reality*, HC 1667

- c) How do the approaches taken by the Devolved Administrations to produce a technically skilled workforce differ from the current approach in England? What are the strengths/weakness of the different approaches?
- d) Could the Government and others do more to raise the status of technical subjects?
- e) What more should be done to attract and retain a more diverse technically skilled workforce?⁶

3. We received 32 written submissions to this inquiry and took oral evidence from six panels of witnesses, including:

- Engineering employers;
- Young people who had recently experienced engineering education;
- Teachers and representatives of educational establishments;
- Professional engineering bodies; and
- The Government, including the Department for Education's Chief Scientific Adviser and two responsible Ministers (Elizabeth Truss MP, Parliamentary Under-Secretary of State (Education and Childcare) and Matthew Hancock MP, Parliamentary Under-Secretary of State (Skills), Department for Education and Department for Business, Innovation and Skills).⁷

4. We would like to thank those who provided written and oral evidence to this inquiry, with particular thanks to the JCB Academy for hosting the Chair's visit in November 2012.

5. At age 14, students reach an important milestone in education where they are asked to make subject choices influencing the career path they will follow. When announcing the inquiry we noted three key developments of interest in England: (i) the introduction of the English Baccalaureate as a performance measure in 2010; (ii) the introduction of University Technical Colleges; and (iii) reforms to vocational qualifications, particularly affecting the engineering Diploma.⁸ Our Report therefore addresses these three developments. We note that the impact of reforms to higher education on STEM subjects and apprenticeships have been the subject of other recent Parliamentary inquiries.⁹

6. Chapter 2 of this Report outlines the engineering skills gap and the UK's need for skilled engineers. Chapter 3 examines engineering education and choices at the critical period between 14 and 19 years. Chapter 4 examines how to encourage young people towards study and careers in engineering. Chapter 5 explores evidence and decision-making in the Department for Education and in Chapter 5 we set out some final conclusions.

⁶ "Committee announce new inquiry into Engineering Skills", Science and Technology Committee, www.parliament.uk

⁷ A full list of witnesses is provided at the back of this Report.

⁸ "Committee announce new inquiry into Engineering Skills", Science and Technology Committee, www.parliament.uk

⁹ House of Lords Science and Technology Committee, Second Report of Session 2012–13, *Higher Education in Science, Technology, Engineering and Mathematics (STEM) subjects*, HL 37; Business, Innovation and Skills Committee, Fifth Report of Session 2012–13, *Apprenticeships*, HC 83–I

2 The engineering skills gap

Needs of engineering employers

7. The UK's engineering sector comprises over half a million engineering companies employing 5.4 million people.¹⁰ The Royal Academy of Engineering explained that “the current engineering skills base is complex as engineering skills are deployed in all sectors of the economy”.¹¹ It estimated that there are 2.3 million “skilled people in the engineering-related skills base” making up eight per cent of the UK workforce.¹² This engineering workforce produces “one fifth of the national [Gross Domestic Product] and half of UK exports”.¹³ Engineering UK stated:

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.¹⁴

8. We wanted to determine whether there was a need to improve engineering education and skills in the UK and particularly whether the current skills base met the needs of engineering employers.¹⁵ Despite the size and productivity of the engineering sector, the evidence put forward by engineering employers overwhelmingly pointed to a worsening skills gap, both in the number and quality of engineers. For example, the Engineering Employers Federation (EEF) stated:

Companies strived to hold onto skills during the recession, and as demand has picked up again, more and more businesses are reporting difficulties in recruiting skilled workers they need to occupy jobs. Furthermore, manufacturers expect the problem to escalate with two-thirds of manufacturers predicting difficulties recruiting production staff in the next five years. This concern is shared by all companies, regardless of size or sector.¹⁶

9. The Royal Academy of Engineering has estimated that around 820,000 science, engineering and technology (SET) professionals will be required by 2020, with 80 per cent of these required in engineering.¹⁷ Lyn Tomkins, UK Operations Director, Sector Skills Council for Science, Engineering and Manufacturing Technologies (SEMTEA), stated “we need something like 82,000 engineers and technicians just to deal with retirements to 2016”.¹⁸ Engineering UK stated “the demand for skilled engineers and technicians is

¹⁰ “Engineering UK 2013: The state of Engineering”, Engineering UK, www.engineeringuk.com

¹¹ Ev 56 para 4

¹² *Ibid*

¹³ *Ibid*

¹⁴ Ev w50

¹⁵ This report focuses mostly on the needs of engineering businesses; however, the issues will generally also apply to public sector employers.

¹⁶ Ev 74 para 5

¹⁷ Ev w30 para 2

¹⁸ Q 3

strong; for example, the Technician Council estimates there will be a demand for 450,000 technicians by 2020".¹⁹ One indicator that the economy needs more graduate level engineers is "a persistent, sizeable wage premium for people holding engineering degrees" that has grown over the last 20 years.²⁰ Professor Alison Wolf's 2011 *Review of Vocational Education* noted that "the shortage of maths and science skills [...] is reflected in the fact that virtually every home student who applies for an engineering degree is offered a place, at a time when more and more applicants, overall, do not secure entry to university".²¹ Differences in career routes for engineers and technicians are explored in the next chapter.

10. As well as the sheer gap in numbers, the quality of engineers entering the workforce was also a focus of concern. For example, National Grid stated:

We are able to fill our vacancies currently, but this does not mean that we are generally satisfied with the adequacy of the engineering skill base in the UK. We currently screen some 25,000 applications in order to get some 280 trainees. Our observation is that the number of applicants with the competence and qualities we seek is not appreciably greater than the number we recruit, which implies a significant underlying weakness in supply for the skills we require.²²

British Airways has found that while "the applicants and intake for industrial apprentices are of a high standard academically", they "lack hand skills and airmanship" such as "an understanding of working in an industrial area and of safety and regulatory requirements in an engineering situation".²³ The quality of engineering education and skills provision will be covered in more detail in the next chapter of this Report.

11. As a consequence of the skills gap, the engineering industry "is struggling to recruit engineers" and consequently some companies have to recruit from outside the UK.²⁴ SEMTA stated that "31% of high tech manufacturing firms 'had recruited people from outside the UK owing to a lack of suitably qualified people from within the UK'".²⁵ However, as the Royal Academy of Engineering highlighted, recruiting from the international labour market is complicated by visa restrictions and "in certain sectors (such as defence) this is not an option".²⁶

Why we need more engineers

12. The UK's need for engineers will be driven by various factors, including replacement demand due to engineers leaving the labour market and expansion in some sectors, such as

¹⁹ Ev w50

²⁰ "Jobs and Growth, The importance of engineering skills to the UK economy", Royal Academy of Engineering, September 2012, www.raeng.org.uk

²¹ Department of Education, *Review of Vocational Education – The Wolf Report*, March 2011, page 76

²² Ev 53 para 4.1

²³ Ev w70 para 1.1

²⁴ Ev w51

²⁵ Ev 64 para 3

²⁶ "Jobs and Growth, The importance of engineering skills to the UK economy", Royal Academy of Engineering, September 2012, www.raeng.org.uk

nuclear new build and Information and Communications Technology (ICT).²⁷ The Royal Academy of Engineering highlighted the need for 830,000 SET professionals by 2020 “with a high proportion being engineers” and stated that “surveys [...] show that this demand will not be met by fresh graduates from UK universities” as there were “only 89,000 STEM graduates per year”.²⁸

13. Economic growth is a central ambition of the Government and crucial to the UK’s global competitiveness.²⁹ The Government stated in its 2011 *Plan for Growth* that “we should determine to become a world-leader in, for example, advanced manufacturing, life sciences, creative industries, green energy and non-financial business services”.³⁰ The Government considers that “manufacturing has been, and continues to be an important part of the UK economy”.³¹ The *Plan for Growth* noted that “manufacturing is the third largest sector in the UK economy after professional and business services and the retail sector in terms of share of UK GDP” yet acknowledged that “the supply of STEM skills still falls short of anticipated demand for technicians and engineers”.³² In November 2012, Lord Heseltine’s report *No stone unturned in pursuit of growth* stated that “UK industry [...] appears to be relatively less skills intensive and employs fewer graduates in professional and technical occupations than its major competitors” and that “no boom in growth can be achieved without a significant rethink as to how we develop skills in this country – both funding training and its delivery”.³³ When we asked Matthew Hancock MP, Parliamentary Under-Secretary of State for Skills, how improving engineering skills fitted into the Government’s growth agenda, he confirmed that it was “critical”.³⁴

14. Other engineering sectors are also crucial to the achievement of Government policies and ambitions. Two recent examples are: the Energy and Climate Change Committee expressed concern at the shortage of skilled scientists and engineers in its 2012 report on the *Future of Marine Renewables in the UK*,³⁵ and the Lords Science and Technology Committee noted that nuclear new build plans required significant numbers of STEM graduates over the next decade.³⁶ In general, the UK needs to:

maintain capability in civil engineering, engineering construction, electricity production and distribution, gas, water and sanitation, transportation, process manufacture, nuclear engineering, electronics, food manufacture, fuels, high-value

²⁷ “Jobs and Growth, The importance of engineering skills to the UK economy”, para 4, Royal Academy of Engineering, September 2012, www.raeng.org.uk; Q 141 [Dr Bill Mitchell]

²⁸ “Jobs and Growth, The importance of engineering skills to the UK economy”, Royal Academy of Engineering, September 2012, www.raeng.org.uk

²⁹ HM Treasury, *The Plan for Growth*, March 2011, page 3

³⁰ HM Treasury, *The Plan for Growth*, March 2011, page 3

³¹ “Manufacturing”, Department for Business, Innovation and Skills, webarchive.nationalarchives.gov.uk

³² HM Treasury, *The Plan for Growth*, March 2011, page 85

³³ Department of Business, Innovation and Skills, *No stone unturned in pursuit of growth*, October 2012, page 21

³⁴ Q 191

³⁵ Energy and Climate Change Committee, Eleventh Report of Session 2012-13, *The Future of Marine Renewables in the UK*, HC 1624

³⁶ House of Lords Science and Technology Committee, Third Report of Session 2010-12, *Nuclear Research and Development Capabilities*, HL 221, paras 118–127

materials, consumer products, IT, software and healthcare services. All depend on engineering knowledge and skills.³⁷

15. Despite the Government's recognition of the importance of engineering skills, particularly to the growth agenda, there is a persistent gap in the numbers of engineers required to achieve economic growth, which is likely to worsen unless radical action is taken.

Diversity in engineering

16. The statistics we received on the under-representation of women in engineering varied, no doubt due to different methods of gathering data, but are stark nonetheless. The Royal Academy of Engineering stated that “only six per cent of people in engineering occupations are women”.³⁸ The EEF provided international comparisons: “only nine per cent of engineering professionals are women compared to 18 per cent in Spain, 20 per cent in Italy and 26 per cent in Sweden”.³⁹ The EEF added that “nearly two-thirds of men who graduated in engineering and technology disciplines entered employment within engineering and technology”, whereas “for women this figure was [...] 45.8 per cent”.⁴⁰ Education for Engineering (E4E) explained that under-representation was not due to a lack of ability as, for example, “a higher proportion of females achieve A*–C grades in at least two science GCSEs and in mathematics GCSE compared with males”.⁴¹ A leakage of female students then progressively occurs in physics A-level, an important precursor to engineering undergraduate degrees, as “only around 20% of the cohort for physics A level are female” and in higher education “the proportion of women in engineering subjects falls to around 12%”.⁴²

17. Several written submissions also mentioned the representation of ethnic minorities in engineering, which was less straightforward. E4E differentiated between different ethnic groups, stating that “there is considerable variation in participation and attainment in sciences and mathematics at [Key Stage 4] across different ethnic groups”.⁴³ 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”.⁴⁴ EADS UK stated that because it “is not unusual now to see over 30% of the [higher education and postgraduate] intake from overseas”, the student body “is far more diverse than the UK population, except for

³⁷ “Jobs and Growth, The importance of engineering skills to the UK economy”, Royal Academy of Engineering, September 2012, www.raeng.org.uk, page 5

³⁸ Ev 59 [RAEng] para 20

³⁹ Ev 77 para 40

⁴⁰ Ev 78 para 41

⁴¹ Ev w40 para 44

⁴² *Ibid*

⁴³ Ev w38 para 19

⁴⁴ *Ibid*

gender”.⁴⁵ Therefore a crucial point was that “the issue here is not so much about having [diversity] as the opportunity (or lack of it) for different groups in UK society”.⁴⁶

18. Engineering employers recognised the need to improve diversity, particularly given the demand for skilled engineers. SEMTA stated that “enabling the entry of underrepresented groups and particularly women into professions which are traditionally and predominantly male is economically vital”.⁴⁷ Andrew Churchill, Managing Director, JJ Churchill Ltd., stated that women were “half of our potential pool of recruits, and to ignore it would be criminal at a time when we are short of skills. It is unconscionable and it makes bad sense”.⁴⁸

19. The lack of gender and ethnic diversity in engineering adds to the already significant skills gap. This is not a new issue and several organisations and initiatives exist to improve diversity in STEM⁴⁹ subjects and the workforce. For example, the Royal Academy of Engineering runs a “Diversity in Engineering programme that is funded [by Government] to the order of about £250,000 per year over the four-year spending review period”.⁵⁰ However, EADS UK, an aerospace and defence company, indicated that many organisations exist to improve diversity but “tend to focus on gender equality” even though “under-represented ethnic groups also need support”.⁵¹ Richard Earp, Education and Skills Manager at National Grid, stated “the reality [...] is that we have not moved the dial very far, for instance, in terms of female participation in engineering degrees. [...] One could conclude that none of this effort has been successful”.⁵² More optimistically, the Baker Dearing Educational Trust considered that “a lot of good work is already being done to promote careers in [STEM]” and that “these efforts are making a difference and must continue”.⁵³

20. In this chapter we have outlined the gaps in the engineering skills base with regards to the numbers, quality and diversity of engineers, in order to provide a backdrop for the remainder of the Report. These issues will be explored further throughout the Report. The next chapter focuses on the different educational and training options in engineering available for people aged 14–19 years.

⁴⁵ Ev w25 para 5.5

⁴⁶ *Ibid*

⁴⁷ Ev72 para 29

⁴⁸ Q 36

⁴⁹ Science, Technology, Engineering and Maths

⁵⁰ Q 155 [Dr Matthew Harrison]

⁵¹ Ev w25 para 5.3

⁵² Q 37

⁵³ Ev w8 para 37

3 Engineering education (14-19 years)

21. A key decision point in a young person's education comes at around 14 years, or entry into level 2 qualifications in England and Wales.⁵⁴ At this stage of the curriculum, students choose to study optional subjects alongside compulsory subjects such as mathematics and English, usually GCSE qualifications. Additionally, the option to study engineering as a discrete subject is often first presented to students at this age.⁵⁵ Our inquiry focused on 14–19 education, or Level 2 and 3 qualifications (equivalent to GCSEs and A-levels in England and Wales). However, we recognise the importance of inspiring younger people to consider engineering study and careers before reaching this stage of education, and we address this issue in more detail in the next chapter.

22. There are many ways of becoming an engineer. Education for Engineering (E4E) summarised the different paths to professional engineering:

- a) Work-located training, for example Advanced Apprenticeships (an integrated vocational and work-located learning path);
- b) Further Education (FE) college-based vocational education/training (classroom-based learning, possibly including working experience);
- c) University-based education, which may include a “sandwich” work placement and/or work experience (general or “academic” path);
- d) Non-formal and informal learning; and
- e) A combination of the above over a working lifetime.⁵⁶

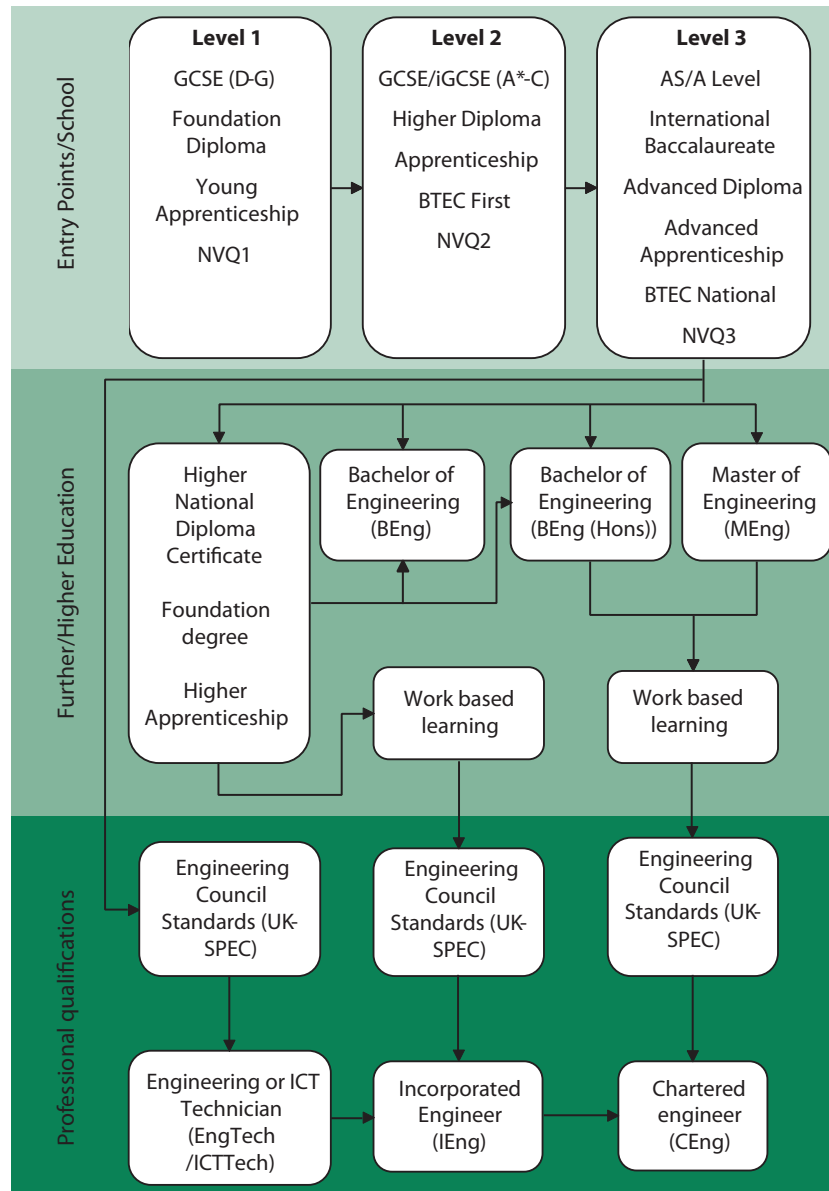
Examples of qualifications that can lead to careers or further study in engineering include science GCSEs (England, Wales and Northern Ireland), diplomas and apprenticeships.⁵⁷ Figure 1 illustrates the different career routes into engineering in England.

⁵⁴ We focus on England and the UK Government Department for Education as education policy is a devolved matter. England, Wales and Northern Ireland have historically had similar qualification systems whereas the Scottish education system is different.

⁵⁵ For example, the GCSE or Diploma in Engineering

⁵⁶ Ev w37 para 12

⁵⁷ “Some examples of qualifications for careers in Engineering and Technology”, Tomorrow's Engineers, www.tomorrowsengineers.org.uk

Figure 1: Career route map for engineering in England⁵⁸

23. When embarking on this inquiry we asked whether employers in the engineering sector preferred an academic or a vocational profile. The response affirmed that employers want engineers with both practical and theoretical skills. National Grid emphasised that engineering is, by its nature, both academic and vocational, and provided an example to illustrate the point:

Consider a technician with the problem of 'how can I make this motor run better?' It is useful if he/she starts with an understanding of the basic parameters that determine how a motor works—the academic knowledge [...]. He or she might then assess how these parameters could be varied in the situation at hand and then choose an option.

⁵⁸ "Career Route Map for Engineering in England", Tomorrow's Engineers, www.thebigbangfair.co.uk; Career route maps for Wales and Scotland are also available.

However, the outcome is likely to be better if he/she also has an appreciation of the practicalities of the tools and test equipment at his/her disposal, how to interpret drawings and data sheets, how to select components from standard ranges, and the likely time and cost of each option. Ideally he/she would also then have the practical skills to carry out some modification. It is this combination of academic understanding and practical application that delivers efficient solutions.⁵⁹

Education for Engineering (E4E) stated that “the distinction between academic and vocational is not useful” and “the concern should be with whether a qualification and experience profile is fit for purpose”.⁶⁰ National Grid considered the distinction to be “almost always unhelpful as it often implies a different standard of attainment: academic is somehow ‘cleverer’”.⁶¹

24. As good engineers need theoretical knowledge and practical skills to enter the profession at any level, engineering education and training must provide both.

GCSEs and the English Baccalaureate

25. On 20 January 2011, the Department for Education (DfE) announced a review of the National Curriculum in England.⁶² It was the Government’s intention “that the National Curriculum be slimmed down so that it properly reflects the body of essential knowledge in key subjects and does not absorb the overwhelming majority of teaching time in schools”.⁶³ The Review, covering Key Stages 1 to 4 (ages 5–16 years), “is considering which subjects beyond English, mathematics, science and physical education, if any, should be part of the new National Curriculum from September 2014”.⁶⁴ In September 2012, the DfE also launched a consultation on *Reforming Key Stage 4 Qualifications*, reflecting the DfE’s ambition “to restore rigour and confidence to our examination system at age 16”.⁶⁵ The rationale for reform was explained in the consultation document, which stated:

GCSEs were introduced with good intentions. In particular, they introduced the concept of an almost universal qualification that would allow students of all abilities to sit examinations in core subjects, and would provide them with a grade which recognised the progress they had made. [...] That principle of universality is one that we are determined to maintain.

However, there is clear evidence that the standards of our examinations have fallen over time, and that the expectations they set for our students are now below those of our international competitors. [...] Employers, universities and colleges are dissatisfied with school leavers’ literacy and numeracy, with 42% of employers

⁵⁹ Ev 54 para 4.8–4.9

⁶⁰ Ev w 37 para 8

⁶¹ Ev 53 para 4.10

⁶² “Review of the National Curriculum”, Department for Education, www.education.gov.uk

⁶³ “Review of the National Curriculum in England FAQs”, Department for Education, www.education.gov.uk

⁶⁴ “Review of the National Curriculum in England FAQs”, Department for Education, www.education.gov.uk

⁶⁵ “Reforming Key Stage 4 qualifications: consultation”, Department for Education, www.education.gov.uk

needing to organise additional training for at least some young people joining them from school or college.⁶⁶

The DfE's proposals included a new title for the qualifications, and stated that "given the extent of differences [...] between current GCSEs and our new qualifications, we do not believe it would be fair on students if we continued to use the title 'GCSE'".⁶⁷ The new qualifications would therefore be called English Baccalaureate Certificates (EBCs), and achieving EBCs in English, maths, the sciences, history or geography and a language would result in attainment of the full English Baccalaureate, a performance measure for schools and not a qualification in itself.⁶⁸ Schools would start teaching new qualifications in English, mathematics and the sciences from 2015, with students first entering the new exams in the summer of 2017.⁶⁹ The timetable for the introduction of qualifications in history, geography and languages will be determined following the Government's consultation.⁷⁰ The consultation document also stated that "there will be a separate consultation on reforms to the school accountability system" later in 2012 although the Government had not announced further details by the time this Report was published.⁷¹

26. The concept of the English Baccalaureate (EBac) already exists; the EBac was introduced as a performance measure in the 2010 performance tables. Currently the EBac is a means of recognising where students have achieved a GCSE grade C or above in the subjects outlined in the previous paragraph. Under the Government's proposals, EBCs would replace the GCSEs counting towards the EBac, but other GCSEs would continue to be provided. The core subjects were selected on the basis that they were "facilitating subjects" for progression to university, as identified by the Russell Group of universities.⁷² They are also intended to "encourage students to keep their options open for longer".⁷³ The EBac "is intended to give pupils greater opportunity to study in and beyond the vital core of English, mathematics and the sciences" and "has a particular focus on key subjects which have, in the past, been withdrawn from Key Stage 4 by some schools, even where pupils might benefit from them".⁷⁴ The Government argued that "the EBac also provides a firm basis for a wide range of technical routes post-16".⁷⁵ The EBac has so far only been applied to a small percentage of the Key Stage 4 cohort: the table below shows entry into and achievement of the EBac since it was introduced. Figures for 2011/12 are provisional.

⁶⁶ "Reforming Key Stage 4 qualifications: consultation", Department for Education, www.education.gov.uk, paras 3.2–3.3

⁶⁷ "Reforming Key Stage 4 qualifications: consultation", Department for Education, www.education.gov.uk, para 4.8

⁶⁸ "Reforming Key Stage 4 qualifications: consultation", Department for Education, www.education.gov.uk, para 4.9

⁶⁹ "Reforming Key Stage 4 qualifications: consultation", Department for Education, www.education.gov.uk, para 1.4

⁷⁰ "Reforming Key Stage 4 qualifications: consultation", Department for Education, www.education.gov.uk, para 1.4

⁷¹ "Reforming Key Stage 4 qualifications: consultation", Department for Education, www.education.gov.uk, para 1.5

⁷² "The English Baccalaureate", Department for Education, www.education.gov.uk

⁷³ Q 211 [Elizabeth Truss]

⁷⁴ "The English Baccalaureate", Department for Education, www.education.gov.uk

⁷⁵ Ev50 para 4

Table 1: Entry into and achievement of the English Baccalaureate (2009/10 to 2011/12)⁷⁶

	Pupils entering the EBac		Pupils achieving the EBac	
	Number	% of KS4 cohort	Number	% of KS4 cohort
All Schools ⁷⁷				
2009/10	140,551	22.0	99,652	15.6
2010/11	148,986	23.8	110,374	17.6
2011/12	155,839	25.0	113,101	18.1
State-funded Schools ⁷⁸				
2009/10	126,172	21.8	87,518	15.1
2010/11	122,524	21.6	87,090	15.4
2011/12	129,248	23.0	89,923	16.0

As the EBac was announced in 2011 and retrospectively applied to 2010 figures, students who achieved the EBac in 2009/10 and 2010/11 could not have planned to do so when making GCSE choices. The 2011/12 cohort of students and schools was the first that was able to make subject choices in the knowledge of what contributed to the EBac. The data shows that there was slight increase in the percentages of students entering the EBac in that academic year compared to 2010/11.

27. We heard mixed views on the impact of the EBac on engineering education. There was some support for the EBac, for example the Stoke-on-Trent and Staffordshire Local Enterprise Partnership stated that “some aspects [...] will be welcomed by engineering employers, particularly the emphasis upon raising the standard of Mathematics, English and Science”.⁷⁹ Richard Earp, National Grid, stated “we have always looked for GCSEs in maths, English and science” and added “I am not really too bothered about which GCSEs they have, beyond [this]”.⁸⁰ Others expressed concern that the EBac performance measure would cause schools to place less focus on provision of non-core EBac subjects, some of which provide routes into engineering. The Open University was “particularly concerned that the English Baccalaureate downgrades exposure to technologies in general and ICT specifically”.⁸¹ Jim Wade, the Principal of the JCB Academy, considered that:

The move towards a more ‘classical curriculum’ as envisaged with the English Baccalaureate has led to a warping of the courses followed by young people in England. This has seen a move towards English Baccalaureate subjects and a move away from those subjects which have a technical bias.⁸²

Worryingly, OCR, a qualification awarding body, stated:

There is evidence of schools switching large numbers of students away from Product Design, Engineering, Manufacturing and Applied Science GCSEs, including

⁷⁶ Ev 84 Table 1

⁷⁷ Including state-funded schools, independent schools, independent special schools, non-maintained special schools, hospital schools, Pupil Referral Units and Alternative Provision

⁷⁸ Including Academies, Free Schools, City Technology Colleges and state-funded special schools but excluding independent schools, independent special schools, non-maintained special schools, hospital schools, Pupil Referral Units and Alternative Provision

⁷⁹ Ev w31 para 2.4

⁸⁰ Q 22

⁸¹ Ev w4 para 21

⁸² Ev 56 para 2.2

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 EBac 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.⁸³

National Grid expressed the strongest criticism of the EBac and stated that it “seems to be at best irrelevant to improving the UK’s engineering skill base” and “at worst it may exacerbate negative perceptions of engineering careers [...] and discourage schools from offering technical subjects”.⁸⁴

28. Two key subjects were identified as crucial to engineering but outside the EBac: Design and Technology (D&T) and Information and Communications Technology (ICT). D&T is important for engineering because “design processes and design skills are an integral part of the engineering ecosystem”.⁸⁵ E4E stated that “D&T is an important subject at A level for engineering” and it “has been identified by Russell Group universities as a ‘useful’ A level”.⁸⁶ E4E added that “around a quarter of students accepted onto engineering degree courses in the UK had an A level in D&T” and “in some subjects it was significantly higher, e.g. 74% of students accepted onto Production and Manufacturing Engineering degree programmes had D&T A level”.⁸⁷ One student at the JCB Academy, told us that she had “always loved design and technology at school” and said that winning a design and technology award had “spurred” her on to continue with studying design and engineering.⁸⁸ The Design Council stated that “the EBac provides little space for students to take additional subjects beyond a prescribed core” and endorsed the view that “an additional ‘creative’ subject, such as D&T or Art & Design, should form part of the performance measure the EBac is aligned [to]”.⁸⁹

29. Design and Technology is currently a compulsory National Curriculum subject, with a statutory Programme of Study, at Key Stages 1-3.⁹⁰ The majority of respondents to the Government’s National Curriculum consultation (78 per cent) supported the retention of D&T as a National Curriculum subject.⁹¹ However, only 41 per cent of these respondents considered that D&T should be retained at Key Stage 4.⁹² The Society of Motor Manufacturers and Traders (SMMT) stated that “the possible removal of D&T as a compulsory subject in the upcoming National Curriculum Review has also raised concerns within the automotive industry” and added that “early exposure to engineering disciplines,

⁸³ Ev w19 para 7.4

⁸⁴ Ev 53 para 4.20

⁸⁵ Ev w55 para 2

⁸⁶ Ev w39 para 29

⁸⁷ *Ibid*

⁸⁸ Q 44-45

⁸⁹ Ev w57 para 18

⁹⁰ Department for Education, *Review of the National Curriculum for England: Summary report of the call for evidence*, page 31

⁹¹ Department for Education, *Review of the National Curriculum for England: Summary report of the call for evidence*, page 31

⁹² Department for Education, *Review of the National Curriculum for England: Summary report of the call for evidence*, page 32

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".⁹³ The importance of D&T to the UK's manufacturing base and economy was also emphasised by 11 per cent of respondents to the Government's consultation.⁹⁴

30. ICT education was also a cause for concern: Dr Bill Mitchell, Director of the BCS Academy of Computing, explained the skills gap:

There are lots of shortages of skill in the IT world. Probably one of the most alarming is that 90% of companies cannot recruit people who can deal with cyber-security. That is a big problem. [...] There was a report by Demos last year that included a quote from one of Tech City's entrepreneurs: "There just aren't enough Computer Scientists in the UK. And we need Computer Scientists, we don't need—what do they call it—ICT trained people. We need real Computer Scientists who do software engineering and programming." [...] If you also look at data from BIS, it shows that the number of jobs that are going to require specialist IT skills is increasing at four times the average rate of other jobs in the economy. That suggests that there is a growing skills gap in the IT profession.⁹⁵

The BCS has been pressing the government to include Computer Science as a fourth science GCSE in the EBac.⁹⁶ ICT is also currently a compulsory National Curriculum subject, with a statutory Programme of Study, at Key Stages 1–4 and the majority of respondents to the Government's National Curriculum Review (77 per cent) supported this, including strong support for ICT to remain a National Curriculum subject at Key Stage 4.⁹⁷

31. The EBac subjects do not comprise the entire curriculum: Carole Willis, Chief Scientific Adviser, DfE, clarified that "the EBac is only supposed to cover part of the curriculum. It leaves about 30% or 40% of time in the curriculum for studying other things".⁹⁸ Ms Willis considered that "as a route into engineering, [the EBac] is quite powerful" and explained that:

The rationale for setting up the EBac was partly around international evidence that other high-performing jurisdictions were asking their students to study a similar range of core academic subjects up to the age of 16, before they went on to specialise in other things, and the fact that the progression rates for the EBac subjects were particularly high. I know that there are lots of other vocational routes to HE and to other engineering occupations, but to the extent that the acquisition of maths and physics A levels are important, the EBac students are much more likely to go on to

⁹³ Ev w11 para 13

⁹⁴ Department for Education, *Review of the National Curriculum for England: Summary report of the call for evidence*, page 32

⁹⁵ Q 141

⁹⁶ Ev w39 para 30

⁹⁷ Department for Education, *Review of the National Curriculum for England: Summary report of the call for evidence*, page 38

⁹⁸ Q 181

study science A levels than pupils getting five good GCSEs including English and maths, for example.⁹⁹

When we put the criticisms of the EBac to Elizabeth Truss MP, Parliamentary Under-Secretary of State for Education and Childcare, she stated:

What we have seen since we introduced [the EBac] is that the number of students studying single sciences has gone up, and obviously physics and maths are key underpinning subjects for engineering, so what the English Baccalaureate does is highlight the importance of rigorous science subjects. That is positive. The number of pupils taking GCSE triple science has gone up from 48,000 in 2007 to 152,000 in 2012, so we have seen a strong increase in the number of students taking science subjects, which is an important background to engineering.¹⁰⁰

Indeed there is some evidence that the EBac has correlated with a greater uptake of science GCSEs: 93 per cent of GCSE students are due to take double or triple science GCSEs in summer 2014, which is the highest proportion for at least two decades.¹⁰¹ Between summer 2010 and summer 2014, the proportion of students taking double science GCSE is set to increase by 28 per cent and to increase by 113 per cent for students taking triple science GCSE.¹⁰²

32. The Education Committee commented in its 2011 report on *The English Baccalaureate* that the “choice of subjects included in the EBac has been one of the most controversial aspects of its creation”.¹⁰³ However, the EBac is intended to provide students with a solid grounding in key subjects, and it appears that there has been a greater uptake of science GCSEs since the performance measure was introduced.

33. We welcome the EBac’s focus on attainment of maths and science GCSEs, which are important precursors for further study and careers leading to engineering. However, we are concerned that important subjects such as Design and Technology (D&T) are being adversely affected as schools focus on the EBac. Although the EBac leaves curriculum time to study other subjects, schools are very likely to focus on the subjects by which their performance is measured and less on non-EBac subjects.

34. We recommend that Design and Technology should remain in the National Curriculum at Key Stage 4.

35. The consultation on Reforming Key Stage 4 Qualifications closed before this Report was published but we expect the Government to take into account our views when deciding the future of Key Stage 4 Qualifications. In addition, the Government must consider how to reward schools and recognise performance in non-EBac subjects when it reviews on the school accountability system.

⁹⁹ Q 181

¹⁰⁰ Q 194

¹⁰¹ “Twice as many students now taking key academic subjects thanks to the EBacc”, Department for Education, 5 October 2012

¹⁰² “Twice as many students now taking key academic subjects thanks to the EBacc”, Department for Education, 5 October 2012

¹⁰³ Education Committee, Fifth Report of Session 2010–12, *The English Baccalaureate*, HC 851

Vocational education

36. In September 2010, the Government asked Professor Alison Wolf to conduct an independent review of vocational education, stating:

For many years our education system has failed to value practical education, choosing to give far greater emphasis to purely academic achievements. This has left a gap in the country's skills base and, as a result, a shortage of appropriately trained and educated young people to fulfil the needs of our employers. To help support our economic recovery, we need to ensure that this position does not continue and in future we are able to meet the needs of our labour market.¹⁰⁴

Professor Wolf was asked “to consider how vocational education for 14–19 year olds can be improved in order to promote successful progression into the labour market and into higher level education and training routes” and to provide “practical recommendations to help inform future policy direction, taking into account current financial constraints”.¹⁰⁵ The *Wolf Review of Vocational Education* was published in March 2011 and the Government response was published in May 2011.¹⁰⁶

37. The Wolf Review stated that “performance measures should [...] reinforce the commitment to a common core of study at Key Stage 4, with vocational specialisation normally confined to 20% of a pupil's timetable”.¹⁰⁷ The Review recommended that:

- a) The DfE should distinguish clearly between those qualifications, both vocational and academic, which can contribute to performance indicators at Key Stage 4, and those which cannot; and
- b) Non-GCSE/iGCSE qualifications from the approved list should make a limited contribution to an individual student's score on any performance measures that use accumulated and averaged point scores.¹⁰⁸

In response to these recommendations, the Government stated that it wanted “the vast majority of 14–16 year olds to be taught an academic core, which can then be supplemented by a vocational element”.¹⁰⁹ Preferred qualifications for the 14–16 age group would therefore “be of an appropriate size to complement the academic core for the majority of students”.¹¹⁰ The Government stated in its written submission to this inquiry that:

Following the reforms [of vocational education], there are 140 high quality qualifications which will count as equivalent to one GCSE in the 2014 Key Stage 4

¹⁰⁴ HC Deb, 9 September 2010, col 20WS

¹⁰⁵ “Review of vocational education – The Wolf Report”, Department for Education, www.education.gov.uk, 2 July 2012

¹⁰⁶ “Government publishes response to the Wolf Review of Vocational Education”, Department for Education, www.education.gov.uk, 12 May 2011

¹⁰⁷ Department for Education, *Review of Vocational Education – The Wolf Report*, March 2011

¹⁰⁸ Department for Education, *Review of Vocational Education – The Wolf Report*, March 2011

¹⁰⁹ Department for Education, *Wolf review of vocational education: Government response*, 12 May 2011

¹¹⁰ Department for Education, *Wolf review of vocational education: Government response*, 12 May 2011

performance tables. Of these, nine are in engineering. These include the two 'Principal Learning in Engineering' qualifications at levels 1 and 2 which represent the core of the current Engineering Diploma.¹¹¹

The Engineering Diploma

38. The Diploma in Engineering is a qualification for 14–19 year olds and has been available in schools and colleges since 2008.¹¹² It is available at 3 levels: Foundation, Higher and Advanced, and sits alongside the traditional educational pathways of GCSEs and A Levels (see Figure 1 on page 15). We were told by the Department for Education that the Engineering Level 2 Diploma is equivalent to 7 GCSEs. The Principal Learning Component (core of the Diploma) currently counts as equivalent to 5 GCSEs and is the size of 3.5 GCSEs. It offers students classroom-based learning combined with work-related practical experience.¹¹³ However, following the Wolf Review, the Government introduced reforms to vocational education that meant the Engineering Diploma would be equivalent to one GCSE in performance tables, despite requiring curriculum time equivalent to several GCSEs.¹¹⁴

39. Newstead Wood School, a specialist engineering school, stated “the Engineering Diploma Level 2 is [...] more than a vocational STEM course” as “the level of mathematical and scientific knowledge it requires to work at its best is GCSE A grade”.¹¹⁵ The Engineering Diploma was developed with engineering employers; the Engineering Employers Federation (EEF) stated that “the Diploma is widely recognised by the industry as a route to providing young people, the next generation of engineers, with the skills they need for the future”.¹¹⁶ An important point was made by Lyn Tomkins, SEMTA, who highlighted that the diploma “is also attracting a significantly high number of girls”.¹¹⁷

40. National Grid expressed concern that following vocational education reforms, “the Engineering Diploma will become a less attractive qualification to schools”.¹¹⁸ Newstead Wood School stated that “the skills and scope [of the Diploma] range beyond those of a single GCSE”.¹¹⁹ The EEF stated “the downgrading of Diplomas has not sent out the right signal to both employers and young people that Government is serious about the status and value of vocational education” and added that “the impact of these changes will undoubtedly be a reduction in the number of schools offering the Diploma as the additional support needed to offer such a course would not be reflected in league tables”.¹²⁰ The change to the value of the Engineering Diploma was described by the SMTT as “a

¹¹¹ Ev 51 para 14

¹¹² “About the Diploma”, The Diploma in Engineering, www.engineeringdiploma.com

¹¹³ “About the Diploma”, The Diploma in Engineering, www.engineeringdiploma.com

¹¹⁴ Ev 52 para 1.4

¹¹⁵ Ev 60 para 5

¹¹⁶ Ev 75 para 19

¹¹⁷ Q 3

¹¹⁸ Ev 52 para 1.4

¹¹⁹ Ev 60 para 5

¹²⁰ Ev 75 para 19-20

retrograde step, out-of-sync with government's stated intentions to rebalance the economy towards manufacturing"¹²¹ and by EDF Energy as "detrimental to the recruitment of young people into the sector".¹²² However, EADS UK stated that "the changes will probably have a detrimental effect on [...] the Engineering Diploma but will not adversely impact the very important STEM subjects" and that therefore "it should have little or no effect on the skills base needed by the engineering sector".¹²³

41. We asked Dr Matthew Harrison, Director of Education, Royal Academy of Engineering, what the impacts had been, and he responded:

We see its impact in the numbers. We never had the time for the diploma in engineering to prove itself, because it was only in its second year when the Diploma Aggregation Service was removed. The diploma stopped at that point. We do not know where it would have got to, but it was climbing rapidly. It hit a peak, and now it is clearly dropping off.¹²⁴

We took evidence from two students currently studying the Engineering Diploma and sought their views on whether changing its GCSE equivalence would influence subject choices amongst students. Both students considered that they might still choose the diploma, but one stated that "maybe the quantity of GCSEs won't be enough for some people" and another added "there were 16 people in our class and 13 of them took the diploma because it was worth that many GCSEs [...] Taking it down to one GCSE would stop people from taking it".¹²⁵

42. The engineering community had already started discussions with Government over how to adapt and develop engineering qualifications in light of the reforms to vocational education, before our inquiry commenced. On 8 May 2012, at a roundtable meeting chaired by John Hayes MP, then Minister for Skills, engineering organisations agreed with awarding bodies to develop new qualifications that reflect the quality and attractiveness of the Engineering Diploma and its Principal Learning component.¹²⁶ Then in a November 2012 speech, the Chancellor of the Exchequer announced that the Engineering Diploma would be "reworked".¹²⁷ The DfE stated that "the Royal Academy of Engineering will work with employers, professional bodies and schools to design the qualifications and they will be available for students to sit as early as 2014".¹²⁸ Dr Harrison explained how the engineering diploma would be redesigned:

Principal Learning, the main technical core of the diploma, is still available now [...] schools will continue work with it while we, as a broad coalition across the profession, including employers and teachers at colleges and schools, look at

¹²¹ Ev w11 para 13

¹²² Ev w62 para 26

¹²³ Ev w22 para 2.4

¹²⁴ Q 148

¹²⁵ Q 86

¹²⁶ Ev 51 para 15

¹²⁷ "Government accused of engineering diploma U-turn", BBC News, www.news.bbc.co.uk, 3 November 2012

¹²⁸ "Government accused of engineering diploma U-turn", BBC News, www.news.bbc.co.uk, 3 November 2012

producing a more flexible alternative. We are taking the large qualification, retaining its content, retaining the deep employer engagement and retaining its progression value [...] We want to preserve all of that, while giving schools the opportunity to offer all four of these linked qualifications, or perhaps three or even two, very much alongside the core subjects, and alongside the English Baccalaureate if that is what they want to do [...] We will finish our work in May 2013, so it will be available for first teaching in September 2014.¹²⁹

Mr Hancock, Minister for Skills, stated that the reworked diploma “won’t be a diploma” but “four separate qualifications”.¹³⁰ He hoped “that the sign-off will be in November 2013, to be taught from the following year”.¹³¹ When we asked whether it had been a mistake to downgrade the diploma, the Minister stated:

I would not describe it as being downgraded. The system was brought in with the overall goal of ensuring that valuable and high-quality vocational qualifications were recognised as such. One of the rules within that system to make it work was that each qualification could count for no more in terms of equivalence than one GCSE. I know that a strong argument was made that the Principal Learning component and the Engineering Diploma should count for more. When I arrived in this job in early September, one of the first things that I did was to get on the phone to the Royal Academy of Engineering and talk about bringing in what look likely to be four separate qualifications that both fit within the accountability structure and are rigorous and employer led.¹³²

When pressed further, the Minister added that working with the Royal Academy of Engineering to redesign the diploma “sends an extremely strong signal about [...] the value that we attach to engineering”.¹³³

43. The Engineering Diploma was a qualification regarded highly by schools, employers and students, combining theoretical knowledge with hands-on practical skills. The Government’s reforms to vocational education meant that Level 2 of the Engineering Diploma could not count as equivalent to more than one GCSE despite requiring curriculum time and effort equivalent to several GCSEs. **The change in GCSE equivalence of the Engineering Diploma following vocational education reforms potentially sends a poor message from Government about the value of engineering education, which is at odds with the Government’s frequently stated emphasis on the importance of engineering to the UK, and may lead to the Diploma being a less attractive qualification to schools. The change was, in our view, made in haste and we feel the Government should have fully developed its plans for a redesigned set of engineering qualifications before announcing what was perceived as a downgrading of the Engineering Diploma. We are pleased the Government is now engaging with the engineering community to address this.**

¹²⁹ Qq 145–147

¹³⁰ Q 201

¹³¹ Q 202

¹³² Q 198

¹³³ Q 200

44. *We recommend that where the Engineering Diploma or its successor is taught, it should be included in performance measures for schools alongside the EBac.*

Technical Baccalaureate

45. A Technical Baccalaureate (TechBac) is being developed by City and Guilds, the Baker Dearing Educational Trust, University Technical Colleges (UTCs) and other educational institutions.¹³⁴ In December 2012, Lord Baker of Dorking, founder of the Baker Dearing Educational Trust, announced plans for a TechBac that would combine technical qualifications with English, Maths and ICT at levels 2 and 3.¹³⁵ The TechBac would be a performance measure similar to the EBac.¹³⁶ It is intended that the TechBac will be available from 2013 with the intention of provision on a wider basis in 2014.¹³⁷ Some, such as the Association of Colleges, have welcomed the concept of a TechBac.¹³⁸ However, the Education Committee noted concerns that the “EBac will be for the bright kids, and the TechBac will be for the less bright kids” and stated that it did “not recommend the creation of such a baccalaureate at this time”.¹³⁹

46. The proposed TechBac has attracted the support of both the Opposition and Government.¹⁴⁰ In December 2012, the Minister for Skills stated that:

World-class vocational education is vital for a world-class economy, so we are bringing rigour to vocational education by recognising the best qualifications, strengthening apprenticeships and introducing a Tech Bac to reward and celebrate stretching occupational education. [...]

The Tech Bac [...] is one of the things we will do to ensure higher quality occupational and vocational qualifications and more respect for them. I look forward to consulting widely and will set out more details in due course.¹⁴¹

47. ***We look forward to the Government’s proposals for a Technical Baccalaureate with interest. If the TechBac is to be a success, we consider that the following conditions must be met: (i) its structure should reflect our observations in paragraph 24 of this Report; (ii) while offering a more creative and technical curriculum, the TechBac should offer a broad base of education to facilitate a wide range of further study and career options; (iii) the Government must endeavour to ensure that the TechBac does not suffer from the cultural misperception that plagues vocational education, namely that it is for less bright students; and (iv) schools must be incentivised to focus on the TechBac. To achieve this, the TechBac should be equivalent to the EBac in all respects.***

¹³⁴ “City & Guilds to create new TechBac for 2013”, City and Guilds, www.cityandguilds.com, December 2012

¹³⁵ “Lord Baker leapfrogs government with plans for his own TechBac”, TES, www.tes.co.uk, 17 December 2012

¹³⁶ “Schools to be rewarded for technical skills”, Financial Times, www.ft.com, 11 December 2012

¹³⁷ “Lord Baker leapfrogs government with plans for his own TechBac”, TES, www.tes.co.uk, 17 December 2012

¹³⁸ “AoC respond to proposals for a technical baccalaureate made by the Labour leader”, Association of Colleges, www.aoc.co.uk, 2 October 2012

¹³⁹ Education Committee, Fifth Report of Session 2010–12, *The English Baccalaureate*, HC 851, paras 47–48

¹⁴⁰ “City & Guilds to create new TechBac for 2013”, City and Guild, www.cityandguilds.com, December 2012; “TechBac: Miliband sets sights on ‘forgotten 50 per cent’”, TES, www.tes.co.uk, 5 October 2012

¹⁴¹ HC Deb, 3 December 2012, col 569

Work experience

48. As discussed previously, the best engineers have both theoretical knowledge and practical skills. The value of work-based experience was regularly stressed to us during this inquiry and it was highlighted by the students we talked to at the JCB Academy as a rewarding and valuable part of their study. Steve Radley, EEF, stated that “if young people have that opportunity to learn about work at first hand through work experience, that is absolutely vital”.¹⁴² Richard Earp, Education and Skills Manager, National Grid stated that “the best thing you can do in promoting engineering as a career is good quality work experience”.¹⁴³ Ms Luff, Newstead Wood School, confirmed the importance of work experience in promoting engineering as a career with a personal example:

Until I did my work experience and saw what a work placement was like in an engineering company, I just thought I wanted to take an engineering degree because I liked the subjects and topics covered but I don't want to be an engineer. I would rather use my skills maybe to go into the City and make loads of money. But it turns out that engineering is what I like. [...] Work placements, for me, are the things that open people's eyes.¹⁴⁴

However, employers find that these practical skills are often lacking, as highlighted by British Airways¹⁴⁵ and National Grid.¹⁴⁶

49. The Wolf Report examined work experience and recommended that:

DfE should evaluate models for supplying genuine work experience to 16–18 year olds who are enrolled as full-time students, not apprentices, and for reimbursing local employers in a flexible way, using core funds. Schools and colleges should be encouraged to prioritise longer internships for older students, reflecting the fact that almost no young people move into full-time employment at 16; and government should correspondingly remove their statutory duty to provide every young person at KS4 with a standard amount of “work-related learning”.¹⁴⁷

In response, the Government decided to “seek to remove the statutory duty to provide every young person at Key Stage 4 (14–16 year olds) with work-related learning” adding that:

We anticipate that the duty will be removed from the start of the academic year 2012/13 and release support for more work experience for older pupils. However, schools will still be free to determine whether and how work experience for young people at Key Stage 4 is provided.¹⁴⁸

¹⁴² Q 27

¹⁴³ Q 29

¹⁴⁴ Q 65

¹⁴⁵ Ev w70 para 1.1

¹⁴⁶ Ev 53 para 4.2

¹⁴⁷ Department for Education, *Review of Vocational Education – The Wolf Report*, March 2011, page 17

¹⁴⁸ Department for Education, *Wolf review of vocational education: Government response*, 12 May 2011, page 12

50. We heard mixed views about the removal of compulsory work experience at Key Stage 4. Mr Earp, National Grid, emphasised that “one of the worst things you can do is bad quality work experience” and that therefore he was “not sure that [he] support[ed] a blanket requirement for two weeks’ work experience”.¹⁴⁹ Yet many more appeared to hold a less favourable opinion of the change. For example, Mr Radley, EEF stated that the change was “regrettable” and that EEF “would like to see that reversed”.¹⁵⁰ Jim Wade, Principal of the JCB Academy, stated that “it has been an error”.¹⁵¹ The JCB Academy stated that “many schools in our local area will not be offering work experience to students from next year”¹⁵² and Mr Wade explained that:

[Schools] have financial pressures [...] [they] have league table pressures and organisational issues. To do work experience is a difficult, time-consuming and costly thing for a school. Therefore, some schools will make the decision that, if youngsters want to do it, perhaps it is up to their parents to do it in the holidays, but it is not an entitlement.¹⁵³

Maggie Galliers, President of the Association of Colleges (AoC), added that “it is not just some but many schools who are cutting back now on work placements”¹⁵⁴ and Liz Allen, Headteacher, Newstead Wood School, added:

What are we educating young people for if it isn’t preparing them for the workplace? It would be utterly ridiculous if they didn’t have that experience as part of their learning package, but I say that as a school that is confident and philosophically inclined to do it. Many schools don’t have that privilege.¹⁵⁵

The Education Committee added its voice to these concerns and recommended in January 2013 that “the Government’s statutory guidance to schools is strengthened to require schools to provide careers education and work-related learning as part of their duty”.¹⁵⁶

51. We asked Ms Willis, DfE on what evidence the decision to remove the statutory duty on schools to provide work experience had been based. She explained that:

[Wolf] concluded [...] that work experience is really important. It is a very valuable way for young people to attain the kind of skills that employers need in the labour market [...]. The rationale for her recommendation that that duty be removed from Key Stage 4 is that it was better undertaken at Key Stage 5. The study programmes that the Department is working on at the moment expect all young people, unless they are doing an apprenticeship that has that core employment component in it already, will be undertaking some form of work experience, and we shall be piloting

¹⁴⁹ Q 29

¹⁵⁰ Q 27

¹⁵¹ Q 126

¹⁵² Ev 56 para 2.4

¹⁵³ Q 125

¹⁵⁴ Q 126

¹⁵⁵ Q 126

¹⁵⁶ Education Committee, Seventh Report of Session 2012–13, *Careers guidance for young people: The impact of the new duty on schools*, HC 632–I, para 109

that; indeed, we are in the process of trialling the best way to do that with an independent evaluation.¹⁵⁷

52. However, Ms Willis was not able to inform us of any evidence (or research undertaken by the DfE to produce evidence) that supported the change to work experience requirements other than the Wolf Report.¹⁵⁸ When we asked if the DfE intended to gather evidence about the effect that lack of work experience may have on children at Key Stage 4, she responded:

The main way in which that would be monitored is in terms of the progression rates for young people. We have just introduced—this year—a new set of destination measures, so we will be looking at those quite carefully. Those are broken down by institution, and they look at what routes young people go on to once they have left that particular institution.¹⁵⁹

53. We asked the Ministers why the requirement for pupils to do a standard amount of work experience at KS4 was being removed and Mr Hancock stated:

The study programmes that we are introducing from 16 to 18 require work experience. The problem with the 14 to 16 requirement is that it was extremely highly specified, and it did not always work. In many cases, it led to people doing work experience-like activity, but the problem with that is that there is nothing like work experience except work experience. The way that it was designed was complicated and top-down, and it led to a poor-quality experience. Instead, we have freed up the curriculum to make sure that there is the flexibility to provide it. For 16 to 19-year-olds, we are requiring it as part of the programmes of study.¹⁶⁰

54. Although the Government's rationale appeared reasonable when applied to work experience generally, the postponement of engineering work experience from KS4 to post-16 study will pose particular problems. Mr Earp, National Grid, pointed out that:

The biggest loss of people for the higher skilled STEM careers occurs with their post-16 choices. If they are not going to see the world at work or experience good quality STEM employers before choosing which A-levels or level 3 subjects to do, then we have a real problem. We have to show them during key stage 4 what it is all about.¹⁶¹

55. Good work experience is an important part of engineering education. It puts classroom learning into context, provides inspiration and is a source of career information. In addition, work experience can provide students with valuable practical skills.

56. Recognising the challenge of providing quality work experience at Key Stage 4, the Government decided to remove the statutory duty on schools to provide work

¹⁵⁷ Q 184

¹⁵⁸ Q 185

¹⁵⁹ Q 187

¹⁶⁰ Q 221

¹⁶¹ Q 29

experience altogether and place greater emphasis on work experience in post-16 study. However with regard to engineering we recommend: (i) STEM work experience should take place before 16 years, before students make choices about study or work post-16; and (ii) that despite the curriculum and league table pressures a degree of compulsion should exist. There are already anecdotes suggesting that many schools are cutting back on provision of work experience and we are concerned about the impact of this on the provision of future engineers.

57. *The evidence we have received suggests that work experience is important for engineering education. We endorse the recommendation of the Education Committee that the Government's statutory guidance to schools should require them to provide work-related learning.* Careers advice is further explored in paragraph 70.

58. **We are concerned that the DfE has accepted the Wolf review's recommendation without appearing to attempt any assessment of its own on the impact of removing compulsory work experience at Key Stage 4.** We will address the DfE's use of research and evidence in Chapter 5 of this report.

University Technical Colleges

59. University Technical Colleges (UTCs) are “a new concept in education”, offering 14–19 year olds the opportunity to take a full time, technically-oriented course of study.¹⁶² UTCs integrate national curriculum requirements with the technical and vocational elements and are heavily influenced by local and national employers who also provide support and work experience for students.¹⁶³ There are five UTCs: the JCB Academy in Staffordshire opened in 2010, the Black Country UTC in Walsall opened in 2011 and a further three opened in September 2012 (Aston, Central Bedfordshire and Hackney). The Government is committed to opening at least 24 UTCs open by 2014 and is planning 34 in total.¹⁶⁴

60. The engineering community universally welcomed UTCs: the Royal Academy of Engineering stated that “UTCs provide an exemplar of what excellent 14-19 technical [...] education looks like”.¹⁶⁵ Some have suggested that there should be more: for example, the Baker Dearing Education Trust suggested that the Government “set an immediate target to open at least 100 UTCs before the next general election”.¹⁶⁶ However, there were some concerns about UTCs. Newstead Wood School cautioned “they will not provide national coverage and there will remain a need for Secondary Schools to be committed to engineering learning programmes”.¹⁶⁷ National Grid was “a strong supporter of the UTC movement” but added “it is the take up and standard of technical education in mainstream schools that will provide the broad foundation for STEM skills that the UK economy needs

¹⁶² “About University Technical Colleges”, University Technical Colleges, www.utcolleges.org.uk

¹⁶³ “About University Technical Colleges”, University Technical Colleges, www.utcolleges.org.uk

¹⁶⁴ Ev 51 para 16

¹⁶⁵ Ev 59 para 18

¹⁶⁶ Ev w6 para 4

¹⁶⁷ Ev 60 para 6

going forward".¹⁶⁸ Industry witnesses broadly shared concerns that the reach of UTCs would be limited by their number and geography.¹⁶⁹

61. Jim Wade, Principal of the JCB Academy (the first UTC), had concerns about the Government's targets:

like any Government policy, it can't be that the target is to open this number by this date, because it is about making sure that the quality of the experience for those young people is fantastic [...] If you set a target of having this number by this date, the danger is that you run for the target rather than ensure you have the quality. [...] Another small caveat is that we had 20 months [to set up] [...] That is not the funding they are getting to set up UTCs at the present moment.¹⁷⁰

62. We asked Ms Willis, DfE, what evidence had been gathered on the effectiveness of UTCs and she responded:

There are only five open at the moment, as you will be aware, and we do not have any results from them yet. We will have results from the two that opened in September 2011¹⁷¹ when we have developed performance tables at Christmas, or finalised them. I shall be looking very carefully at the attainment within those different institutions. What we collect is quite a lot of information on background pupil characteristics, through the school census. I shall be looking to undertake analysis, controlling for the background characteristics of the pupils entering those kinds of institution, and comparing them with similar attainment levels in other sorts of institution to see whether, and the extent to which, those organisations are adding value.¹⁷²

When we asked for evidence behind the Government's ambition to open 34 UTCs, Ms Willis stated:

There are a couple of things. The university technical colleges partly grew out of the city technology colleges, which have been open for a longer period, and some of the promising results in those organisations. But [...]the core rationale behind those UTCs is to have active engagement from employers and universities to help ensure that the programmes of study that are being completed can enable young people to have the best possible chance of going on to HE and some form of employment. There is that particularly valuable aspect, and that degree of engagement with such organisations.¹⁷³

In effect, Ms Willis was not able to demonstrate any evidence base for the target to open 34 UTCs. We asked the Minister for Skills, who stated:

¹⁶⁸ Ev 55 para 4.27

¹⁶⁹ For example, Q 10 [Andrew Churchill]

¹⁷⁰ Q 111

¹⁷¹ The JCB Academy opened in 2010

¹⁷² Q 175

¹⁷³ Q 176

There are 28 UTCs in the pipeline in addition to the five that are already open [...] Of course we will keep measuring their success as they come along, but it takes quite a long time to get measures of success. You have to wait to get a full measure of success, because you have to wait for children to go through, but you have to look at all the indicators that you can. We are keeping a very close eye on them, but so far the feedback has been extremely positive.¹⁷⁴

We note that the Minister indicated that there were 28 UTCs “in the pipeline”, a figure that appeared to be at odds with the target of opening 34 UTCs.

63. University Technical Colleges (UTCs) are a welcome development and the limited evidence that is available suggests that they are effective providers of engineering education. However, the network of UTCs will not provide nationwide coverage and the Government must also focus on good engineering education in schools and colleges.

64. The Government and all partners involved in the establishment and operation of UTCs should focus on quality not quantity. This includes being flexible if a new UTC needs more time or resource to establish itself, for example. The quality of education offered must not be sacrificed for the sake of political deadlines.

65. The Government must clarify its UTC targets and how it will measure success. First, it must clarify the rationale behind the target number. Second, it should be clear about what it expects UTCs to achieve and how performance will be monitored. Third, the lessons learned from opening the first five UTCs must be shared with those involved in establishing new UTCs, including engineering employers.

4 Inspiring the next generation

66. Improvements to the education system can help to plug the engineering skills gap, but young people must be inspired to study science and engineering in the first place. Bentley Motors stated that “the subjects taught at secondary schools within the curriculum do not necessarily inspire children to careers in engineering” and that “it is school children—from primary school onwards that must be attracted into this career from an early age”.¹⁷⁵ The Baker Dearing Educational Trust also considered that “more needs to be done to introduce children to technical and engineering occupations from primary school upwards”.¹⁷⁶ Matthew Harrison, Director of Education, Royal Academy of Engineering summarised the importance of early engagement, stating “the message is really clear: if you are a young person, get engaged with STEM and be successful with STEM, because the chances of re-engagement as an adult are so much lower”.¹⁷⁷

67. Inspiring the next generation of scientists and engineers is a worthy but well-worn theme and we do not intend to repeat the general issues around STEM in-depth. We did, however, find during this inquiry that engineering suffers from specific problems and we have focused on these.

Perceptions of engineering

68. Various stereotypes of engineering prevailed amongst young people. National Grid stated that young people struggle to visualise themselves as engineers, either because they “have no idea what being an engineer involves or, worse, they have an impression that it is a menial job, typically for men in overalls”.¹⁷⁸ The Baker Dearing Educational Trust stated “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”.¹⁷⁹ Bentley Motors stated that “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”.¹⁸⁰ A 2007 study by the Royal Academy of Engineering and Engineering and Technology Board on *Public attitudes to and perceptions of engineering and engineers 2007* found that younger people knew least about engineering and what engineers did.¹⁸¹ Engineering also tended to be seen as a male-dominated profession.¹⁸² An apprentice at National Grid stated “none of my friends know what I do” and “they associate it with construction; they assume I am on a building site [...] they assume

¹⁷⁵ Ev w35 para 3.8

¹⁷⁶ Ev w8 para 38.

¹⁷⁷ Q 138

¹⁷⁸ Ev 55 para 4.22

¹⁷⁹ Ev w8 para 36

¹⁸⁰ Ev w36 para 3.12

¹⁸¹ “Public Attitudes to and Perceptions of Engineering and Engineers 2007”, The Royal Academy of Engineering, www.raeng.org.uk, 2007

¹⁸² “Public Attitudes to and Perceptions of Engineering and Engineers 2007”, The Royal Academy of Engineering, www.raeng.org.uk, 2007, page 18

engineering is dirty work”.¹⁸³ National Grid highlighted that “a particularly worrying finding was that too often teachers are no better informed, and may even reinforce negative stereotypes”.¹⁸⁴

69. Such perceptions are often far from reality. The Baker Dearing Educational Trust stated “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”.¹⁸⁵ The Stoke-on-Trent and Staffordshire Local Enterprise Partnership (LEP) stated that “statistics show people earn some of the best salaries in engineering and manufacturing compared to many other degree study areas [...] The problem is how many GCSE and A level students know that and more importantly the staff giving them independent careers advice and guidance?”¹⁸⁶ Misperceptions of engineering influence young peoples’ study and career choices. Cogent, a sector skills council, highlighted recent surveys of young people that “showed students had low awareness *of* and interest *in* technical career opportunities”.¹⁸⁷

Careers advice

70. A poor understanding of engineering careers can often be rectified by good careers advice; for example, a student at Newstead Wood School, explained how careers advice had affected her choices:

We had a careers adviser at school. [...] they get you an organised two-week work experience placement in year 10 on something you think you might be interested in [...] Mine was an engineering placement because I told them that I liked maths and physics, so they pushed me towards that. [...] They went through university degrees and all the routes into engineering you could do. [...]

Most of the time [careers advisers] said that, if you took an engineering degree, basically it would take you anywhere. I could go and work in the City; I could work in an engineering firm; I could work abroad; I could be a designer [...] the fact they told me that engineering was something that could take me anywhere was what pushed me to taking that.¹⁸⁸

71. Ms Galliers explained that schools were faced with “perverse incentives in the system to advise young people that to stay on in my school sixth form is the right answer”.¹⁸⁹ Jim Wade, Principal of the JCB Academy, added:

a really good example of that are league tables. We are now measured on our destinations. If you take my school, last year, of the year 13 students, 50% chose to go

¹⁸³ Qq 60–61

¹⁸⁴ Ev 55 para 4.22

¹⁸⁵ Ev w8 para 36

¹⁸⁶ Ev w32 para 4.7

¹⁸⁷ Ev w33 para 4.1

¹⁸⁸ Qq 56–57

¹⁸⁹ Q 100

into higher apprenticeships. Most of those students had offers at universities, and a significant number had offers at Russell Group universities but have chosen instead higher apprenticeships with organisations like Rolls-Royce, Bentley or JCB itself. In the league tables we will now get a low score of the percentage of students going to university because they won't count. [...] potentially there is a perverse incentive for me to sit down with those students and say, "Oh no, you don't want to do a higher apprenticeship; actually you want to be doing that," because that would look better for us.¹⁹⁰

72. The Education Act 2011 placed schools under a duty to secure access to independent and impartial careers guidance for their pupils from September 2012 (independent is defined as external to the school).¹⁹¹ According to the DfE:

Once the duty on schools has been commenced, there will be no expectation that local authorities will provide a universal careers service. The statutory responsibility under section 68 of the Education and Skills Act 2008 requiring local authorities to encourage, enable and assist the participation of young people in education or training, remains unchanged.¹⁹²

No specific budget has been allocated for the provision of these services and there is no legal requirement for careers guidance to be provided by a professional careers adviser.¹⁹³ Maggie Galliers, President of the Association of Colleges (AoC) stated "a duty has been placed on schools now to offer independent advice and guidance, but few schools have the resources to do all that that job requires".¹⁹⁴

73. Regardless of the new duty, school staff are likely to remain an important source of careers advice for students. Careers advisers and teachers may be separate roles with schools, as highlighted by Ms Allen, who stated that "it is just impossible to be both a teacher and a careers guide".¹⁹⁵ The Engineering Employers Federation (EEF) expressed concern about "the lack of direction as to how schools will offer guidance and the lack of any requirement to engage with business" and has recommended that STEM careers advice could be improved by "making it part of CPD [Continuing Professional Development] for science teachers".¹⁹⁶

74. The witnesses representing education providers were additionally concerned about the cost implications of the new duty on schools to secure careers advice. Liz Allen, Head of Newstead Wood School, stated:

¹⁹⁰ Q 100

¹⁹¹ Department for Education, *The Education Act 2011: The duty to secure independent and impartial careers guidance for young people in schools – Statutory guidance for head teachers, school staff, governing bodies and local authorities*, March 2012

¹⁹² Department for Education, *The Education Act 2011: The duty to secure independent and impartial careers guidance for young people in schools – Statutory guidance for head teachers, school staff, governing bodies and local authorities*, March 2012

¹⁹³ "Engineering UK 2013: The state of Engineering", Engineering UK, www.engineeringuk.com, page 38

¹⁹⁴ Q 100

¹⁹⁵ Q 105

¹⁹⁶ Ev 77 para 35

At a time at which careers advice and guidance is being delegated to schools, our funding is being cut by 1.5%, or 3% in the sixth form. [...] having to trim about £60,000 a year from the school budget, at the same time as having to create discrete careers advice and guidance in the school, is a tricky one to manage.¹⁹⁷

Mr Wade pondered the question of how to ensure careers advice was impartial and stated:

I said jokingly to our careers adviser that I thought she was a bit too successful last year because she got nearly a third of our 16-year-olds on apprenticeship programmes so they didn't come into the sixth form. That is the type of tension that exists probably within any school environment. I don't necessarily disagree with delegating that responsibility to schools, but there is a real tension in trying to make that independent advice and guidance to make sure youngsters go the right way.¹⁹⁸

75. The Cogent Sector Skills Council stated “we often hear that what is lacking is a coherent, UK wide careers information and education system”.¹⁹⁹ A National Careers Service was launched in 2012.²⁰⁰ It provides “information, advice and guidance” to help people “make decisions on learning, training and work opportunities” and “offers confidential and impartial advice, supported by qualified careers advisers”.²⁰¹ Education for Engineering (E4E) stated “we will watch with interest the development of the National Careers Service”.²⁰² However, the National Careers Service “will not provide face-to face guidance for those under 19” who would only be offered online and telephone services.²⁰³ In January 2013, the Education Committee's Report on *Careers guidance for young people: The impact of the new duty on schools* set out in detail the importance of face-to-face careers advice for young people.²⁰⁴ It also recommended:

that the Department for Education introduces into the statutory guidance a requirement for schools to publish an annual careers plan, to include information on the support and resources available to its pupils in planning their career development. Schools should be required to review the plan systematically on an annual basis, taking into account the views of students, parents, employers and other learning providers.²⁰⁵

¹⁹⁷ Q 104

¹⁹⁸ Q 104

¹⁹⁹ Ev w33 para 3.4

²⁰⁰ Department for Education, *The Education Act 2011: The duty to secure independent and impartial careers guidance for young people in schools – Statutory guidance for head teachers, school staff, governing bodies and local authorities*, March 2012

²⁰¹ “About us”, National Careers Service, www.nationalcareersservice.direct.gov.uk

²⁰² Ev w39 para 34

²⁰³ Ev 77 para 33; “Engineering UK 2013: The state of Engineering”, Engineering UK, www.engineeringuk.com, page 38

²⁰⁴ Education Committee, Seventh Report of Session 2012–13, *Careers guidance for young people: The impact of the new duty on schools*, HC 632-I

²⁰⁵ Education Committee, Seventh Report of Session 2012–13, *Careers guidance for young people: The impact of the new duty on schools*, HC 632-I, para 63

76. We discussed careers guidance with Matthew Hancock MP, Parliamentary Under-Secretary of State for Skills, who explained that the “centralised duty” was new and needed to be implemented properly.²⁰⁶

77. The new duty on schools to provide access to independent and impartial advice is laudable and in principle we would support greater autonomy for schools to provide careers advice. However the duty poses problems in practice. First, there are resource implications for schools that have been given more responsibility, but no additional budget, to secure careers guidance. Second, there is little guidance on the quality of careers guidance that should be available to students. *The Government must monitor the impact of the new statutory duty and if, by September 2013, there is evidence that the duty is having a detrimental effect on schools or students, the duty should be reviewed or additional support provided to schools.*

78. *Informed face-to-face careers advice is essential for informing career choices and every young person should have the opportunity to access it. The Government should set out how it plans to ensure that all students have the opportunity to access face-to-face careers advice, with the National Careers Service as one possible resource.*

Employer engagement

79. As well as formal careers advice, students also gain valuable career knowledge from work experience and engagement with potential future employers, as highlighted in the previous chapter. Employer engagement includes day-to-day interaction and involvement in school curricula (as with UTCs, for example), provision of work experience opportunities and promotional campaigns aimed at young people and parents. Employer engagement with schools was seen as crucial to inspiring young people and enabling a better understanding of what engineering careers can offer. Employers placed a particular responsibility to facilitate this engagement on themselves rather than schools. National Grid considered that “employers have a duty to help schools explain engineering and to show students the positive opportunities that a technical education can open up for them”.²⁰⁷ Andrew Churchill, Managing Director of JJ Churchill Ltd, stated:

We know that the schools find it hard to understand our sector. I believe it is unreasonable to expect teachers to have a great in-depth experience and knowledge of the manufacturing sector. [...] the only group that can do that is the employers. That is our bit of the bargain.²⁰⁸

80. Nigel Fine, Chief Executive, Institute of Engineering and Technology, explained that the engineering profession had a number of programmes to inspire people:

For example, the Big Bang Fair [...] is organised by the whole profession. It includes industry as well, with Government support. It ensures that young people, and their parents and teachers, who are big influences on young people deciding on their

²⁰⁶ Q 212

²⁰⁷ Ev 55 para 4.24

²⁰⁸ Q 20

careers, can have a great experience, and come along and understand what it is that engineers and engineering are all about.

Statistics show that when young people have been through those programmes [...] there is an increasing awareness, and a positive awareness, of the value of the engineering profession and a career in engineering. We run another programme called Tomorrow's Engineers. Again, the engineering profession is coming together with industry in an outreach programme around the country, putting on a series of events that bring engineering into the lives of young people, to explain the variety of engineering activities that there are and the diversity of opportunities.²⁰⁹

81. The Government's *See Inside Manufacturing* initiative was praised by the Society of Motor Manufacturers and Traders (SMMT) for being "effective in raising awareness of engineering and manufacturing careers".²¹⁰ The initiative was jointly introduced with the Automotive Council and "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".²¹¹ According to the SMMT:

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.²¹²

The scheme was also welcomed by the Engineering Employers Federation (EEF) who considered that "such campaigns and initiatives give engineering a much needed promotional boost. We hope to see a firm commitment from the Government to continue these projects and increase awareness of their work".²¹³ However, school participation is crucial to success, as Lyn Tomkins, UK Operations Director, SEMTA, noted with reference to the *See Inside Manufacturing* initiative:

A lot of employers went to a lot of trouble to open their doors and invite the schools in, but at the first attempt a lot of schools just didn't bother to show up on the day. [...] None the less, the employers tried again [later in the year], and it was really well received. [...] if a school can just think, "We won't bother taking students to a leading factory that is opening its doors", then it is a great disappointment, especially if it is on their doorstep.²¹⁴

82. On a more ongoing basis, the Stoke-on-Trent and Staffordshire Local Enterprise Partnership (LEP) recommended that science and maths teachers should develop links with local industry "to make mainstream curriculum more relevant to manufacturing and

²⁰⁹ Q 142

²¹⁰ Ev w11 para 16

²¹¹ Ev w11 para 16

²¹² Ev w11 para 16

²¹³ EV 77 para 30

²¹⁴ Q 20

engineering” and that “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”.²¹⁵ EADS UK stated that “companies should be incentivised to take a greater part in working with schools” and that it did not consider that the Government “offer[ed] support or incentives to large employers to be actively involved in promoting STEM projects and believe[d] the Government do not have an awareness of the lengths employers are going to support STEM subjects”.²¹⁶

Roles of schools and teachers

83. Teachers, parents and peer groups are commonly cited as leading influences on young peoples’ career choices. We were interested in the role of teachers in providing career guidance. Engineering UK stated:

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 8 out of 10 answer the pupils’ questions based on their own knowledge and experience.²¹⁷

Similarly, the JCB Academy considered that “advice for those wishing to follow technical careers is often limited and ill informed due to the background of those providing the advice”.²¹⁸ Nigel Fine, IET, described “our woeful inability to give career advice to young people” by explaining that:

Career advice is not good in this country. Parents are not giving good advice. One in three parents do not know about engineering or engineering careers. Teachers are supposed to have a bit more insight, but one in five teachers in the STEM area may advise against engineering because they do not understand engineering or what it does.²¹⁹

84. Engineering UK called for STEM teachers to have “the right careers information to ensure that students are being shown the potential of a career” in engineering and suggested “extend[ing] engineering work experience opportunities to teachers so that they see modern engineering for themselves”.²²⁰ The Baker Dearing Educational Trust suggested that “teacher training programmes (including continuous professional development programmes) should help teachers deliver effective hands-on learning to all age groups”.²²¹ Steve Radley, EEF, acknowledged that “a lot of responsibilities are put on

²¹⁵ Ev w28

²¹⁶ Ev w23 para 4.2

²¹⁷ Ev w52 para 4

²¹⁸ Ev 56 para 2.3

²¹⁹ Q 154

²²⁰ Ev w52 para 4

²²¹ Ev w8 para 30

teachers” but suggested that “part of the teachers’ CPD should involve spending at least a few days in industry”.²²² He considered that it would allow them to “reinforce the messages that employers are looking to get across” and “bring things to life and make them a lot more exciting and relevant to young people”.²²³ We considered teacher skills and training in our 2011 Report on *Practical experiments in school science lessons and science field trips*, and recommended that “the Government needs to provide strong encouragement to schools in facilitating science teachers to maintain and develop the knowledge and practical science skills necessary to provide students with a high quality science education”.²²⁴

85. We were pleased that employers placed a strong emphasis on the role of industry in engaging young people. Campaigns such as the “Big Bang Fair” and “See Inside Manufacturing” can be effective at promoting engineering careers, and should be encouraged and supported by Government. However, the success of such initiatives depends on the willingness of parents, schools and teachers to promote them to young people. In addition, such initiatives are naturally resource-intensive and run infrequently, so everyday engagement at school-level remains important.

86. We support the principle of engaging school teachers with the engineering industry on an ongoing basis, including spending time in industry. *Government must ensure that schools have sufficient resources to ensure Continuing Professional Development is a norm not a luxury. Employers also have a key role in providing careers advice to students. Engagement with local engineering industry should be particularly encouraged amongst teachers of STEM subjects. We recognise that teachers already face many conflicting pressures. Therefore we recommend that engagement with industry be a core requirement of teachers’ Continuing Professional Development (CPD).*

87. *We recommend that learned societies, professional engineering institutions and trade bodies put an obligation on their members to systematically engage in promoting engineering and technology as a career through a structured programme of educational engagement.*

²²² Q 21

²²³ Q 21

²²⁴ Science and Technology Committee, Ninth Report of Session 2010–12, *Practical experiments in school science lessons and science field trips*, HC 1060–I

5 Research and evidence in DfE

88. This inquiry has scrutinised policy areas shared between two Government Departments: the Department for Education (DfE) and the Department for Business, Innovation and Skills (BIS). However, the focus of our scrutiny has been the DfE, and as well as examining the DfE's policies we were interested in the Department's use of research and evidence: the relationship between evidence and policy continues to be a key theme in our work as a committee.

Chief Scientific Adviser

89. Carole Willis is the DfE's Chief Scientific Adviser (CSA) and Director of Research and Analysis. The roles of CSAs vary between Departments, with some CSAs being externally appointed experts and others internal civil servants. Ms Willis falls into the latter category, and described her role as follows:

There are three key aspects to my role, which are fundamentally all about ensuring that the right robust evidence is being fed in to inform Ministers' policy decisions. I do that by ensuring that evidence is generated from within the Department, and analysis is undertaken. We have a very large set of admin data around attainment, which we feed in and analyse, looking at the potential impacts of different policies. I ensure that information is brought in from outside the Department, both in the form of external research that is commissioned by others, and from our own research programme, which commissions different pieces of work on different policy questions.

I also ensure that we bring in a range of different external experts to help and advise on particular issues. That is the external role of gathering the evidence and feeding it through to Ministers. I am also responsible for 200 professional analysts within the Department, who work across all the policy and delivery issues within the Department, helping to ensure that policy is driven by and informed by the best available robust evidence. Finally, personally I have a direct role in advising Ministers and advising senior policy officials around the evidence base and issues around different policy questions.²²⁵

Research budget

90. When we asked the DfE for figures on its research budget over this spending review period, it told us that its "research budget was £9.5 [million] in 2011–12" and that it "was £9.5 [million] at the start of 2012–13".²²⁶ The DfE added:

The budget was reduced during this year as, after careful review, it seemed highly likely that it would be underspent this year and the funds were needed for other priorities. We expect to spend around £6.2 [million] on research this year. In

²²⁵ Q 161

²²⁶ Ev 82

addition to the research budget, evaluation activity is funded from a range of different programme budgets across the department, depending on the need to evaluate new policy initiatives. There is no fixed budget for this evaluation activity. The Department's detailed budgets—including the research budget—have not been decided for the remainder of the spending review period. They are subject to a business planning process which is currently underway and will conclude in the New Year.²²⁷

Ms Willis explained that:

We are just about to go into the next business planning round, where I will be looking very carefully, including consulting external academics, at what the evidence gaps are within the Department that we need to address over the next year or so, and I will be presenting advice to Ministers about what we should be doing, what we should be spending money on, and therefore how much we should be spending on research going forward.²²⁸

When asked whether she expected the research budget to increase or decrease, she responded:

I have not done the work yet. It is a demand-driven approach, including demand from me, so there is no “right amount” of research. We need to look carefully at the evidence gaps, and what needs to be undertaken to fill those.²²⁹

91. We are concerned that the Department for Education; (i) does not have a clear definition of what constitutes research spend; (ii) has not planned its research spend sufficiently in advance; (iii) has no established budget for evaluation of policies; and (iv) does not protect or ring-fence its research budget from “other priorities”. The desire to remain flexible and “demand-driven” is not at odds with strategic, long-term thinking about research and evaluation.

92. The DfE's Chief Scientific Adviser (CSA), who also holds the post of Director of Research and Analysis, gave oral evidence on 21 November 2012 and told us she had “not done the work yet” on future research spending, yet written evidence from the DfE following the evidence session stated that business planning would conclude in the New Year. This suggests to us either that strategic planning of research spending in the DfE is given very little time or that the CSA has limited involvement. *We would be interested in an explanation from Government on this matter.*

Evidence-based policy

93. While investigating the impacts of Government changes to vocational education, the Engineering Diploma, the EBac and University Technical Colleges, we picked up warning signals about the relative lack evidence on which to base conclusions. For example, the Royal Society stated “we believe it is too early to draw conclusions about the few University

²²⁷ Ev 83

²²⁸ Q 171

²²⁹ Q 172

Technical Colleges that have opened since September 2010 or to assess the impact of the English Baccalaureate, introduced in early 2011”.²³⁰ Education for Engineering (E4E), stated:

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 [...] pre-2000 is nigh impossible.²³¹

94. We have already touched on some of these issues previously in the Report. In paragraph 26 we noted that although the Government provided EBac attainment figures from the three years between 2009/10 to 2011/12, the decision to knowingly enter into EBac-relevant GCSEs could only have been taken by the 2011/12 cohort of students and schools. Yet the Government intends to replace the current GCSE qualifications with the EBCs in 2017. The Education Select Committee has also expressed concerns about the retrospective introduction of the EBac, including that there was a lack of proper consultation and that the EBac was introduced before the completion of the Government’s curriculum review.²³² It also concluded that “any measure which examines schools’ performance in particular subjects would be better introduced once the curriculum itself has been defined and finalised”.²³³ Similarly, in Chapter 3 we summarised our efforts to obtain evidence from the Government on the effectiveness of University Technical Colleges, and the lack of a satisfactory response received. The change to the Engineering Diploma’s GCSE equivalence following the Government’s vocational education reforms was a mistake, as evidenced by the unanimous outcry it caused, as well as the Government’s subsequent action to redesign the qualification.

95. Our recommendation to the Department for Education (DfE), based on our experience during this inquiry, is that greater focus needs to be placed on evidence before future changes are made, and needs to leave sufficient time for evidence to be gathered on the effectiveness of its proposed changes before introducing further change. We recommend that the DfE conducts a re-evaluation of its attitude towards the role of evidence in policy and decision-making.

Randomised Controlled Trials

96. One method of gathering evidence is to use randomised controlled trials (RCTs). The Cabinet Office considers that RCTs “are the best way of determining whether a policy is working”.²³⁴ RCTs test “which of two or more interventions is the most effective at attaining a specific, measurable outcome”.²³⁵ Randomisation means that the subjects (be they students or schools) are randomly allocated to receive a particular intervention, thus avoiding selection bias. Controlled conditions essentially mean that the environment

²³⁰ Ev w12

²³¹ Ev w38 para 20

²³² Education Committee, Fifth Report of Session 2010-12, *The English Baccalaureate*, HC 851, paras 15–20

²³³ Education Committee, Fifth Report of Session 2010-12, *The English Baccalaureate*, HC 851, para 20

²³⁴ Cabinet Office, *Test, Learn, Adapt: Developing Public Policy with Randomised Controlled Trials*, June 2012

²³⁵ Cabinet Office, *Test, Learn, Adapt: Developing Public Policy with Randomised Controlled Trials*, June 2012

around all the subjects is kept as similar as possible, to minimise the possibility that something other than the intervention has caused the outcome being tested.

97. A common objection to the use of RCTs in public policy is that it is “unethical to withhold a new intervention from people who could benefit from it”.²³⁶ Indeed a similar argument was put forward by Ms Willis during our predecessor Committee’s 2009 inquiry into Early Literacy Interventions. She stated:

social policy is quite different to medical policy. You cannot, for example, do double blind randomised controlled trials as you can in medical practice. It is sometimes difficult to get people to take part in randomised controlled trials. Some local authorities or schools perceive it as unfair that some of their pupils will be getting some sort of intervention that others are not.²³⁷

However, the Cabinet Office’s June 2012 paper *Test, Learn, Adapt: Developing Public Policy with Randomised Controlled Trials* addressed this objection:

It is also worth noting that policies are often rolled out slowly, on a staggered basis, with some regions “going early”, and these phased introductions are not generally regarded as unethical. The delivery of the Sure Start programme is an example of this. If anything, a phased introduction in the context of an RCT is more ethical, because it generates new high quality information that may help to demonstrate that an intervention is cost effective.²³⁸

We asked Ms Willis whether her views on the utility of RCTs in education policy had changed and she told us:

We are looking very carefully at randomised control trials, and I have been discussing this with the Secretary of State, who has been very interested in some of the work that the Cabinet Office has been doing [...] The Secretary of State [...] is very interested in it, and has been challenging us on whether we should be doing more RCTs. We are going to build a process into the research approvals process that I chair, to look in all cases, for all of our research, every time a question comes up as to whether we could adopt a randomised control trial approach.²³⁹

98. We are pleased that the DfE has warmed to the concept of using Randomised Controlled Trials (RCTs) in education policy and that the Department is challenging itself on the use of RCTs. Policy should be backed up by evidence and although evidence can come from many sources, RCTs are particularly useful in social policy. The possibility of gathering evidence from RCTs should be seriously considered every time the DfE considers an education policy change.

²³⁶ Cabinet Office, *Test, Learn, Adapt: Developing Public Policy with Randomised Controlled Trials*, June 2012

²³⁷ Science and Technology Committee, Second Report of Session 2009-10, *Evidence Check 1: Early Literacy Interventions*, HC 44, Q 163

²³⁸ Cabinet Office, *Test, Learn, Adapt: Developing Public Policy with Randomised Controlled Trials*, June 2012

²³⁹ Q 162

6 Conclusions

99. At first glance, recent educational reforms have the appearance of supporting engineering education, for example the rationalisation of vocational qualifications following the Wolf Review was generally welcomed, the EBac includes a focus on science and maths education and UTCs have met with approval from the engineering community. However, the devil is in the detail and some of the individual effects of such changes could be detrimental to engineering education, for example the recent changes to the Engineering Diploma following the Wolf Review. We consider that the Government's approach towards engineering education in some aspects has not been effective.

100. The Government's stated views on the importance of engineering and manufacturing to the UK are inconsistent with its actions in education policy. The Government has a powerful influence on schools, students and parents through performance and accountability measures and has direct responsibility for ensuring good education for the UK's future engineers. It must use its actions, in the form of policy and incentives, more effectively to promote technical and engineering education.

Conclusions and recommendations

The engineering skills gap

1. Despite the Government's recognition of the importance of engineering skills, particularly to the growth agenda, there is a persistent gap in the numbers of engineers required to achieve economic growth, which is likely to worsen unless radical action is taken. (Paragraph 15)

Engineering education

2. As good engineers need theoretical knowledge and practical skills to enter the profession at any level, engineering education and training must provide both. (Paragraph 24)

GCSEs and the English Baccalaureate

3. We welcome the EBac's focus on attainment of maths and science GCSEs, which are important precursors for further study and careers leading to engineering. However, we are concerned that important subjects such as Design and Technology (D&T) are being adversely affected as schools focus on the EBac. Although the EBac leaves curriculum time to study other subjects, schools are very likely to focus on the subjects by which their performance is measured and less on non-EBac subjects. (Paragraph 33)
4. *We recommend that Design and Technology should remain in the National Curriculum at Key Stage 4.* (Paragraph 34)
5. *The consultation on Reforming Key Stage 4 Qualifications closed before this Report was published but we expect the Government to take into account our views when deciding the future of Key Stage 4 Qualifications. In addition, the Government must consider how to reward schools and recognise performance in non-EBac subjects when it reviews on the school accountability system.* (Paragraph 35)

Vocational education

6. The change in GCSE equivalence of the Engineering Diploma following vocational education reforms potentially sends a poor message from Government about the value of engineering education, which is at odds with the Government's frequently stated emphasis on the importance of engineering to the UK, and may lead to the Diploma being a less attractive qualification to schools. The change was, in our view, made in haste and we feel the Government should have fully developed its plans for a redesigned set of engineering qualifications before announcing what was perceived as a downgrading of the Engineering Diploma. We are pleased the Government is now engaging with the engineering community to address this. (Paragraph 43)

7. *We recommend that where the Engineering Diploma or its successor is taught, it should be included in performance measures for schools alongside the EBac. (Paragraph 44)*
8. *We look forward to the Government's proposals for a Technical Baccalaureate with interest. If the TechBac is to be a success, we consider that the following conditions must be met: (i) its structure should reflect our observations in paragraph 24 of this Report; (ii) while offering a more creative and technical curriculum, the TechBac should offer a broad base of education to facilitate a wide range of further study and career options; (iii) the Government must endeavour to ensure that the TechBac does not suffer from the cultural misperception that plagues vocational education, namely that it is for less bright students; and (iv) schools must be incentivised to focus on the TechBac. To achieve this, the TechBac should be equivalent to the EBac in all respects. (Paragraph 47)*

Work experience

9. *Good work experience is an important part of engineering education. It puts classroom learning into context, provides inspiration and is a source of career information. In addition, work experience can provide students with valuable practical skills. (Paragraph 55)*
10. *Recognising the challenge of providing quality work experience at Key Stage 4, the Government decided to remove the statutory duty on schools to provide work experience altogether and place greater emphasis on work experience in post-16 study. However with regard to engineering we recommend: (i) STEM work experience should take place before 16 years, before students make choices about study or work post-16; and (ii) that despite the curriculum and league table pressures a degree of compulsion should exist. There are already anecdotes suggesting that many schools are cutting back on provision of work experience and we are concerned about the impact of this on the provision of future engineers. (Paragraph 56)*
11. *The evidence we have received suggests that work experience is important for engineering education. We endorse the recommendation of the Education Committee that the Government's statutory guidance to schools should require them to provide work-related learning. (Paragraph 57)*
12. *We are concerned that the DfE has accepted the Wolf review's recommendation without appearing to attempt any assessment of its own on the impact of removing compulsory work experience at Key Stage 4. (Paragraph 58)*

University Technical Colleges

13. *University Technical Colleges (UTCs) are a welcome development and the limited evidence that is available suggests that they are effective providers of engineering education. However, the network of UTCs will not provide nationwide coverage and the Government must also focus on good engineering education in schools and colleges. (Paragraph 63)*

14. *The Government and all partners involved in the establishment and operation of UTCs should focus on quality not quantity. This includes being flexible if a new UTC needs more time or resource to establish itself, for example. The quality of education offered must not be sacrificed for the sake of political deadlines. (Paragraph 64)*
15. *The Government must clarify its UTC targets and how it will measure success. First, it must clarify the rationale behind the target number. Second, it should be clear about what it expects UTCs to achieve and how performance will be monitored. Third, the lessons learned from opening the first five UTCs must be shared with those involved in establishing new UTCs, including engineering employers. (Paragraph 65)*

Careers advice

16. The new duty on schools to provide access to independent and impartial advice is laudable and in principle we would support greater autonomy for schools to provide careers advice. However the duty poses problems in practice. First, there are resource implications for schools that have been given more responsibility, but no additional budget, to secure careers guidance. Second, there is little guidance on the quality of careers guidance that should be available to students. *The Government must monitor the impact of the new statutory duty and if, by September 2013, there is evidence that the duty is having a detrimental effect on schools or students, the duty should be reviewed or additional support provided to schools. (Paragraph 77)*
17. *Informed face-to-face careers advice is essential for informing career choices and every young person should have the opportunity to access it. The Government should set out how it plans to ensure that all students have the opportunity to access face-to-face careers advice, with the National Careers Service as one possible resource. (Paragraph 78)*
18. We were pleased that employers placed a strong emphasis on the role of industry in engaging young people. Campaigns such as the “Big Bang Fair” and “See Inside Manufacturing” can be effective at promoting engineering careers, and should be encouraged and supported by Government. However, the success of such initiatives depends on the willingness of parents, schools and teachers to promote them to young people. In addition, such initiatives are naturally resource-intensive and run infrequently, so everyday engagement at school-level remains important. (Paragraph 85)
19. We support the principle of engaging school teachers with the engineering industry on an ongoing basis, including spending time in industry. *Government must ensure that schools have sufficient resources to ensure Continuing Professional Development is a norm not a luxury. Employers also have a key role in providing careers advice to students. Engagement with local engineering industry should be particularly encouraged amongst teachers of STEM subjects. We recognise that teachers already face many conflicting pressures. Therefore we recommend that engagement with industry be a core requirement of teachers’ Continuing Professional Development (CPD). (Paragraph 86)*

20. *We recommend that learned societies, professional engineering institutions and trade bodies put an obligation on their members to systematically engage in promoting engineering and technology as a career through a structured programme of educational engagement.* (Paragraph 87)

Research and evidence in DfE

21. We are concerned that the Department for Education; (i) does not have a clear definition of what constitutes research spend; (ii) has not planned its research spend sufficiently in advance; (iii) has no established budget for evaluation of policies; and (iv) does not protect or ring-fence its research budget from “other priorities”. The desire to remain flexible and “demand-driven” is not at odds with strategic, long-term thinking about research and evaluation. (Paragraph 91)
22. The DfE’s Chief Scientific Adviser (CSA), who also holds the post of Director of Research and Analysis, gave oral evidence on 21 November 2012 and told us she had “not done the work yet” on future research spending, yet written evidence from the DfE following the evidence session stated that business planning would conclude in the New Year. This suggests to us either that strategic planning of research spending in the DfE is given very little time or that the CSA has limited involvement. *We would be interested in an explanation from Government on this matter.* (Paragraph 92)
23. Our recommendation to the Department for Education (DfE), based on our experience during this inquiry, is that greater focus needs to be placed on evidence before future changes are made, and needs to leave sufficient time for evidence to be gathered on the effectiveness of its proposed changes before introducing further change. *We recommend that the DfE conducts a re-evaluation of its attitude towards the role of evidence in policy and decision-making.* (Paragraph 95)
24. We are pleased that the DfE has warmed to the concept of using Randomised Controlled Trials (RCTs) in education policy and that the Department is challenging itself on the use of RCTs. *Policy should be backed up by evidence and although evidence can come from many sources, RCTs are particularly useful in social policy. The possibility of gathering evidence from RCTs should be seriously considered every time the DfE considers an education policy change.* (Paragraph 98)

Conclusions

25. At first glance, recent educational reforms have the appearance of supporting engineering education, for example the rationalisation of vocational qualifications following the Wolf Review was generally welcomed, the EBac includes a focus on science and maths education and UTCs have met with approval from the engineering community. However, the devil is in the detail and some of the individual effects of such changes could be detrimental to engineering education, for example the recent changes to the Engineering Diploma following the Wolf Review. We consider that the Government’s approach towards engineering education in some aspects has not been effective. (Paragraph 99)

26. *The Government's stated views on the importance of engineering and manufacturing to the UK are inconsistent with its actions in education policy. The Government has a powerful influence on schools, students and parents through performance and accountability measures and has direct responsibility for ensuring good education for the UK's future engineers. It must use its actions, in the form of policy and incentives, more effectively to promote technical and engineering education. (Paragraph 100)*

Formal Minutes

Wednesday 30 January 2013

Members present:

Andrew Miller, in the Chair

Jim Dowd
Stephen Metcalfe
Stephen Mosley
Pamela Nash

Sarah Newton
Graham Stringer
Roger Williams

Draft Report (*Educating tomorrow's engineers: the impact of Government reforms on 14–19 education*), proposed by the Chair, brought up and read.

Ordered, That the draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 100 read and agreed to.

Summary agreed to.

Resolved, That the Report be the Seventh Report of the Committee to the House.

Ordered, That the Chair make the Report to the House.

Ordered, That embargoed copies of the Report be made available, in accordance with the provisions of Standing Order No. 134.

Written evidence was ordered to be reported to the House for printing with the Report (in addition to that ordered to be reported for publishing on 30 January 2013)

[Adjourned till Wednesday 6 February at 9.00 am

Witnesses

Wednesday 24 October 2012

Page

Steve Radley, Director of Policy, Engineering Employers Federation,
Lynn Tomkins, UK Operations Director, Sector Skills Council for Science,
 Engineering and Manufacturing Technologies,
Richard Earp, Education and Skills Manager, National Grid, and
Andrew Churchill, Managing Director, JJ Churchill Ltd Ev 1

Wednesday 7 November 2012

Georgia Turner, Student, The JCB Academy, **Georgie Luff**, Student,
 Newstead Wood School, and **Kirsty Rossington**, Substation Apprentice,
 National Grid Ev 12

Jim Wade, Principal, The JCB Academy, **Liz Allen**, Headteacher, Newstead
 Wood School, and **Maggie Galliers**, President, Association of Colleges Ev 19

Wednesday 21 November 2012

Dr Bill Mitchell, Director, BCS Academy of Computing,
Nigel Fine, Chief Executive, Institution of Engineering and Technology, and
Dr Matthew Harrison, Director of Education, The Royal Academy of
 Engineering Ev 30

Carole Willis, Chief Scientific Adviser, Department for Education Ev 37

Elizabeth Truss MP, Parliamentary Under-Secretary of State (Education and
 Childcare), Department for Education, and **Matthew Hancock MP**,
 Parliamentary Under-Secretary of State (Skills), Department for Education
 and the Department for Business, Innovation and Skills Ev 42

List of printed written evidence

1	Department for Education (contribution from BIS)	Ev 50, Ev 78, Ev 82
2	National Grid	Ev 52
3	The JCB Academy	Ev 55
4	The Royal Academy of Engineering	Ev 56
5	Newstead Wood School	Ev 60
6	Association of Colleges	Ev 60
7	Semta	Ev 64
8	EEF	Ev 73

List of additional written evidence

(published in Volume II on the Committee's website www.parliament.uk/science)

9	Carre's Grammar School, Sleaford	Ev w1
10	Blast Absorption Systems Limited	Ev w1
11	The Open University	Ev w2
12	Baker Dearing Educational Trust	Ev w5
13	The Society of Motor Manufacturers and Traders (SMMT)	Ev w9
14	The Royal Society	Ev w12
15	National Apprenticeship Service	Ev w13
16	OCR (Oxford Cambridge and RSA Examinations)	Ev w18
17	EADS UK	Ev w21
18	National Skills Academy Process Industries (in collaboration with the North East of England Process Industry Cluster)	Ev w26
19	Prospect	Ev w27
20	Stoke-on-Trent and Staffordshire Local Enterprise Partnership	Ev w28
21	Cogent Sector Skills Council	Ev w32
22	Bentley Motors	Ev w34
23	E4E	Ev w36
24	Engineering Professors' Council (EPC)	Ev w43
25	Chemical Industries Association	Ev w47
26	OPITO	Ev w48
27	Engineering UK	Ev w50
28	The British Standards Institution	Ev w53
29	University of Cumbria	Ev w54
30	Design Council	Ev w55
31	EDF Energy	Ev w59
32	Pearson	Ev w62
33	Environment Agency	Ev w65
34	Engineering and Machinery Alliance (EAMA)	Ev w67
35	British Airways	Ev w68

List of Reports from the Committee during the current Parliament

The reference number of the Government's response to each Report is printed in brackets after the HC printing number.

Session 2012–13

First Special Report	Science in the Met Office: Government Response to the Committee's Thirteenth Report of Session 2010–12	HC 162
First Report	Devil's bargain? Energy risks and the public	HC 428 (HC 677)
Second Report	Pre-appointment hearing with the Government's preferred candidate for Chair of the Medical Research Council	HC 510–I
Second Special Report	Engineering in government: follow-up to the 2009 report on Engineering: turning ideas into reality: Government Response to the Committee's Fifteenth Report of Session 2010–12	HC 511
Third Report	The Census and social science	HC 322
Fourth Report	Building scientific capacity for development	HC 377
Fifth Report	Regulation of medical implants in the EU and UK	HC 163 (Cm 8496)
Sixth Report	Proposed merger of British Antarctic Survey and National Oceanography Centre	HC 699
Third Special Report	Devil's bargain? Energy risks and the public: Government Response to the Committee's First Report of Session 2012–13	HC 677
Fourth Special Report	Building scientific capacity for development: Government and UK Collaborative on Development Sciences Response to the Committee's Fourth Report of Session 2012–13	HC 907
Fifth Special Report	Proposed merger of British Antarctic Survey and National Oceanography Centre: Natural Environment Research Council Response to the Committee's Sixth Report of Session 2012–13	HC 906

Session 2010–12

First Special Report	The Legacy Report: Government Response to the Committee's Ninth Report of Session 2009–10	HC 370
First Report	The Reviews into the University of East Anglia's Climatic Research Unit's E-mails	HC 444 (HC 496)
Second Report	Technology and Innovation Centres	HC 618 (HC 1041)
Third Report	Scientific advice and evidence in emergencies	HC 498 (HC 1042 and HC 1139)
Second Special Report	The Reviews into the University of East Anglia's Climatic Research Unit's E-mails: Government Response to the Committee's First Report of Session 2010–12	HC 496

Fourth Report	Astronomy and Particle Physics	HC 806 (HC 1425)
Fifth Report	Strategically important metals	HC 726 (HC 1479)
Third Special Report	Technology and Innovation Centres: Government Response to the Committee's Second Report of Session 2010–12	HC 1041
Fourth Special Report	Scientific advice and evidence in emergencies: Government Response to the Committee's Third Report of Session 2010–12	HC 1042
Sixth Report	UK Centre for Medical Research and Innovation (UKCMRI)	HC 727 (HC 1475)
Fifth Special Report	Bioengineering: Government Response to the Committee's Seventh Report of 2009–10	HC 1138
Sixth Special Report	Scientific advice and evidence in emergencies: Supplementary Government Response to the Committee's Third Report of Session 2010–12	HC 1139
Seventh Report	The Forensic Science Service	HC 855 (Cm 8215)
Seventh Special Report	Astronomy and Particle Physics: Government and Science and Technology Facilities Council Response to the Committee's Fourth Report of Session 2010–12	HC 1425
Eighth Report	Peer review in scientific publications	HC 856 (HC 1535)
Eighth Special Report	UK Centre for Medical Research and Innovation (UKCMRI): Government Response to the Committee's Sixth Report of session 2010–12	HC 1475
Ninth Report	Practical experiments in school science lessons and science field trips	HC 1060–I (HC 1655)
Ninth Special Report	Strategically important metals: Government Response to the Committee's Fifth Report of Session 2010–12	HC 1479
Tenth Special Report	Peer review in scientific publications: Government and Research Councils UK Responses to the Committee's Eighth Report of Session 2010–12	HC 1535
Tenth Report	Pre-appointment hearing with the Government's preferred candidate for Chair of the Technology Strategy Board	HC 1539–I
Eleventh Special Report	Practical experiments in school science lessons and science field trips: Government and Ofqual Responses to the Committee's Ninth Report of Session 2010–12	HC 1655
Eleventh Report	Alcohol guidelines	HC 1536 (Cm 8329)
Twelfth Report	Malware and cyber crime	HC 1537 (Cm 8328)
Thirteenth Report	Science in the Met Office	HC 1538
Fourteenth Report	Pre-appointment hearing with the Government's preferred candidate for Chair of the Engineering and Physical Sciences Research Council	HC 1871–I
Fifteenth Report	Engineering in government: follow-up to the 2009 report on Engineering: turning ideas into reality	HC 1667 (HC 511, Session 2012–13)

Oral evidence

Taken before the Science and Technology Committee

on Wednesday 24 October 2012

Members present:

Andrew Miller (Chair)

Caroline Dinenage
Jim Dowd
Stephen Metcalfe
Stephen Mosley

Graham Stringer
Hywel Williams
Roger Williams

Examination of Witnesses

Witnesses: **Steve Radley**, Director of Policy, Engineering Employers Federation, **Lynn Tomkins**, UK Operations Director, Sector Skills Council for Science, Engineering and Manufacturing Technologies, **Richard Earp**, Education and Skills Manager, National Grid, and **Andrew Churchill**, Managing Director, JJ Churchill Ltd, gave evidence.

Q1 Chair: We will now move seamlessly on to the beginning of our inquiry into engineering skills. May I welcome the new panel? I think that all four of you have seen that we operate in a very friendly and collegiate way. Hopefully, we can carry on like that. It would be helpful if the four of you could formally introduce yourselves.

Steve Radley: Good morning. I am Steve Radley. I am the policy director for EEF, an organisation that represents 6,000 manufacturers.

Lynn Tomkins: I am Lynn Tomkins from Semta—the Sector Skills Council for Science, Engineering and Manufacturing Technologies. I am the UK Operations Director, responsible for both strategic and direct engagement with employers in the sector.

Richard Earp: Good morning. I am Richard Earp. I am the education and skills manager at National Grid. I have spent the last three years running all of our schools and educational outreach programmes.

Andrew Churchill: Good morning. I am Andrew Churchill, managing director of JJ Churchill Ltd, a family-owned SME precision engineering company that employs about 130 people in the midlands.

Q2 Chair: The first question that I want to pose is about employers' difficulties in recruiting good engineers in the UK and to discuss whether there is in fact a skills gap. Specifically, Mr Churchill and Mr Earp, how do you see your companies' engineering skills need changing in the future?

Andrew Churchill: We compete in a high labour cost economy; therefore, to compete on the cost of labour is going to take us nowhere. We need to compete with the best skills and the best technologies. What we are seeing in aerospace and defence, and in civil and defence nuclear as they get off the ground, is that an increasing level of higher skilled employees is required. That means that I am looking for employees with experience and competence. This is probably common across many engineering sector employers, but I am finding it harder and harder to get that type of competence and experience.

We are relying to a greater and greater degree on our well-established apprenticeship scheme to develop

and grow our own skill sets internally. That is fine, but it means that there is a lack of new blood coming into the business unless we specifically go out and look for other people to bring in. That itself is a difficulty if you are a rural business such as we are—an SME competing with blue-chip multinationals, who are also our customers, and also with some of the security-controlled sectors such as defence and nuclear.

Richard Earp: I think we said in our written evidence that this year we were looking for 280 trainees. In fact, we have taken on 310. We have found the people that we were after. However, our sense was that the strength in depth in the pool from which we were recruiting wasn't quite what we would like it to be. Whilst we have been able to secure people, we had concerns about the strength that is there and what that means for the companies around us and for us, going forward.

We run training schemes at all levels, from apprenticeships through to graduate training schemes. We are growing the intermediate skills sector, which is really quite important. We take on almost 70 trainees with level 3 qualifications on entry and then use a foundation degree route to bring them up to advanced technician status. Something like two thirds of our people don't need degrees. On the other hand, you could cut the data a different way and say that something like two thirds of our people need A-levels or equivalent level 3 qualifications. There are some messages here about the average skill base needing to be stronger. We are looking to recruit people with quite strong science and engineering skills, but the source of those higher skills isn't as strong as we would like it to be. That is our observation.

Q3 Chair: Based on those two responses, Ms Tomkins, in the centre's written evidence you mention problems with the ageing work force and the fact that companies are having difficulty in finding the right skill sets. Do you foresee a point in the future when young engineers in the pipeline are so few and far between that it will have an irreparable impact on industry?

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Lynn Tomkins: I think we are seeing some of those issues now. We need some 82,000 engineers and technicians just to deal with retirements to 2016. There is a key issue in getting the message out to young people that it's a great creative career in engineering. Companies such as Andrew's are quite unusual, as SMEs, in actually taking on young people and training their own apprentices. Only 18% of companies in our sector recruit apprentices and only 16% of SMEs take on graduates. There is a variety of reasons for that, including the bureaucracy of finding good talent and being able to attract it if you are competing with blue-chip companies. There are a number of things that we can do to address that. Toyota and Rolls-Royce in the east midlands certainly get a lot of people applying to work for them. What we are trying to do, if they are tested and make the grade, is to support those young people perhaps to a job with an SME in the region so that they don't need to be retested; they just haven't got a job. In the west midlands, the recruitment of Jaguar Land Rover is having a major impact on companies, because it is taking on 1,000 apprenticeships and 500 graduates. We need schools to promote a career in engineering, and we obviously cover that. The engineering diploma was addressing some of that. It is also attracting a significantly high number of girls, which is, again, an issue. Females in advanced manufacturing and engineering are 21% compared with 48% in other sectors, and even less if you then get into the occupations of engineering. There is a lot to do.

Q4 Chair: You may have heard Sir John answering a question earlier on about science and engineering education. There is a very strong view—it is easy to produce evidence on it—that young people are influenced by those around them from a very young age, yet the sector skills councils are now under pressure to be programme-based and focused on the employers, rather than looking backwards at doing work with schools, and particularly, for example, primary schools. Doesn't that give you a problem in creating your next generation pull-through?

Lynn Tomkins: Yes. Certainly our remit is to support our employers; clearly, by doing that, we are clearly supporting them, if you like, to have positive campaigns. I shall give you an example.

We have regional councils in all of the nine English regions, as well as in Scotland and Wales. The good messages that are powerful to young people are about other young people who have got a great job in a company, what they are earning and so on. We supported our companies to have a campaign in the press. In the region's local companies and in the north-east, we have certainly increased engineering apprenticeship starts over a six-month period. There were 1,800 in 2010; they are now at 2,200 in the first six months of this year. There is lots that employers can do, and they do it, especially the large companies supporting their supply chain. Everybody understands that it is a major task.

Q5 Chair: Would you answer the question directly? Are you now restricted because of the new rules that

you are working under from doing innovative work to reach into areas such as primary schools?

Lynn Tomkins: We are not restricted, but we are not funded to do any careers.

Q6 Chair: You are restricted, then, as funding stops you.

Lynn Tomkins: Yes, we are, as such.

Q7 Stephen Metcalfe: I recognise that a range of levels of qualification are obviously required across the whole engineering sector, but do employers prefer taking on apprentices and training themselves to make sure that they end up with the skills that the business needs, or is it better to take in graduates, bearing in mind that graduates are unlikely to have the relevant experience that you spoke about earlier? Which is the better route?

Richard Earp: From our point of view, I would not say that there is a better route. It is going to sound clichéd, but it's true. The business is a team: you need people with different backgrounds, different experience and education at different levels. We have a strong need for graduates because we have a strong need for people with the necessary analytical skills and, frankly, the depth of theoretical knowledge to solve complex problems. But we also need people with practical skills and people who prefer a lifestyle out doing practical jobs rather than a head office-type job. We need all of them, and I wouldn't say that there is a preference. Like any good team, if you have a weakness in one area, the whole team suffers, so you can't neglect anything.

Andrew Churchill: May I add to that? I agree basically with Richard's comments, but we have to be incredibly careful not to suggest to our youngsters, from primary age onwards and right the way through as students, that to go down the vocational line is in some sense a failure. We are selling our culture and our community short by doing that. It is not the case in Germany. I am not suggesting that we should ape Germany, but vocational training there is seen to be far more of an equivalence and you are not a failure if you don't go immediately from school to university. It isn't just a big company blue-chip prerogative to send your best and brightest apprentices on to university; we do that. We need to expect far more from our SME sector, which, after all, is about 90% of our manufacturing businesses, to do just that. If you articulate career progression for your apprentices, you keep them. If you keep them, they are getting that competence with you and you don't lose them to your competitors.

Steve Radley: I would like to add to some of the points that Andrew and Richard have been making but also in answer to the previous question, with your permission just very quickly.

We have recently conducted some new research, which I think was completed after we had submitted our evidence. It certainly shows that, across the board, employers are saying that their skill needs are increasing across a range of different skills. Between 60% and three quarters of companies are saying that they expect to have higher skills needs in a range of areas over the next few years. Some of this is probably

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to do with things that we traditionally talk about, such as craft technician skills, but we find that other factors such as R and D, technical skills, project management skills and even some other things like sales and marketing are becoming increasingly important. This really reflects employers' focus now on innovation and finding new markets abroad, particularly in emerging economies, and also on developing service offerings and improving their processes.

As Andrew and Richard have said, it is very much horses for courses. Some companies will want to go down the apprenticeship route, but others will want to recruit directly from higher education. When looking into the future, in many cases it will be a hybrid route. In some cases, people will go into a company, get an apprenticeship at level 2 or level 3, or perhaps in the future at a higher level, but over their working lives they will probably go to higher education institutions to get further qualifications at degree level. It will be much more of a hybrid innovative approach in the future.

Q8 Chair: By the way, we would welcome sight of that research.

Lynn Tomkins: May I add to what Andrew said? We have developed a higher advanced apprenticeship that takes people through to level 4 and level 6 and gives IEng status. An apprenticeship is just a starting point and it is definitely valued. Recently, Nigel Whitehead of BAE Systems said that 270 of the 400 leaders in military aircraft manufacturing started as apprentices. There is a real need for a mix.

Q9 Stephen Metcalfe: I wouldn't want you to go away for one minute thinking that I don't recognise the importance of apprenticeships. That is what the question was—that you, as employers, get the opportunity to direct people earlier in their engineering careers. I am not trying to differentiate between the two. Are there advantages in apprenticeships? By the sound of it there are, but it is horses for courses.

Bearing that in mind, though, is it more difficult for small and medium-sized companies to offer apprenticeships? You are obviously doing very well, but you said that only 18% of small businesses are able to do it as opposed to—I couldn't hear whether you said 16% or 60%.

Lynn Tomkins: It is 16% who take on graduates.

Q10 Stephen Metcalfe: What are the barriers to small and medium-sized businesses taking on apprenticeships or graduates?

Lynn Tomkins: A lot of small businesses don't have an HR or training function, so taking on a young person is quite resource-intensive. It is quite complicated. You have to find a good provider, and the staff will be off the job for the first year while you are paying wages. There is a whole range of barriers that are well documented and well researched in doing that.

We are doing some work at the moment, which is supported by the Employer Investment Fund, to target new employers who have never taken on an apprentice. We are very successful. There is a great

willingness if they can be supported in recruitment, because, again, it is attracting the right talent, helping with selection and linking to a good provider who will respond well to a small company. A lot of the contracts for engineering apprenticeships go to the big providers and therefore having flexible delivery is really important. Giving good service to employers is an issue.

Andrew Churchill: There is a division between barriers and perceived barriers, particularly at SME level. There is also the fear of the unknown. My company doesn't have a professional HR department. We can't afford to resource one, but by working closely with the local college we have been able to develop and run our own apprenticeship scheme for seven decades, and 8% of my work force are in apprenticeship. That is our lifeblood.

That fear is something that communication and education of the SME sector can overcome, but one thing it has to be is local. Apprentices and students don't travel. Most don't have driving licences. There is a one-size-fits-all approach; the UTCs are fantastic and I am sure that we will come on to that later, but it is only for that area. You have to engage with the local primary schools, your local schools and local colleges, but it has to be within scooter distance. I know that sounds quite bizarre, but we want to keep them.

The final point is that you must engage as an employer, as an SME, with the parents. You have to shatter that image of dark satanic mills and greasy rags. We are not like that in the UK. I wish that our media would better represent engineering manufacturing today. We need to get our parents into our factories, and our careers advisers at schools and school form teachers, just to see what we are about and how exciting it is. Then you will get that excitement cascading through the generations.

Q11 Stephen Metcalfe: Is there anything more that we as the Government could do? What recommendations would you like to pass across that would improve things?

Richard Earp: We have certainly spent a lot of time in the last three years working with schools. Work that we did about three years ago suggested that one of the issues underpinning Andrew's point is that young people struggle to visualise a professional engineer, certainly in a positive way, so we have been making great efforts to send our engineers into schools to do exactly that.

The system of incentives that drives the school timetable and schools' priorities does not necessarily make space for employers to do that. Perhaps the Government could give some thought to that aspect. Is it essential, if a school is to be perceived as doing well, to involve employers? If we have a system of incentives for schools whereby schools can be seen to be succeeding without involving employers—that is possibly what we have now—then something could be done.

Steve Radley: I would support many of the points that my colleagues on the panel have made about the challenges that employers face, particularly small and medium-sized firms. One other point to recognise is

that, particularly in engineering, the investment required of an employer is significant. Figures from BIS, taking level 2 and level 3 apprenticeships combined, show that the cost to the employer is about £40,000. If you just stripped out level 3, it would be higher than that. That is a significant investment, but employers are willing to make it. On top of that, our research shows that there hasn't been any improvement in terms of the ease of investing in apprenticeships, in finding the right college, as Andrew said, and a provider that is responsive to their needs.

A number of things need to be done. If we are talking about the issue of apprenticeships more widely, looking to the future, we need to raise our level of ambition. Level 1 and level 2 apprenticeships have their place, but looking to the future, if we are going to be competitive as a nation, we need to focus on level 3. Where there is money available to increase funding of apprenticeships, it needs to be particularly directed in that area.

We need to do more to put employers in control in terms of driving standards within apprenticeships. There are far too many apprenticeship standards at the moment, and that is confusing for employers.

We also need to look at exploring alternative funding models. One of the ideas that we are quite attracted to, rather than giving the money up front to the provider, is to route the money through the employer, perhaps through a reduction in the national insurance contributions. That would address some of the cash-flow costs that particularly smaller employers face, but it would also put the employer in control and would drive innovation from providers and make them more responsive.

Lynn Tomkins: In terms of the wider picture for SMEs, Wales has a sector priority fund that employers drive, that we have control of, that employers prioritise, and they have gone for the higher advanced apprenticeship, which is the need to raise skills. They invite employers to tender for that work. So it has driven up quality, it has ensured a good price, and it has allowed flexibility for local provision. Where there is a collection of employers that have a need, we have done that. We would hope to see that opportunity, through the Employer-Ownership Pilots that are about to be released, to make engineering manufacturing a priority within that so that growth can be driven by employers.

Q12 Jim Dowd: My career started as an engineering apprentice, and it has been a catastrophic failure. One can never tell. Can I look at UTCs—university technical colleges, as they are known? There has been an almost universal welcome for the idea—so much so that it leads you to think that somebody has not told you everything. Are there any downsides to UTCs that anybody can see?

Andrew Churchill: The first downside from my perspective is that there is naturally going to be a postcode lottery, a patchwork of opportunity for youngsters, given that the UTCs rely substantially upon large company management expertise, funding and interaction. They are a fantastic step forward and they are very exciting, but they are only part of the

solution. In my area of the midlands, I have a couple of UTCs nearby but not near enough, so they don't help with my catchment zone for youngsters who come to me with that background.

Q13 Jim Dowd: That is not a defect in the proposition, is it?

Andrew Churchill: Not at all. It means that it will not be a universal solution but only an element of the overall provision.

Richard Earp: It is hard to see a huge downside. I absolutely accept the point. I guess, that if policy formation assumes that UTCs on their own are the answer to engineering skills and therefore that nothing else is done, then that is a risk and it would clearly be a mistake, because they are not.

We have been heavily involved with the early UTCs—the very first one in fact—and we like the idea. We think that the prospect of them is great, but they need to be nurtured and to find their position in the education system more generally. There are a number of risks to their future success, not least of which is the scalability of the model.

One reason why we are behind them is that we want them to be beacons. We want them to be exemplars in engineering education. What we often say to the UTCs that we have worked with is, “Are you going to reach out to your local schools? Are you going to share the project work and the new learning techniques and so on that you are going to develop with other schools?” For us as a company, that is going to be one of the things that we will always be looking for, because we know that we have to spread the message much more widely.

Q14 Jim Dowd: Is the danger not precisely the converse of that, namely, that schools more generally will say, “Technical education is now dealt with as a specialism, so we don't need to bother”?

Richard Earp: That is a danger, and we have to be alert to it. We need to set a new standard. We need schools specialising in this. For example, we have gone in and given projects to a couple of UTCs for their students to work on. That same project material, and the stuff that we have developed to support it, can and will be available to all schools. It is about using them as leaders, not as being the only answer.

Steve Radley: We are very attracted to the idea of UTCs. It is extremely early days; only 34 of them have been approved and have funding, and not all of them are up and running.

Q15 Jim Dowd: Is that enough?

Steve Radley: We need to look at expanding things, but we need to look harder at how the first few are doing before we go too fast. There are a number of very attractive aspects of it. It gets universities and employers working together, and it gives employers an opportunity to get involved in influencing curriculums and providing support. Probably very importantly, one thing that our overall education system could learn from UTCs is that their students are taught by teachers with real-life practical experience of work.

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One potential threat—this is something that we are probably coming on to—is that there are some attractions to the idea of introducing an English baccalaureate, but it is very important that the way it is introduced doesn't constrain the development of UTCs or put them on a lower level of esteem than the English baccalaureate. It is absolutely vital to address those issues.

Lynn Tomkins: I would like to add to Andrew's point. There are two very good examples in the west midlands, but again it is only one part of the solution. We need to look at Group Training Associations, which are much smaller specialist providers that can provide a local solution, but we have not missed the fact that one size doesn't fit all.

Q16 Jim Dowd: I don't think that anybody is suggesting that this is all that needs to be done. I am trying to examine what is being done in this area. Is the answer that it is quite promising?

Lynn Tomkins: Yes.

Q17 Jim Dowd: May I say to Mr Churchill in conclusion that the dark satanic mills to which Blake referred, given the coded intellectual satire of the Victorian era, are actually Oxford and Cambridge?

Andrew Churchill: I am fully aware of that, but it is used as a shorthand in common parlance and by the media for the antithesis of that.

Q18 Caroline Dinenage: I would like to talk about other academic groups that are producing the sort of skilled work force that employers tell us they need and which is lacking. The first would be the engineering diploma, and, as you know, there have been changes to that. Some people have reported to us that they felt the engineering diploma wasn't popular in schools because it was only one qualification and that, although it was the equivalent of many GCSEs, it didn't look particularly impressive in the league tables because it was only one qualification. The opposite of that is that others have felt that, by the Government not necessarily celebrating that as a vocational qualification, in some way they are not promoting vocational qualifications and not celebrating engineering. I wanted to have your thoughts on the engineering diploma and whether you think that it is a worthwhile qualification in the eyes of employers, first of all.

Andrew Churchill: There has been a relatively low take-up of the diploma, but it has not really been long enough in existence for us to make a proper assessment of where it is going. It was debased substantially and very quickly, down from five GCSE equivalents to one GCSE equivalent. That has sent a very unfortunate and very loud message to careers advisers and to secondary school teachers that engineering does not have the same basis of value as academic subjects. I fully understand that that is not the intention of it, by the way; I understand the intention of rebasing it, but intentions and perceptions are quite different things.

It would be a pity to chop and change too quickly, too radically, without having analysed the benefits and weaknesses of what went before. We are leaving

youngsters, careers advisers and teachers—and SMEs—with the perception of a constantly changing basis for engineering achievement at school level. That constant change is unsettling. It leads you as a teacher perhaps much more to lean towards the academic bias because it is simpler. The E-bac will also probably accentuate that if we are not very careful, as some of you mentioned earlier. There are elements of truth in all that you have said, but the biggest damage has been the perception of the debasing.

Richard Earp: I would agree with that. We support the Government's efforts to ensure high standards in English, maths and science. They are absolutely the bedrock of engineering and employability, but it is not enough on its own. Having the diploma alongside high standards in maths, English and science was a pretty good introduction for young engineers. In that sense, the fact that it is not there any more is regrettable. Yes, the message that it sent to schools about what their priorities should be is unfortunate, and we need to think quite carefully about that.

Q19 Caroline Dinenage: Do you think that, in its original form, it was a worthwhile qualification in the eyes of employers?

Richard Earp: Yes. My only hesitation is that any qualification depends on how well it is taught by the teachers in that school. Where it was taught well, and where it was alongside a good maths and science background, it was a good qualification, yes.

Lynn Tomkins: I can confirm that our employers welcomed the opportunity to develop an engineering diploma, and you can see from our evidence how many. We also worked with academic institutions. It was a great route to an apprenticeship or an engineering degree. It attracted a significantly higher number of girls who took that opportunity, with an increase of 35%, when 5% are taking engineering apprenticeships, and employers were hugely disappointed by the downgrading of it. I have an automotive strategy group, and when the first results came out a number of them had already offered jobs, irrelevant of the diploma results, because they had had a really good grounding and had worked with them and their schools. There was huge disappointment at the downgrading.

Andrew Churchill: May I come back on that? One of the difficulties as an employer when recruiting youngsters to be apprentices is that you can't reasonably expect them to be experienced. That is what they are; they are just starting out on their careers. I recruit for attitude and aptitude. I can't look at academic results; they are no longer a good enough indicator. I am looking for that spark that says they will find engineering and manufacturing really exciting.

The one thing that the engineering diploma did was to provide an opportunity for the student to learn something about the engineering and manufacturing world, with visits and so on as part of it, before making the leap into the unknown of taking an apprenticeship or doing an engineering degree. With that gone, and with design and technology coming out of secondary education—although there are debates

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about doing it in the primary sector—we employers, particularly SMEs, are left with a group of youngsters that know almost nothing about our sector at all unless one of the parents happens to work in engineering. The only way that we can engage now is right on the front line by going to see those primary school children and then getting them in for work experience at secondary level. One of the arrows that we have lost from our quiver is trying to educate people on what the manufacturing world in the UK is about today.

Q20 Caroline Dinenage: What can the Government do to make the engineering diploma more attractive not only to students but to employers and schools?

Lynn Tomkins: The downgrading was a huge turn-off for schools and students, and we would like it reinstated. We have employers that have put the point to John Hayes, and we clearly expect it to be made to Mr Hancock, the new Minister.

Richard Earp: It comes back to the point that we mentioned earlier about having a system of incentives for schools. It may or may not be appropriate to put the engineering qualification in an E-bac wrapper or something like that, but, if the criteria that schools are judged on—leagues tables, Ofsted inspections and so on—exclude coming to see what manufacturing industry is about and exploring engineering, then schools aren't going to do it. That is our assumption, and the evidence seems to support it. That system of incentives needs to be looked at very hard. Finding out about the world of work and engineering has to be in there somehow.

Steve Radley: A further point about incentives to schools goes beyond the downgrading. If you look at diplomas as a whole, the level of pass rates is pretty low. If that continues to be the case, there is clearly not going to be an incentive for schools to get involved.

That takes us back to some of the earlier points that have been made. It is not just about the status of the diploma in terms of the grades that it accounts for. It is about putting together a pretty complex consortium of employers, teachers and technical colleges, and getting good delivery. It is a good idea, but the problem in many cases is that it has been undermined by weak delivery.

Richard Earp: I would agree with that. Our support for it in principle, as I said, is based on the fact that where it is taught well we have seen it do well. If there is a pragmatic argument that it is just too difficult to put together the ingredients for a well-taught diploma and therefore young people are better off spending their time doing something else, that may well be true, but the policy response therefore needs to be, "Well, let's sort out the practical difficulties. Let's make it happen rather than let's not do it."

Lynn Tomkins: Just to pick up on Andrew's point, the Government had a "see inside manufacturing" initiative that they started in the automotive sector last summer. A lot of employers went to a lot of trouble to open their doors and invite the schools in, but at the first attempt a lot of schools just didn't bother to show up on the day. You can imagine the disappointment there was in them not wanting to do

that. None the less, the employers tried again in the October, and it was really well received. Aerospace is another sector that could become involved. But, again, if a school can just think, "We won't bother taking students to a leading factory that is opening its doors", then it is a great disappointment, especially if it is on their doorstep. Employers really struggle to deal with that sort of concept. Why would they not want their students to experience what it is like?

Richard Earp: The answer is that what they are judged on doesn't require them to do so.

Andrew Churchill: May I add to Lynn's comments? This is where I think the responsibility comes back on the employers rather than the Government, which might seem slightly oxymoronic.

We know that the schools find it hard to understand our sector. I believe it is unreasonable to expect teachers to have a great in-depth experience and knowledge of the manufacturing sector. Making sure that you have that engagement with your local primary and secondary schools means that, when a "see inside manufacturing" event comes along, they will attend because they see the value. I am sorry to say it, but the only group that can do that is the employers. That is our bit of the bargain. Your bit is to facilitate it; our bit is to make sure that the groundwork and understanding is there to start with.

Richard Earp: We have certainly done that. We have also got involved in teachers' CPD work; a potentially efficient opportunity for employers to get involved in education is to talk to groups of teachers. We have held open days for teachers at our premises, and we have worked with some of the science learning centres in helping with teacher training courses and CPD courses. We welcome those opportunities, and we will continue to do that. That might be something that the employers can do efficiently, and well, and more of.

Q21 Caroline Dinenage: That is right. I have seen the practical knock-on effect of engineering skills. Qinetiq in my constituency runs a power boat challenge. It sends engineers to the schools to give kids tips on how to build the boats, and on the final day they take them to a massive indoor water tank where they have the chance to race the boats. As a result, they understand the potential attraction of a career in engineering but without necessarily knowing that it is engineering they are doing because it is wrapped in adventure and fun.

Steve Radley: The point about CPD is really important. I agree with Andrew that ultimately a lot of this is down to employers. They have to find innovative and exciting ways to host visits to their factories or going into schools and stimulating young people. There is a very important role that teachers can play in reinforcing that.

I know that a lot of responsibilities are put on teachers, but one thing that we would be keen on would be to require that part of the teachers' CPD should involve spending at least a few days in industry. That would allow them to reinforce the messages that employers are looking to get across. Also, when they teach some of these key subjects such as science and maths, it would allow them to bring

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things to life and make them a lot more exciting and relevant to young people.

Q22 Caroline Dinenage: That is a good point. You mentioned the English baccalaureate. Some employers have welcomed it because of its strong emphasis on maths and science, but others have flagged up the fact that it would marginalise things such as design technology and computer science. Which GCSE subjects are important for producing skilled engineers, and what is your view on the English baccalaureate? Who would like to start?

Richard Earp: We are not going to be quoting the English baccalaureate as an entry qualification to any of our training schemes. That probably says something, in the sense that it is not exactly what we are looking for. However, we have always looked for GCSEs in maths, English and science. We just don't see the necessity to prioritise some of the humanities and languages subjects over design technology, electronics, business studies or any of the other GCSEs.

Andrew said something earlier about academic qualifications and their relevance. They are important. Standards in maths, English and science are certainly important, and evidence that someone has applied themselves enough to get a set of qualifications is important, but, like most employers, we use lots of other criteria to decide which young people we want to employ. I am not really too bothered about which GCSEs they have, beyond maths, English and science. I would love to see them doing the sort of challenge that you describe, where they get involved with practical engineering projects or have been out and done things. That tends to serve them better in our recruitment and assessment process.

Q23 Caroline Dinenage: The girls' team won, incidentally.

Richard Earp: Excellent; fantastic.

Q24 Caroline Dinenage: Does anyone else have any thoughts on this aspect?

Andrew Churchill: Yes, if I may. It would be hard to find a manufacturing or engineering employer who was keen to say that the STEM subjects weren't important. We all agree on that; there is no problem there. For a lot of youngsters, finding the link between those key core subjects and the real world—the bridge of application, of which the motorboat challenge was a perfect example—is the spark that is needed to secure success in those STEM subjects.

If you take design and technology out of the curriculum, a lot of children will find it hard to see how what they are learning from the blackboard—I am betraying my age now; I mean the whiteboard and the projector—is linked to the real world where they might end up being employed. Yes, STEM subjects are terribly important, but, for goodness sake, let us not lose design and technology. After all, I think that I am correct in saying that, of the non-compulsory GCSEs, design and technology is by far and away the most popular. Let's leave room for it. Am I right, Lynn?

Lynn Tomkins: Yes.

Andrew Churchill: Yes, let's leave room for that.

Q25 Chair: Does anyone disagree with that?

Lynn Tomkins: No; you have a small employer who has answered that really powerfully.

Steve Radley: I completely agree with that, but there is a wider point to be made. All parties are looking at the reform of qualifications, but E-bacs, A-bacs and Tech-bacs all have interesting elements. Richard mentioned English and maths, but it can't be a substitute for really driving up the standard of attainment in English and maths. We set one of our key benchmarks so that 65% of people at GCSE level should be getting A to C grades in English and maths. We are some way below that at the moment. It is not just about reforming the qualifications. We have to find other ways to drive up teaching standards in those basic building blocks.

Q26 Stephen Mosley: You were speaking about teachers and the effect that they have on children. What sort of careers advice do young people get at school? Could it be improved?

Andrew Churchill: In our limited experience, yes, hugely, but our experience is very specific and very local. Some schools are excellent when it comes down to the individual that provides the careers advice and probably their own experience and background. Others are having to rely on what they have picked up elsewhere rather than from a direct experience of manufacturing, and that is very weak. I don't necessarily blame the teachers or the careers advisers, but it is something that needs to be addressed if we are going to articulate the real opportunity for employment in high-calibre jobs in engineering and manufacturing in the future.

Richard Earp: It is vital that we talk to teachers and careers advisers to make sure that they understand what modern employers need. Careers advice is a really difficult job. How on earth typically one individual in a secondary school with 1,400 pupils can stay abreast of all the opportunities in the various sectors and professions I don't know. It is a really difficult job. We certainly welcome any opportunity we can get to talk to them and we do. There is no substitute for getting out and spending time there. As employers, we are very willing to step up to the plate and do that.

Q27 Chair: It is about creating space in the curriculum to allow the teachers to have the time to get involved in professional development so that they understand your sector.

Richard Earp: Yes. Many teachers progress from education straight back into schools, but, as one of my colleagues said earlier, spending time in industry is very helpful. We certainly run a few secondments. Yes, we must make space for them to reach out and experience the world of work.

Steve Radley: There are a couple of recent trends that we would find particularly unhelpful. One of the things is that there has been a removal of the requirement for schools to provide face-to-face careers advice. These days, young people can get a lot of good information from technology and from their

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own research, but, given the complex choices that many now have to make about a range of difficult qualifications and different routes into work and careers, they need some good face-to-face advice as well.

The other regrettable change is the dropping of the need for work experience at key stage 4 for 14 to 16-year-olds to be compulsory. We would like to see that reversed. That would be really important. As well as getting good advice from teachers and careers advisers, if young people have that opportunity to learn about work at first hand through work experience, that is absolutely vital.

Q28 Roger Williams: I have been involved in some of this previously, and one of the thoughts that I had was that, if careers advice was delivered by the school teacher or someone else employed by the school, however well intentioned the advice, it would not be as good as it could be, because the school would be tempted to point the pupils in a direction that the school would benefit from—for instance, going on to do A-levels or whatever. It seems to me that externally generated careers advice is the very best thing for young people.

Andrew Churchill: That certainly works extremely well. Both of my village primary schools do World of Work weeks at the age of about eight. The schools get in a variety of different skills, from engineering to veterinary work and beauticians, to talk for about 40 minutes about their job. I find that that really lights a fire with youngsters.

Coming back to the diversity question, I always question a group of eight-year-olds at the beginning of a visit, and the girls will put up their hands and say that they want to become nail technologists or beauticians, and the boys will say that they want to be bricklayers or boiler repairers. There is nothing wrong with any of those, by the way, but the children are not thinking about manufacturing. At the end, they have thought about it. That is important.

Chair: Hywel, do you want to push this a bit further?

Q29 Hywel Williams: I should have prefaced my question about work experience. I used to learn at something called the practice centre at Bangor university, which was involved for years in finding placements and supporting them, and then assessing assessors and supporting assessors and all that sort of work, which was quite highly developed because it was at the post-graduate level. Talking to employers at the time, you would ask what they wanted, and they would say, "What have you got?" You didn't really feel that employers were always on board.

To some extent, you have already answered my question, because I was going to ask you how important you think work placements are, but there are supplementaries to that. How do SMEs deal with work placements because of the resources issue and also the localism issue? Do you just hook up with your local schools, or is there room for wider experience for people at the other end of the country?

Andrew Churchill: I offer about 10 to 12 work placements of a week each year. With 130 employees, that is about as many as I can manage. Every student,

typically from 15 to 19 years of age, in that bracket, gets a taste of everything in every single department, including administration and finance. About 80% of those weeks are with very local schools, and they get my priority because within my seven-year strategic plan they are going to be some of my apprentices. For other schools, particularly those attended by the children of people who work for me who come from further afield, I am very happy to open the doors to them as well. Naturally, I focus on the very local area because it is in my own interests.

Richard Earp: The issue of work experience and seeing the world at work is really very important. Twice a year, we give over a large part of our training centre to set-piece courses that we run for year 10s; we take about 100 students a year through that. We also have work experience places throughout the business. One of the things that our research told us was that the best thing you can do in promoting engineering as a career is good quality work experience. However, the flipside of that is that one of the worst things you can do is bad quality work experience. We are absolutely in favour of ensuring that in key stage 4 somehow young people get exposed to the world of work and get to see the reality of what high-quality engineering and manufacturing looks like.

I am not sure that I support a blanket requirement for two weeks' work experience. There is plenty of evidence that not all employers step up to the plate and give those young people a positive experience for two weeks. In that case, given the loss of curriculum time, they could have been doing something more profitable. It probably would be a mistake crudely to say that we are just going to do two weeks work experience. There are programmes to ensure that students visit a range of different employers over the course of key stage 4, for example. Certainly in science and engineering, the biggest loss of people for the higher skilled STEM careers occurs with their post-16 choices. If they are not going to see the world of work or experience good quality STEM employers before choosing which A-levels or level 3 subjects to do, then we have a real problem. We have to show them during key stage 4 what it is all about.

Lynn Tomkins: A range of things has been discussed. Impartial careers advice has been implied. Good work experience might be only a day or a few days or a really positive week. We also touched on teachers having some good industry experience so that they can talk in an informed way about what a subject can lead to in terms of a career. There are a number of areas. Our employers are certainly asking for guidance on what is a quality work experience and what they should include in it so that they know how to meet it.

Steve Radley: May I add one additional element that I think is missing from this discussion? Being an economist, I like to think that people make rational choices. One thing that is happening now is that young people are being required to fund a lot more of their higher education. They need better information on what these qualifications will lead to in terms of earnings potential. There is good data out there showing that, if you take an engineering qualification or an engineering degree, it will lead to much higher

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earnings over your lifetime, and we need to find better ways of getting that information to young people making these subject choices.

Q30 Hywel Williams: May I ask a quick technical question on the value of having off-the-shelf work experience for school students as opposed to tailoring the experience to the individual student's express needs? Is there a dynamic here? Can you have the luxury of trying to find a student's specific needs rather than taking something off the shelf?

Richard Earp: That would be the ideal, of course. Part of good quality work experience is about addressing that person as an individual, but that is extremely difficult to do. During the work experience week that we run, we try to signal clearly to teachers what the week is all about, what we are going to be doing and at what level we will be pitching our material, so that we can match students to the opportunities as best we can. That dialogue is really important, and you have to do it, but it is probably utopia to think that we can tailor something perfectly to every student.

Andrew Churchill: I would add that it is particularly hard for us to tailor it. We do a week with a day in each department. However, unless it is extremely obvious that a youngster has a natural bent in a certain area, we quite often find that youngsters have the chance to get a taste of something that they had never heard of before. Had it been tailored up front, they would have missed that experience. I would be careful about over-tailoring. I would give them as broad an experience as possible, with a taste of work in as many areas as I can.

Q31 Chair: Going on with the question of careers advice and what should be done to improve it, there is a whole raft of ideas that one hears about. Of course every sector has its own nuances, and even within sectors, whether in big or small companies. Is there a big risk that we will end up with an attempt at one size fits all when, in reality, there needs to be a much better tailoring of systems to meet the needs of local students in local areas where local jobs are available?

Richard Earp: Yes, there has to be some tailoring. You have to give space for local employers and national employers operating locally. National Grid's engagement with schools differs quite a lot between the schools around our headquarters, for example, and those elsewhere in the country where we have a different presence. Actually, the successful engagement always depends upon the quality of rapport between the people who go in and the teachers themselves. It is about creating the space where people can have those conversations.

In reaching out to schools, it is quite interesting that you often have iterative conversations at the beginning. The schools don't quite know what we do and what we can offer. We know what we have got but do not necessarily know what they want and how it fits in with the curriculum. You have to go around that loop a couple of times before you can make things fit.

Q32 Chair: In some parts of the country the engineering industry is stronger than in others, but that does not mean that a supply of engineers might not come from other parts of the country.

The other part of that question is how you strengthen the professional development of teachers in areas where outreach programmes to the local factories and so on are not practical.

Richard Earp: One opportunity that I am aware of, although my colleagues may know of others, is courses that are run by Science Learning Centres—for example, development courses. We have helped to run one of those courses. We started off at Southampton. It is a regional course in that part of the world

Q33 Chair: Do you see it as part of the role of the engineering industry to engage in those outreach courses?

Richard Earp: Yes. It appears to be efficient for us to talk to a group of 20 teachers and all the students that they can reach. We talk strongly about what our business looks like, about its future and future challenges, and what that means for their students. That seems to us to be an efficient opportunity that we are certainly going to explore further.

Steve Radley: In some cases, you are pointing to the fact that in parts of the country there is probably a lack of employers with the critical mass to provide that on their own. There is probably a role for bodies like ours to facilitate employers to come together to do that. It is something that local enterprise partnerships could usefully do themselves.

I return to the earlier part of your question. You are absolutely right that you should never think that there is a one-size-fits-all approach to careers advice. You need local variation and tailored solutions. If anything, at the moment, there is a greater risk that the requirements on schools to provide careers advice are becoming too loose, and that will lead to poor provision.

Q34 Roger Williams: The fact that there are fewer girls and women in engineering has been a well-worked theme, despite the fact that girls do better in maths and science examinations. It was Education for Engineering that said that the lack of black youngsters in those subjects and in engineering wasn't an ethnic issue but one of socio-economics. Because there were more black pupils in low socio-economic groups, that is why they weren't going forward. However, even when girls and women and people from ethnic minorities go into engineering, they are not well retained. Is that because of bad practice by engineering companies, or is there some other issue?

Andrew Churchill: I shall probably be shot by my peer group for saying this, but I think that there is an element of that. We are a family business, and we know all of our employees very well and know what the families are up to. We are family-friendly in terms of flexible working time and looking after the health of all our employees. I am not talking from a statutory perspective but about providing private health care for all our employees, top to bottom. That makes good sense. We retain our employees and retain that competence. It also means that as family requirements

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change—perhaps a youngster gets married and has children—we can flex the hours. It has to be within business needs, and it is not always possible, but it's amazing what is possible when you have an environment that allows that discussion to take place. We don't need it to be Government policy to be told that it's a good idea to talk to our work force; it is just common sense.

Richard Earp: You certainly won't be shot by me for saying that. I agree with that wholeheartedly. We certainly go to great efforts to ensure that we retain all the people that we have spent quite a lot of money training. By and large, we are pretty successful at that. The issue of women in science and engineering is a long-standing one. We are not for giving up on it. We still spend time in girls' schools, for example, specifically, and we ensure that, in the work experience weeks, we have 50:50 representation. We shall continue working at it, but it is a problem that has been around for decades. As we heard from Sir John earlier, there are no glib solutions to some of these things, and I don't think there ever are.

Q35 Roger Williams: Are there any other reflections on that aspect?

Lynn Tomkins: We have certainly done some major work in this area over the last five years since the report on women in work was published. Funding was set aside for some sector skills councils to address the issue, particularly in sectors where women were under-represented. We got involved. Over the last five years we have developed a qualification, and 1,300 women in work have gone through that. The results are quite startling in terms of the number of women who have been promoted following that or who have taken on additional responsibilities. It is not just about the employers not doing their bit; it is about women recognising that they need to have the confidence to ask for the flexibility to tailor their careers and own them.

We can send you some examples where we have tackled some hard areas. For example, the submarine base at Barrow put all its women, in all occupations, through that. Atkins, too, is doing some leading work on that. It is a qualification that it really is delivering for women. For example, after doing the programme, a top-flight physics engineer with Airbus had three promotions because it gave her the tools to think about what she needed to do to progress. There was a willing employer who did not understand that perhaps women don't go for these jobs because they presume they are not going to get them. We have done quite a lot of work and that qualification has been taken up by some of our leading companies. Indeed, some of our SMEs also use it to help them keep their talent.

Steve Radley: I agree with all those points, so I won't repeat them. Ultimately, as well as everything that has been said, the key thing is influencing the choices that young people make at school. As well as the points already made about careers advice, there is a role for influencing younger people, and also their parents, at an earlier stage. You certainly wouldn't provide really formal careers advice in primary schools, but you could look at providing something like careers awareness. We work with some very good innovative

organisations, such as Primary Engineer, that go into schools and stimulate young people—girls and boys and all ethnic groups—to get really excited about engineering and science at a very early stage. We would like to see more of that.

Q36 Roger Williams: As always, we have heard some terrific examples of good practice. As a generality, would you say that, within engineering, diversity is important to engineering businesses? Should they do more to make it work for them?

Andrew Churchill: It is half of our potential pool of recruits, and to ignore it would be criminal at a time when we are short of skills. It is unconscionable and it makes bad sense. It is time that we did something to address it rather than hand-wringing.

Q37 Roger Williams: There have been campaigns to increase diversity in engineering and other parts of industry. How have those campaigns affected either businesses or organisations such as those we have here today?

Richard Earp: The reality, I guess, is that we have not moved the dial very far in terms of female participation in engineering degrees. I know that universities are not the whole story by any means, but things have not moved very far. One could conclude that none of this effort has been successful. That just means that we have to work harder and be smarter at it.

Primary schools are very important. I have personal experience of running an after-school science and engineering club—an Imagineering club—in a primary school. One year, when I walked in at the beginning, they were all boys. The teachers said, "Well, you know, girls don't do this sort of thing." Where on earth has that attitude come from? It is not something that any of us would have supported or endorsed or said. These are popular culture messages, and all of us in any kind of leadership role in society need to address that all the time. There is no magic bullet; it is just lots of continuous effort. We need to keep saying to everybody that 'this is for you'.

Lynn Tomkins: You are right that for the last 10 years it has gone from 19% to 21% and 6% in terms of engineering apprenticeships. The only significant link that we saw was with the engineering diploma, which was up at 35%, which has the potential to increase the number of females coming in.

Steve Radley: I know that it was not exactly the reason behind your question, but, as well as all the points that we are making about employers working with schools and what goes on in terms of careers advice and teaching at schools, we can't neglect the fact that one of the routes for employers recruiting a diverse work force is what they do in recruiting from abroad. As well as what employers can do, we need to look at some aspects of migration policy—particularly the closure of the tier 1 post-study route. Clearly that is a very important route so that employers can make full use of all the sources of skilled people.

Q38 Jim Dowd: I have a brief question. We have a fridge magnet at home that says, "Do you want to

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speak to the man in charge or the woman who knows what's going on?"

Chair: That's quite right, in your household.

Jim Dowd: Janet bought it, by the way.

As you said on a number of occasions, Mr Earp, particularly in reply to Roger, we need local priority and tailored solutions in careers advice. How can you pursue that and avoid Mr Churchill's postcode lottery? The point is that either everybody does it the same, which avoids the postcode lottery, or you allow local priority, which will then bring in distinctions between one area and another. How do we reconcile that and how do you reconcile it?

Steve Radley: If you look at careers advice, there needs to be a national requirement right across the country on the level of advice that schools need to make available, however they provide it. Where you can do things in terms of local tailoring, it is about how you involve employers.

Q39 Jim Dowd: That is going to make things different in one area compared with another. Then you come up with a postcode lottery.

Andrew Churchill: We have to recognise that things already differ according to the skills of the careers adviser in a particular school. I don't believe for a moment that you are proposing this, but, assuming that we are going to have a vanilla-flavoured approach to careers advice across schools, that is not an opportunity that will ever pertain. There will be different opportunities in different parts of the country, and that will be reflected, quite rightly, in education.

We need to find a halfway house. We still need to give opportunities to students in schools where there is not a well-established, large manufacturing base so that they will still be able to taste and touch design and technology. For instance, when the E-bac comes in, will there be room left for that so that, if it does light a spark, the students will have the opportunity to pursue it either at degree level or to look further afield? If they have not had that opportunity and they live in one of those black spots, you then have that perfect storm where someone who could have gone into a career and really offered value to society will miss it because they did not understand that it was something that they would enjoy.

Lynn Tomkins: You could certainly give the big picture by saying, "If you become an engineer, this is the wide range of careers you could pursue." To be

honest, lots of people will work in different environments as engineers during their lifetime, but you can also contextualise it to, "Locally, this is what engineering manufacture looks like and these are the sorts of companies you would work in, but in other regions there are these opportunities."

That obviously applies globally. Young people starting off on their careers might not want to be limited to working only in the UK. We can give the standard information on what a career as an engineer can deliver and then what it can mean locally, and also what it can mean globally. Given the way of the world, you are not normally in a job for 40 years. We also need to talk about that stepping stone; you might do your degree and then do something practical, or start as an apprentice and do your degree later in life, but it is definitely doable.

We could look at better ways of delivering it online. There would be a clearing place where you could get that information online because young people use that, but you could then go and talk to someone or you can experience that these are the companies who offer quality work experience. That would also support schools. Students could then think, "What should I expect from my work experience?" It would also support employers who might like to offer it but who don't have a clue what it means.

Richard Earp: Perhaps you could ask schools to demonstrate, for example, at Ofsted inspections, how they have worked with local employers to innovate some good practice, but also how they have gone out and borrowed some ideas from other regions. In that way, best practice is spread. Inevitably, solutions need to be worked up locally. I am not sure that it is entirely a postcode lottery, but you will get differing quality in different places initially. You then have to ensure that it does not persist.

Chair: May I thank members of the panel for their contribution this morning? It has been very enlightening. Clearly, there are potentially some other pieces of evidence, including, Mr Radley, the report to which you referred. Any further information that you might like to submit would be most welcome.

This is clearly not an easy subject to look at because we are spanning the whole definition of engineering, which in itself is a fairly wide word. I thank you very much for your attendance this morning and for your very helpful answers.

Wednesday 7 November 2012

Members present:

Andrew Miller (Chair)

Jim Dowd
Stephen Metcalfe
Stephen Mosley

Pamela Nash
Graham Stringer

Examination of Witnesses

Witnesses: **Georgia Turner**, Student, JCB Academy, **Georgie Luff**, Student, Newstead Wood School, and **Kirsty Rossington**, Substation Apprentice, National Grid, gave evidence.

Q40 Chair: Can I say good morning to the witnesses and welcome to Parliament? I want to start off by formally asking you to introduce yourselves, and we will ask a few questions.

Kirsty Rossington: I am Kirsty Rossington. I am currently a third-year apprentice working for National Grid, and I am based up in the north-east near Teesside.

Georgie Luff: I am Georgie Luff. I am in upper sixth, year 13, at Newstead Wood school for girls in Orpington. I am studying maths, further maths and physics.

Georgia Turner: I am Georgia Turner. I attend the JCB Academy and am in year 11.

Q41 Chair: I want you to start off by telling us a little about the work or study that you are doing at the present time, just so that we have a flavour of it. I will start with you, Kirsty, because you are in a quite different role; you are now working and so on. Tell us about it.

Kirsty Rossington: I have done two years of my apprenticeship already; it is a three-year course. As to qualifications, during the apprenticeship I have just done a City and Guilds and am midway through doing a Level 3 NVQ as part of the course as well. That means I am at the training centre for some of the time doing my qualifications and courses for the job, and then I am out on site putting all that into practice. The majority of my third year is now on site to complete my NVQ.

Q42 Chair: But you didn't start off as an apprentice, did you?

Kirsty Rossington: For National Grid, yes.

Q43 Chair: But you have done things before that.

Kirsty Rossington: Yes. I took a bit of an unconventional route into it. I actually went to university after I did my A-levels and then came back and started my apprenticeship afterwards.

Georgie Luff: As I said, I am taking maths, further maths and physics at the moment. I am still taking my A-levels; it is all very work-based and not practical-based, because I didn't have room to take any design A-levels as well. But I am also taking further mechanics classes because I feel that is the link to engineering at university that I need, and I really enjoy it. I am enjoying my subjects and I can't wait to study engineering further.

Georgia Turner: I am doing an engineering and business diploma along with English, maths, triple science and religious studies. I am also doing an NVQ in German and Mandarin at the moment.

Q44 Chair: The second question I want to ask you, and then I am going to ask my colleagues to chip in, is what inspired you to study the fields you are studying now. What was the on switch, if you like, especially, Kirsty, because you have changed direction? What inspired you to make the change you have taken?

Kirsty Rossington: I did my GCSEs at school and ended up going through and doing my A-levels. I wasn't really sure what I wanted to do and ended up going down a sport route. I enjoyed sport at school; I did PE A-level and ended up going to university. I got about halfway through my degree and realised it wasn't what I wanted a career in. I had done a few work placements in various things, such as sports developments, and realised it wasn't what I wanted; I didn't want a career in it, so about halfway through I started looking at my options and thought I would have to rethink it; so I had a bit of a rethink.

Georgie Luff: I always loved design and technology at school, so when I came to choose my GCSEs and school offered an engineering diploma I jumped at the chance of taking it, because for me it was the idea of going to college alongside school and using all their equipment and the practical side to it. I thought I would give it a go. Just before I definitely decided to take it, my physics class offered a trip to a lecture on the Bloodhound supersonic car. I went along, and it just was absolutely fascinating. For me, that was the turning point that I had to study engineering, build cars and race them across the world. After all the experience I have had I have moved slightly away from cars, but that was definitely my turning point and the thing that made me want to take engineering as a subject.

Q45 Chair: So we are not going to see you as the first female F1 driver but you will be the first top designer.

Georgie Luff: Definitely.

Georgia Turner: I have always grown up around engineering. My brother is at university doing engineering, and my dad works within the JCB so he is very much in touch with the engineering side. I have grown up close to JCB as well, so I saw machine after machine drive past my house when I was little.

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I have always sat at home drawing and sketching, little things like a kettle or anything like that. I am really interested in drawing. In year 8 I won a design and technology award and that was when I was spurred on to carry on and do design and engineering for my future.

Q46 Chair: Having the JCB Academy on your doorstep must have been a complete gift.

Georgia Turner: Definitely, yes.

Chair: When Xameerah and I went to see the school the other day, the first thing I said when we left was, "I want to go back to school."

Q47 Stephen Metcalfe: Of the subjects you have studied over your educational career so far, which do you think are most important to building a foundation on which you can then go into engineering?

Kirsty Rossington: My science and maths GCSEs. I can definitely see that now coming out during my apprenticeship. I did technology as well while I was at school; I chose woodwork. Especially in the first year of my apprenticeship, a lot of the hand skills I was learning and developing mirrored what I had already done at school. I had already had a taste of that, so it was definitely those three.

Georgie Luff: For me, it has to be maths and physics. They are the non-practical side of engineering, but they are the basics and the building blocks of everything you need. You can't go and design without understanding, and I am only just seeing now in my A2s that the maths and physics I have learned over the years are finally coming together in a practical sense, especially, as I said before, with mechanics. I don't think you can be an engineer without that prior knowledge, so they are definitely the key ones.

Q48 Stephen Metcalfe: But do you think you need physical, practical skills as well?

Georgie Luff: They are helpful but not necessary. I have had practical skills and have done a lot of design. It is really extra projects more so than taking a design and technology qualification. The practical skills you can build over time and they are things you can quite easily pick up, but if you don't understand the basics of momentum, say, you will never be able to design something that physically is going to work.

Georgia Turner: Maths, physics and the sciences are really important, but you also need to know English for communication. Without communication, the product is never going to be built, end of story. We do a lot of practical work at the academy. Without that I don't think I would have been able to do our challenges in as much detail, because you don't understand the procedures you have to take to manufacture.

Q49 Stephen Metcalfe: You have all heard of the English baccalaureate, which will focus on English, maths, the humanities and the sciences. At the moment it doesn't include any kind of practical, engineering or design technology-type qualification. I think you said you had done design technology at GCSE.

Georgie Luff: I took the engineering diploma.

Q50 Stephen Metcalfe: Would you have made space for that if the focus had been more on the English baccalaureate?

Georgie Luff: Sorry?

Q51 Stephen Metcalfe: I am sorry, yes. Let me put it in a clearer way. My concern—tell me whether you agree with me—is that, if schools are judged on the English baccalaureate, and so English, maths, the sciences and humanities is where the focus for the school is, is there a danger that you would be pushed towards that rather than perhaps doing some of the more practical subjects that might help to encourage or inspire people to do engineering?

Georgie Luff: Definitely. If the school is being ranked on its English baccalaureate, it is not going to be pushing for subjects that aren't putting them on the league tables. Part of the reason I took the diploma is that Newstead is an engineering specialist school. It pushed it and told me the positives of taking it and where it could lead me, but if someone hadn't stood there and told me, "This is what an engineering diploma can give you", I wouldn't have taken it. I think schools will move away from that if more emphasis is put on the more basic English, maths and humanities.

Q52 Stephen Metcalfe: Outside maths, physics and science, which I think you have all agreed are very important, is there one other subject that you would like to see pushed or promoted that would help people get a better understanding of engineering?

Kirsty Rossington: I would say engineering as a subject. I know a couple of friends' brothers and sisters who are at school now and are getting an opportunity to select it as a subject. I never got that option when I was at school. If it was there today, I imagine that as a whole it would give you such a broad base to lead on from.

Georgie Luff: That is exactly what the engineering diploma did for me. It covered every aspect of engineering I could have at a basic level so that afterwards you can go into your A-levels choosing subjects that help you progress into engineering as a career. I just think it is the most fantastic thing that I did.

Georgia Turner: I went to JCB because of the engineering diploma, and it has definitely given me a wider range of ideas myself and understanding.

Q53 Stephen Mosley: Could I pick on Kirsty first—in a nice way, I promise you? What made you decide to go and do an apprenticeship?

Kirsty Rossington: Really just the idea that I could still get more qualifications but learn a trade at the same time; to do a job that means something; to be able to go in to work in the morning and leave knowing I have made a difference to something myself; I have changed something for the better, rather than, when I was at university, my options were office-based generic jobs that I didn't necessarily need my degree for. The fact I could learn something like that really appealed to me.

Q54 Stephen Mosley: How did you find out about the opportunity at National Grid?

Kirsty Rossington: It was my dad. He had just completed his 40 years with the company. He started as an apprentice at 16 and has worked his way up. He was my inspiration and just mentioned it as an idea to explore.

Q55 Stephen Mosley: How did you find it going to that interview, because I guess it is quite a male-dominated career and company, isn't it? How did you find it as a young lady?

Kirsty Rossington: It was okay. Even now some people ask me, "How is it working in such a male-dominated environment?" On my site I'm the only girl, but, to be honest, it doesn't make a difference at all; everyone is treated the same; we do the same work. It doesn't make a difference. So, yes, it's great; I love it.

Q56 Pamela Nash: I want to ask each of you about careers advice. You are all at different stages in your academic careers. We didn't really have the careers advice. In the environment I grew up in 10 years ago, if I had said I wanted to be an MP, I am sure I would have been laughed out of the building—maybe even a couple of years ago as well. I want to ask each of you what your experience has been of careers advice. Was it provided within your school or at university, was it external, or did you have none at all?

Georgie Luff: Mine was during school. It started in year 10. We had a careers adviser at school. We went along to a meeting and talked about the subjects we enjoyed. They generally head you in the right direction. Then they get you an organised two-week work experience placement in year 10 on something you think you might be interested in, just to give you an idea. Mine was an engineering placement because I told them that I liked maths and physics, so they pushed me towards that. After that, I went back to school and said to the careers department, "I loved it; it was fantastic. Can you give me some more advice?" They went through university degrees and all the routes into engineering you could do.

The engineering diploma also had a careers section where you could find out about being an engineering technician or take a degree, and it explained the difference between bachelors and masters. It was all laid out for me. School played a massive part in it. Then I took another work experience placement in year 12, which we had to organise ourselves, but the school pushed you to do it. It was all internal for me.

Q57 Pamela Nash: Just before I move on to the other witnesses, you mentioned that your careers adviser had a good understanding of what it took to do an engineering degree. Did you feel that they had a good understanding of what possible careers you could go into beyond that degree?

Georgie Luff: I say "definitely". Most of the time they said that, if you took an engineering degree, basically it would take you anywhere. I could go and work in the City; I could work in an engineering firm; I could work abroad; I could be a designer; I could do anything I wanted, which was what appealed to me.

At the time, although I knew I loved it as a subject, I didn't know that was what I wanted to do for a career. When you are 13 or 15 years old you don't know what you want to do for the rest of your life, so the fact they told me that engineering was something that could take me anywhere was what pushed me to taking that.

Georgia Turner: I had careers advice at school. That was the real place I had it. We had work placement for a week in year 10 and I went to JCB and did design, which I asked to do. I absolutely loved it. About two weeks ago I just finished a second placement. I went to JCB but to a different factory. I enjoyed that again. Also on work placement they give you quite a lot of careers advice there as well. The book we fill in asks you what the people you work with did at uni and everything like that. I learned a lot then, and it definitely steered me in the right direction for what I wanted to do.

Kirsty Rossington: The careers advice I was given was from an external company while I was at secondary school. Basically, it involved a one-to-one 10-minute meeting to discuss your options. The only information she really had about me as a person was the grades I was getting at school. She based it upon that. She saw that I was doing well in all my subjects and said, "You could do your A-levels and go to uni; you're capable of doing it." She didn't really explore any other options for me, apart from that; she didn't know what I enjoyed. She literally just had what was on the paper.

Q58 Pamela Nash: That sounds very familiar. That is exactly what happened to me. Did you have any careers advice when you were studying sports science?

Kirsty Rossington: No, nothing.

Q59 Pamela Nash: I was surprised and delighted that we have an all-women panel. In any inquiry the Committee are doing I don't know that we have ever had an all-women panel made up of more than one witness. It is really nice to have you all here today. Can I ask about your schools? How many girls are doing the subjects that you are doing? What was your experience going through school as well? What we are trying to get to the bottom of is how we can get more girls to do these subjects, so any insights that you have into that would be helpful.

Georgie Luff: We have a full class at my school for the year 10 and year 11 engineering diploma. For year 12, probably 20% of physics and maths classes are girls. Even though it is an all-girls school, it has a mixed sixth form. Quite a lot of the physics and maths candidates are boys. Those are the subjects a lot of them have come into the school for, which surprises me because, being an all-girls school, I thought we would have many more girls in it. I just think it is a subject that people are not overly enthralled by. I don't know. I love it myself. I just think that people see an aspiring career as medicine and law, and engineering isn't something girls think of. Even at school people say to me, "You want to take an engineering degree. What are you going to do—work on cars and be a mechanic?" They just don't understand what it entails.

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Until you educate people as to what they can do with it, they don't want to risk putting themselves into that niche and just take maths and physics. They are not easy subjects.

Q60 Pamela Nash: Do you think there is a lack of prestige associated with engineering?

Georgie Luff: Definitely. There are so many awards, scholarships and things available, but people don't know about them, so they don't find out how engineering should be something to aspire to, not something that you do if you can't be a doctor or lawyer, in my opinion anyway. It is not recognised so much in this country.

Georgia Turner: There are six girls in my year who are students in my year, so we are very much the minority. In year 10, there are about 10 girls of about 130 students in total. We definitely don't have many girls in engineering, but at least it is an increase on what we had in our year. When I left my old school, all my friends were definitely under the impression that I was going to build diggers—that was all I was going to do—and then take some exams afterwards. It's not right in a way because they don't realise what you have to do to be an engineer. They think I am going to build cars or something like that. They are so naive about engineering as a whole. If they were given careers advice where they saw what we get to do, maybe they would think differently, but engineering isn't viewed positively among girls because they want to do something in London, or wherever they want to be.

Kirsty Rossington: I would absolutely agree with the previous comments. Still none of my friends know what I do.

Q61 Pamela Nash: I was just going to ask what your pals said when you told them you were going to National Grid.

Kirsty Rossington: "Is that water?" They still don't know. Quite often, they associate it with construction; they assume I am on a building site. They see that I've got a white hat to wear. They just don't know unless they ask questions. When I did my technology GCSE, there were only two girls in that class of about 40. In my apprenticeship intake, there are 19 of us and two of them are girls, so we are definitely still a minority. I just don't think they know about it. When I had my careers interview I didn't know it was an option for me. It was never mentioned even to explore it. I loved my technology. Maybe if she had seen that in me, she would have been able to mention that I could go this or that way. As a 16-year-old I didn't know what it was; I didn't even consider it. A lot of my friends are still like that now, or they assume engineering is dirty work. They think that if I work with oil I will come out covered in oil, but it's not like that at all.

Q62 Jim Dowd: Would you expand on some of the answers you have all just given? Do you ever feel odd, abnormal, as girls—women—in engineering, given the numbers you have just given? Do you ever feel that all the other girls have got it right and you have got it wrong?

Georgia Turner: No.

Georgie Luff: No.

Kirsty Rossington: No.

Q63 Jim Dowd: But you don't know why it is they don't see it the way you see it.

Kirsty Rossington: I do know why; it's because they don't know, but I am proud to describe my job to people and see their reactions. I am proud of what I do; I love it.

Q64 Jim Dowd: But your dad was doing it for years beforehand anyway, so you had a background or acquaintance with what you would like to do.

Kirsty Rossington: Yes.

Q65 Jim Dowd: This question applies to all three of you. When it was suggested to you that you might pursue engineering as a career for your professional life, did it strike you as novel and something you had never thought of before, or did it accord with something you had felt for a very long time?

Georgia Turner: I had always thought of going into design, even when I was really young. I always wanted to do drawing or sketching, so, for me, engineering was the obvious answer. I never thought, "I'm not sure about that," or, "Oh, that's a bit different;" I definitely wanted to go for that.

Georgie Luff: For me, it was quite the opposite. As soon as I heard you could be an engineer I thought, "Run away now." I had the impression that I would be a mechanic covered in oil, just like everyone else thinks. Until I did my work experience and saw what a work placement was like in an engineering company, I just thought I wanted to take an engineering degree because I liked the subjects and topics covered but I don't want to be an engineer. I would rather use my skills maybe to go into the City and make loads of money. But it turns out that engineering is what I like. The reason people don't know about it is because it's not pushed. Work placements, for me, are the things that open people's eyes. If more girls were pushed into work placements or shown work placements by employers, then we would have a higher uptake in maths and physics.

Q66 Jim Dowd: A work placement is quite late in the day, isn't it?

Georgie Luff: It was in year 10; it was before I had even started my first year of GCSEs.

Q67 Jim Dowd: We have seen and heard evidence from people who say that, whether it is girls or boys, male or female, you need to get them studying particularly the sciences early on in their careers so that they have the qualifications. Leaving it until you get a job placement is a bit late, isn't it?

Georgie Luff: Maybe my suggestion would be to get female engineers to come into schools and give inspirational talks, rather than dragging you out to a work placement.

Q68 Jim Dowd: There are hardly any of you; they are all busy working.

Georgie Luff: I know, but they could spare an hour or two at a school just to inspire those young engineers. If you don't get people to come in and give you the information, you can't learn and become an engineer yourself; you need to be taught.

Q69 Jim Dowd: You mentioned teaching engineering as a subject. There are all kinds of engineering. My background is that I was an electronics engineer. If you got covered in oil doing that you were in serious trouble. You mentioned the principal subjects of physics and maths in particular. Is it anything to do with the way those subjects are taught compared with arts subjects?

Georgie Luff: That is what puts people off. I don't think it is how you teach it; it is the content and the fact that it is quite difficult to understand. You need to knuckle down and practise it and apply it. For an arts subject you can read a book and understand it; you can read a revision guide. For engineering subjects, you need to read it and practise it. If you are not willing to put in the work, you will not do well in it, which is probably something else that puts people off.

Georgia Turner: From an early age, the impression of maths is that it is quite hard; sciences is quite hard for the majority of students. Lessons are normally sitting down and reading from a textbook or copying down from the board. Especially at my old school, that was what it was like. Before you even start high school you have this impression in your head, "Oh, it's another science lesson," or, "Oh, it's maths. I really don't want to do it but as long as I pass I'm fine."

But at the academy I am enjoying those lessons a lot more. The teachers think outside the box. So, instead of just learning about trigonometry, they put it into a situation that you would be familiar with. It helps you to learn it that way so that when you go into the exam you are more familiar with the content. Even though it may be written differently, you are more comfortable doing it. You remember little things they have said that help you through the exams. It is not just the exams; it's the life as well.

Q70 Jim Dowd: It is the mixture of theory and practicality.

Georgie Luff: Yes, which is why the engineering diploma is fantastic. It gives you the practical side and the actual information you need all in one. You learn it and then practise it for a module. You do that for eight modules over two years. By the end of it, you know everything. It's great.

Kirsty Rossington: It is important to remember that it's not just academic qualifications that you need to be able to get into engineering, especially to do an apprenticeship. The entry level is grade Cs in maths and science and it is important to attain those, but probably what you do outside school is more beneficial to you. Definitely when I had my interview for the apprenticeship I needed the basic entry requirements, of course, but the questions were based on what I did in my spare time—the way in which I already used the skills that I would need for the job. That didn't necessarily come from school subjects; it

was outside that. It is definitely important to remember that.

Q71 Jim Dowd: Beyond some of the items you have already mentioned, is there anything further that you think needs to be done to encourage the take-up of engineering as a subject by young people, and young women in particular?

Kirsty Rossington: It is just greater awareness of it. From personal experience, I didn't know I could do it. Nobody mentioned it to me until I was able to go back and do it after university. At the moment, through National Grid, I am taking part in a mentoring scheme. I have been assigned to a year 11 student. I am just waiting for the CRB check to go through so I haven't met her yet, but I will be meeting with her every week just for half an hour or so to have a chat. She has been identified as someone who may not be in education or employment when she leaves school. For me to be able to go in there from a company, from an industry point of view to talk to her, she can see first hand that that is an option. She can just have an informal chat with me.

I am also doing an assembly with another apprentice I work with who has just finished his time. We are both going to our local secondary school in a couple of weeks to do a careers assembly as part of National Grid to let them know this is what you can do. If I had had things like that when I was at school—just a little spark or thought in my head that perhaps I could do it—and someone was standing in front of me who had done it, it would have been really good.

Georgie Luff: I think the extracurricular projects should be pushed more. I have done the EES—the engineering education scheme—and took part in the GreenPower Challenge where you build a car and race it. All these things instigate such an interest in the subject that they are the things that need to be pushed from a younger age. At our school there is something called LEGO LEAP for years 8 and 9.

Q72 Jim Dowd: It is called what?

Georgie Luff: LEGO LEAP. It uses software. I am not part of it. I am year 13, not years 8 or 9. It uses LEGO to design robots and then software to program it, and it performs tasks. From the age of 14 they are learning how to program. In my year, for the engineering education scheme someone taught themselves C codes to build a buggy that would follow a soldier. Things like that, which are different from what you do at school and are exciting, are the things that should be pushed because they are the more real-life situations that show you engineering isn't dirty work and it really is thinking and problem solving that you need to develop.

Georgia Turner: When I was in year 10 there was a group of students, probably in years 6 or 7—all girls—who came to the academy and did a Girls in Engineering half-day, along with the old year 13 girls who were there and some of the engineers from Challenge partners who we are with. They did little tasks. They had to build a buggy and put an egg in it. It had to go down a ramp and not break the egg. They all thought it was really fun, and things like that they then related to engineering, instead of thinking that

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you would be under a car fixing exhausts or something. From that early age they got an impression that was completely different from what they were thinking and my friends are thinking now.

Q73 Jim Dowd: As we move from manufacturing to a more service-based economy, is engineering stigmatised as being old-fashioned and out of date, whereas being able to speak into three telephones at once and get £100,000 a year in the City is a much better proposition?

Georgie Luff: It does sound better when you put it like that, doesn't it? These days, people are seeing engineering more as a developing subject. If you think about it in the workplace, I don't know about people that don't study engineering, but I see it moving towards electronics and high technologies, maybe moving to the moon, for example, or just crazy things you wouldn't have expected to do years ago. In my eyes it is not old-fashioned; it is something we are moving towards and developing all the time. If you don't have an engineering background, maybe you wouldn't see it as that and you would think about steam trains, the industrial revolution and dirt.

Jim Dowd: The three of you seem to be hung up on cars, exhausts and oil. I am sure a lot of people don't have an interest in it, but never ever forget, of course, that it is engineers that make the world go round.

Q74 Stephen Mosley: Georgia and Kirsty, you both talked about family members who had been involved in engineering. Georgie, I know you talked about people coming to school and inspiring young ladies to do engineering, so it sounds like role models are important. Not just thinking about the girls you are at school with or work with but across the board in terms of doing engineering, how important are role models to encourage young people into engineering?

Kirsty Rossington: They are vital, especially if a girl hasn't had the opportunity to think about it as a career herself. If someone is already doing it, it is much easier to be able to see yourself doing it. You can see that someone else has already been successful, especially when you are talking about careers events and things. If you are not sure what you want to do, you need that little bit of a spark to tell you that you can do it; it is an option for you. If you have a role model who is already doing it, enjoying it and loves it and can share it with you, it makes it much easier to see yourself in that situation.

Georgie Luff: You need a role model for anything. People wouldn't start playing football if it wasn't for David Beckham. You need astronauts to inspire new astronauts. You wouldn't go into anything unless you had someone telling you it was great. It is not just engineering that needs role models.

Georgia Turner: My brother is definitely an engineer, given the way he thinks and acts. He is six years older than me. Before I could even walk I saw him building things. I have always seen someone who is really interested in things like that as a role model. That is where my passion for design and engineering came from. I didn't realise until I was a lot older that my dad worked for JCB. I was quite oblivious to what he was like when I was younger. Then I realised that

what my brother was doing would lead to something like JCB. It is the way forward, because everything expands and makes the world go round.

Q75 Stephen Mosley: So among your peer group who are the current role models?

Georgie Luff: In engineering or generally?

Stephen Mosley: Engineering.

Georgie Luff: There aren't any. People don't know about engineers.

Q76 Chair: Is that partly because of the way the media treat engineering? I have done a few events here where I've had people like Brian Cox in, and suddenly my parliamentary colleagues are all interested because of the great image that he portrays about physics. Is there a gap? Do the media need to wake up and realise that engineering shouldn't be presented by clowns like Jeremy Clarkson but in the way that the BBC presents it, for example, in its two very good programmes on Airbus and Rolls-Royce? I don't know whether you have seen them, but I thought that was a much better way of presenting modern engineering than trivialising how and why cars go faster.

Georgie Luff: If it was shown more on telly, which everyone watches, we would have more role models and more interest, and we would spark that interest from a younger age, but the fact that there is, basically, a lack of coverage of engineering means you can't expect people to know about it and go into it.

Kirsty Rossington: I absolutely agree. I am sure that National Grid is a representation of engineering as a whole, but there seems to be a big gap between engineers that have worked there for a long time—people like my dad—and apprenticeships and training programmes and getting people to fill that gap. In between there is not very much. I think that as a whole it is seen as an old industry—that the equipment we work on is old, and at the moment there is nothing out there to bring it into focus.

Q77 Chair: You see the products of engineering frequently but not how people are inspired to create things.

Kirsty Rossington: Yes, but there should be more out there saying to people that it's not an old industry; you can do it; it is fresh and modern—things like the girls are doing at the moment—but unless people know about it they don't see it.

Q78 Chair: Let me put it slightly differently to you, Georgia. Your school is in a building that I found quite inspiring because of its history. It is in Arkwright's original mill. As someone who is interested in science and engineering and our industrial heritage, I felt there was a buzz in that building. Don't you feel that?

Georgia Turner: When I walk over the bridge and over the Archimedes' screw, which is always generating the power we have for the school, I know I am somewhere special. No real school has what we have at the academy. You walk through and see the modern and the old. You have the old archways from where the wheels used to turn, and you definitely know that you are in an historical place but you are

also making history yourself. I like being there. We've got machinery that was donated; we've got old traction engines and things like that that are really old. You are allowed to go and touch them and maybe turn them on. You've got an opportunity that no other students have. With the history, we almost have more drive to succeed in what we want to do, because we don't want to leave a bad impression behind us on such a good building and school.

Q79 Stephen Metcalfe: Going back and touching on what Stephen was talking about a minute ago—about promoting engineering—every time you turn on the television and watch an advert or see a Formula 1 race they are great examples of engineering in action. A man jumping from a balloon on the edge of space is engineering in action; every time you see an iPhone or iPad advert it is engineering in action, and yet people don't seem to see that that is part of engineering, which I suspect probably inspires the majority of people to go into engineering rather than lying under a car changing the oil. Do you think there is a role for engineers in general—people who have grasped its value and what it can achieve—to get out into schools and promote it on a vast scale? Do you think there is a duty on engineers to take their enthusiasm for the subject and inspire primary and secondary school students so that they understand the connection between the product they probably have in their pocket or bag and how it got there? Do you think you should also make that your challenge as you grow into your careers in engineering?

Georgie Luff: I think anyone in our career should be pushing for the younger generation to follow in their footsteps and improve on their work. As we have a lack of engineers in this country, it should be the current engineers' job to come in and inspire new ones. That is probably the missing link at the moment. If we did have a couple of engineers from every company across the country going into their local schools, we would spark up so much interest in it, and it could lead to work experience afterwards. The possibilities are endless, if you just got a couple of people to take the time to go and talk to some young children.

Kirsty Rossington: Absolutely; I totally agree with that. At our training centre at Eakring we often have people coming on work experience. We get groups of schoolchildren coming. It is great to see them there doing the work. We have a little wooden village. They connect it up and make it all light up. There are simple things like that that they can get so excited about that maybe they don't even realise that it is engineering. It's brilliant. If an engineer has been in the job for 30 or 40 years, his enthusiasm for it would naturally touch everybody in the room. They would be able to see it just from his talking about it or showing them something. It would be brilliant.

Q80 Stephen Metcalfe: There are some brilliant examples out there, and that is one of them. My concern is that it gets out to the few schools locally to you; it doesn't get out to all 25,000 primary schools and 8,000 secondary schools. To inspire a generation of engineers, we need to get out there and get into

every school, and not in a particularly glamorous way—just go out and explain to people that that's engineering. So you are going to go and do that.

Georgia Turner: I would if I could.

Stephen Metcalfe: Brilliant; thank you.

Q81 Stephen Mosley: We are getting to the end, and normally the Chair asks a winding-up question along the lines of, "Is there anything else you'd like to add?" Before he does that, may I ask a specific question of Georgie and Georgia? We have your head teachers appearing before us after this. Are there any questions that you think we should be asking them?

Georgie Luff: I think you should be absolutely ribbing them; get the most out of them that you can. Definitely keep asking questions about their opinion on the diploma and how we can improve engineering at a young age between years 7 and 9. For me, that is the key to getting fresh, young engineers into it. Get their opinions on that.

Q82 Jim Dowd: Where did you go to primary school? Newstead Wood is in Bromley or Orpington, isn't it?

Georgie Luff: I went to Hayes primary, which isn't too far.

Q83 Jim Dowd: Did they do anything there along these lines?

Georgie Luff: I didn't really start engineering there.

Q84 Jim Dowd: Newstead Wood has been an entire voyage of discovery for you.

Georgie Luff: It has; it has opened so many doors.

Q85 Chair: The final question is about the diploma. There has been lots of talk about the future of the diploma. If it was determined to be worth only one GCSE, would you have done it?

Georgia Turner: We do a lot of work to get the diploma; it is page after page and hours are spent in getting the diploma in the end. The amount of work you do is worth the current amount of GCSEs.

Q86 Chair: And you do more hours than most schools.

Georgia Turner: Yes. I really enjoy it. If it went down to one GCSE, I really enjoy it and I think I would still do it, because you are still getting the name of the engineering diploma, aren't you? Maybe the quantity of GCSEs won't be enough for some people. If it was only one GCSE, maybe they would want to go and do art or something like that instead. They might want to do that instead.

Georgie Luff: Personally I would still have taken it purely because our school is an engineering specialist school. One DT is compulsory, so I would have taken engineering or design technology of some sort, but I will admit that there were 16 people in our class and 13 of them took the diploma because it was worth that many GCSEs. We would have had a class of three and that wouldn't have run; there would have been no diploma. Taking it down to one GCSE would stop people from taking it; it really would.

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Chair: Thank you very much for coming to see us this morning. It has been extremely helpful. You are of course welcome to stay in the room.

Examination of Witnesses

Witnesses: **Jim Wade**, Principal, JCB Academy, **Liz Allen**, Head teacher, Newstead Wood School, and **Maggie Galliers**, President, Association of Colleges, gave evidence.

Q87 Chair: May I welcome the second panel here this morning? Just for the record, I ask you to introduce yourselves.

Liz Allen: I am Liz Allen, head teacher of Newstead Wood school in the London Borough of Bromley.

Maggie Galliers: I am Maggie Galliers, President of the Association of Colleges and Principal of Leicester College.

Jim Wade: I am Jim Wade, Principal of the JCB Academy in Uttoxeter, Staffordshire.

Q88 Chair: At what stage in the education process is it most vital to engage students in STEM subjects, particularly engineering? Is it primary, secondary or a mixture of both?

Maggie Galliers: I would say the earlier the better, because very young children can learn to build and design and enjoy working with the kinds of materials that would lead to an engineering career later on. Certainly, there is a place for encouraging people in primary schools to think about these sorts of things, but also very specifically in secondary schools, making sure there is impartial advice and guidance. The young people did a splendid job in spelling out what kinds of things really motivate and spell out options, and perhaps what kinds of things close down options.

Jim Wade: My view would be that, yes, it needs to start early, but at the same time there needs to be a clear progression as you move through so that youngsters at a very young age can see what those options and choices are. Potentially, they can see other people—their older brothers and sisters and others—doing those options and getting that interest. There is no point sparking that interest with a 7 or 8-year-old if there is nothing they can go and do in relation to that until perhaps they are 19.

Liz Allen: A child in a sandpit in pre-school is engaged in engineering activity. What we tend to do in the education system is start to put limits and boundaries on that and turn it into content, dissociating it from the activity in the sandpit. I think a big lesson we have to learn as educationists is that we must keep that application of knowledge always, always, from the start, at the forefront. My big bugbear about maths and science at key stage 3 is that it becomes terribly content-driven. I see lots of inspiring science and engineering work happening in key stage 2 in primary school. It is really adventurous, discovery stuff, but then we put it into subject compartments in secondary school and start limiting it by accreditation systems and specifications. There is a big responsibility on educationalists to keep that application of knowledge all the way through from the sandpit to the university.

Q89 Chair: It is interesting that you should say that. Two nights ago, a primary school in Belfast was awarded the Rolls-Royce prize. Interestingly, it was the inspiration of the teachers who understood what you were saying, not because they particularly had science qualifications themselves. I thought that was a really good lesson for the educationists.

Liz Allen: Frequently, they are more creative. One of the issues with subject specialism is that it can limit what a teacher covers. Sometimes the generalist and the excited and interested person is more creative in the opportunities they offer to young people.

Another area that concerns me hugely is the training and professional development of good engineering teachers, particularly in the secondary sector. There just isn't a focus.

Q90 Chair: What are the barriers that stop students pursuing engineering in school and in terms of future careers?

Maggie Galliers: Sometimes it is about advice and guidance not being broad enough. My association did a survey relatively recently among young people. Only 7% were able to name apprenticeships as a possible post-16 route, whereas 63% were able to name A-levels. There is a duty on schools and others to make sure that the advice and guidance young people receive is genuinely impartial and looks at all the options. There is a duty on educationists—schools and colleges—to make sure that we provide those kinds of role models, challenges and opportunities to experience hands-on work that will enable young people properly to understand all the options available to them. As an association we have a concern about that, because the duty of the careers guidance has been put on schools without necessarily the resources to do the job we would all want them to do.

Jim Wade: In part, there is a lack of effective careers and educational guidance in those areas and a lack of role models visible to youngsters. There is also a lack of provision to a certain extent that encourages youngsters to go through and do things. Obviously, the JCB Academy is a very special place, but at my last school of which I was head we ran engineering. The students used to make such fantastic things that the other students used to aspire to go on to that course. If we hadn't had that course at the school, there wouldn't have been that inspiration that provided for other young people. It is partly about career guidance and partly about role models, but by and large we don't have a provision for engineering within most mainstream schools. Therefore, I don't think that encourages youngsters to think about that as they are going on through. The organisation then doesn't have anybody who is an expert within

engineering, within that organisation, to be selling it to youngsters in their school time.

Liz Allen: It takes an immensely brave—some would even say foolhardy—school leader to attack social conservatism among teachers and parents, because you are putting quite a lot of your school’s reputation at risk by doing so. Newstead is in a leafy part of south London and is assumed to be in the heart of middle-class conservatism. 50% of our children are from ethnic minorities; a good 60% are from Lewisham, Greenwich, Crystal Palace and so forth. We have a huge social and ethnic mix, and there is a considerable amount of conservatism, as Georgie was saying, about whether able girls should go into anything other than medicine and law.

In taking on the engineering specialism, Newstead faced a huge amount of parental flak for that. They didn’t think it was appropriate. We need pioneers and confident people who are prepared to break moulds and say, “These are the opportunities.” We are fighting huge social conventions about gender and ethnicity in doing so. As we have been saying all morning, we need flagship, brave ambassadors to go out and break those moulds. The young people you have listened to are those pioneers.

In introducing the engineering diploma at Newstead, we have been successful at level two, as Georgie said, but at level three we have been unsuccessful. The students want to do it at level three, but parents refuse to allow them to do it because it’s not appropriate for girls; they should follow the conventional and traditional route that maths and physics lead to. People like Jim and I have to be heroes about this and stick up for it. I am sorry this is a long answer. If we had the right messages coming from Government that said these pioneers are doing the right thing—just a few messages that might seem like the good guys—it would help us enormously and perhaps persuade parents to trust our judgment.

Q91 Chair: What are you doing to help change the attitude of parents? It is quite clear from the evidence we have heard just now that there is some real enthusiasm among the students. They have got their sights fixed on very prestigious and pretty well-paid careers, so how are you trying to break down those barriers?

Liz Allen: It is a huge task because it is changing the whole approach to learning. Our whole approach particularly is to help able girls, so it is a much bigger picture. Other things are happening. We have been at it for 10 years and are just beginning to feel that we are succeeding, so it’s a long haul. It is about building, creativity, problem solving, personal learning and thinking skills, but also self-esteem and confidence to take risks, to persevere, to take on challenges, to innovate and make a difference. There was a lovely comment from Kirsty. Young people want to make a difference. In engineering you can do that almost better than anything else. It is a long haul, and it is changing the culture of a school to be open and co-constructed so that everybody’s opinion matters. It is a big ethos shift in the whole school.

Q92 Chair: Mr Wade, in your case you are encircled by some of the biggest names in engineering: JCB, Rolls-Royce, Toyota and so on. Some are your sponsors. Is there a different culture there because of the history of the local community, or are there similar traits?

Jim Wade: I would say there are still some similar issues. One of the things that is still true of our organisation—I don’t know whether it is also true of Liz’s school—is that a lot of our students have some connection to engineering, which is why they have chosen to come to our school. It may be a father, brother or uncle, or somebody who has sold it to them as a potential career.

I know you visited us. Picking up on Liz’s point, we set out to try to be an inspirational place to go to. Our view was that, even if you didn’t go there, if you looked at this place you would say, “Wow! Engineering must be important if they have done it with this grade II listed mill.” We almost set out to do that, because we were very conscious that the message we needed to send was that it was an inspirational place that you might aspire to go to.

Q93 Chair: I just wonder whether there is an opposite effect from what Liz Allen described. For example, I observed the English class doing “Romeo and Juliet”, in a very clever way, engaging with issues of conflict in the storyline rather than reading the play simply from beginning to end. I thought it was a very clever way of teaching the subject, but are there some of your parents who think that is a bit irrelevant and they should be doing a bit more of the engineering?

Jim Wade: Georgia made a good point. One of the things we sell is about communication. If you are going to be a good engineer, unless you can sell your idea in an effective way, whether it is at a board meeting or to your colleagues, no one will take up your idea. The communication side is very important to anybody who wants to be a future engineer, as is being able to speak a modern language and perhaps being able to communicate that idea to somebody on the other side of the world. We try to sell that quite rigorously to our students because we do see that, in terms of their long-term benefit and success, they need those skills.

Q94 Stephen Metcalfe: We would all like to see an engineering specialist teacher in every school, but I doubt that is practical. How can we give teachers in schools an enthusiasm for engineering so that they appreciate its value and promote it?

Liz Allen: I wish I knew, but by far one of the strongest features of Newstead—probably Jim would say the same—is the support people. I don’t want to call them “non-teaching” because that sounds as if it is a non-something. They are highly skilled and extraordinarily able people. For our level three engineering diploma delivery we use a technician who delivers most of that programme, because he is just better at it than the teacher-trained person. So they are strong skills.

Q95 Stephen Metcalfe: Is he an engineering specialist?

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Liz Allen: Yes.

Maggie Galliers: Colleges have a long tradition in offering engineering. If I might offer a few green shoots, our preliminary survey this year shows that over half of colleges are seeing an upsurge in interest in engineering courses. I very much hope that when we get the final figures that will be confirmed. Of course we use specialist staff and engineers. Some of them we have to train to teach, but we start with the people who really know their subject. There is a way through this. You are right that it is not feasible for every school to have either the resource to create the engineering environment that would be needed or the technical experts, but there is an opportunity here to use colleges as a resource for this. Of the UTCs in existence so far, 26 of the 33 have a college as a lead or support sponsor. My own college has worked very hard with local schools to offer the principal learning of engineering as part of the diploma. Schoolchildren would come to us for part of the week and do that principal learning and some of the rest of the subjects in the schools.

We have an opportunity to rethink at 14 what the educational landscape looks like. It would be unrealistic to think that we could have a UTC in every neighbourhood, wonderful as they are, but we certainly have colleges in every neighbourhood. The more we can do at 14 either to enrol students directly or work in collaboration with local schools to co-create some of the inspiring examples we were talking about earlier, the more it would benefit everyone.

Liz Allen: You are absolutely right. Georgie mentioned that a large proportion of her principal learning for the engineering diploma level two was delivered at Bromley College, the local FE college. That is a very fruitful partnership, and other things have come from it. I think that collaboration is the key.

Jim Wade: I understand that our position is slightly special, but our partner organisations, like National Grid, Network Rail, as well as the companies mentioned earlier, design the curriculum projects that the youngsters work through. The people from those business organisations help us deliver those to the young people. They run sessions with young people and young people go on visits to those organisations. Those business organisations own those projects at the academy and feel quite passionate about their delivery. On some aspects—perhaps it is a Network Rail problem that youngsters have been set on switches and crossings—my staff, even though a lot of them are engineers and nearly all our maths and science teachers are engineers, don't understand the details of that. So the experts come in from those companies and deliver those sessions to the young people. We get a huge amount of feedback from our youngsters that they love the input from the people coming in who are the real engineers, because it feels really real because of the way they talk to the young people. That is a real growing opportunity to have those meaningful projects in which those businesses are engaged. Earlier you asked the students about people coming in. They have to have something to do and own when they come in to make the experience

for the young people and the business partners a very effective and inspiring one.

Q96 Chair: In the college sector over the last five to eight years or thereabouts there has been a discernible shift in the way colleges engage with employers and create courses that are relevant to the needs of local industry in the way that Mr Wade has described at his school. Was that a thought-out strategy, or did it happen by accident?

Maggie Galliers: I think Government can take some credit for it. We have been incentivised to think about how we might not only be more responsive to industry but sometimes take the lead. If we take my own college as an example, we work with 2,000 employers every year. We are upskilling in the workplace; we are co-creating foundation degrees, higher apprenticeship frameworks and so on. We have those ready-made industry contacts. In my own engineering department, because we offer provision at level two, which contains both underpinning knowledge but also practical skills, some SMEs in particular will be more interested in taking an apprentice who has done a year or so with us, and gained some of those skills and can be useful from day one. They will ring us up and say, "Have you got a good one?" We will be able to set those young people on the path to apprenticeship with that combination of practical and academic skills that they need. Yes, it has been a thought-through strategy, colleges have stepped up to the mark, and we have a lot to bring to this agenda that we need to tap into for the benefit of all young people, whether they are in schools or colleges.

Q97 Stephen Metcalfe: Liz, how much external contact do you have with businesses or other organisations to help promote engineering within the school, excluding college input?

Liz Allen: We do have a lot; we generate a lot. I am a trustee of the Engineering Development Trust, which is important; it keeps me tapped into what is available, but we do drive that hard. The school is active in promoting it. Georgie mentioned our director of careers educational guidance. He taps into parent power and to connect through parents, and our best route to get industry links is through our parents. As Jim has said, you get these great crusading companies that are the bedrock of what you do.

Q98 Stephen Metcalfe: You do, and I have seen examples in my own constituency, but it strikes me that it is a scattergun.

Liz Allen: It is.

Q99 Stephen Metcalfe: We as a committee always get the best and brightest; the schools that are doing the very best; we get the best examples and we get the best students in front of us. My concern is how we scale that up to cover the whole country so that it is not scattergun and does not need an inspiring leader or just to be lucky and be in the right place, but it forms part of the curriculum. There is some external input and the curriculum is not so tight and packed that there isn't room for all these wonderful experiences that can inspire generations to go on to

be engineers, or anything else that might take their fancy. We have to make some space and scale it up.

Liz Allen: We were two thirds of the way there with the engineering diploma. I am sorry to bang on about it, but we were. I understand the Government's approach to diplomas. Because of the 14, I would speak like this only about the engineering diploma. But it did all of that. It required employer engagement and students to apply their learning, and it required collaboration with FE and other educational institutions. They are essential elements of the engineering diploma. It is there, but, as Georgia quite rightly said, because of that amount of scope, its talent has been too greatly reduced. I am sure that courses like that are the vehicle because it is in the specification that you have employer engagement; it is there in the programme.

Maggie Galliers: My understanding is that the Chancellor made an announcement recently that there would be a good hard look at the principal learning in engineering. It may well have the potential to become four GCSEs again. We would very much welcome that. To make a more general comment in relation to your question, it is my belief that curriculum qualifications and performance league tables need to be thought of in the round. At the moment we have some elements of silo thinking. What has been thought about perhaps in terms of qualification reform, performance league tables and so on is not necessarily joined up with curriculum and has the danger of creating some perverse incentives in the system. Some of the questions you were asking about how EBCs might impact on this are the right ones.

Stephen Metcalfe: I might come back to that in a minute.

Chair: You might be inviting us to suggest that the Secretary of State ought to do the engineering diploma, but we will pass on that one.

Q100 Pamela Nash: You heard my questions to the last panel about careers advice and what their experience was. Could you share with us your general view about careers advice in the UK? One of the quotes here from the written evidence is that it is virtually non-existent. Could I also ask about your particular experience as head teachers and principals of careers advice for students in your schools?

Jim Wade: This is going to sound terrible, but I will make a general comment and then say that obviously we don't do that at the JCB Academy. Generally, youngsters' access is poor in terms of both the amount of support they get and the inputs. We are in a slightly privileged position because youngsters have chosen to come to us at 14 with a particular aspect in mind and they work with a lot of our business partners over that period. We also employ a full-time careers education and guidance support worker. She comes from an apprenticeship background, which provides our youngsters with that detailed knowledge. She also provides careers lessons for the students, and it gives youngsters that opening up.

I was really interested in what the students said because they all talked about the impact of work experience on their career thinking, and I would agree with that. Even if it is not the most fantastic

experience you ever have in your life, for a lot of youngsters that opportunity to go out into the workplace and talk to the employers they are with during that week informs their own career thinking.

Maggie Galliers: Clearly we work with students across a broad spectrum of backgrounds, so not all of our students will have the good fortune to have parents who are interested and able to advise them well. They depend heavily on the advice that they get from schools. With the demise of the Connexions Service, a duty has been placed on schools now to offer independent advice and guidance, but few schools have the resources to do all that that job requires. There are, I am afraid, perverse incentives in the system to advise young people that to stay on in my school sixth form is the right answer. You can absolutely understand why people think that, particularly when they are passionate about the quality of what they do post-16, but it means that we as colleges are finding it increasingly difficult to get into schools and even start thinking about some of the alternatives that might be available. We need to go further and follow the good example of schools like Jim's to see how we can qualify people within schools to a Kitemark standard to offer truly impartial advice and guidance and also put a duty on them to ensure that colleges, apprenticeships and other post-16 options are laid out before young people.

Liz Allen: The Connexions Service never served the students in Newstead because children were traffic-lighted. Newstead students always came up green because it is a selective school, so they never got their entitlement to careers advice and guidance through the Connexions Service. You can appreciate that that horrified me and so we have always had internally a careers department. I have a director of careers education and guidance, with a full-time assistant and a careers resource within the school. He is qualified in careers education and guidance and is impartial, and I take your point that it is critically important that students have access to independent and impartial advice.

At Newstead we have considerable churn between years 11 and 12. A number of students move on to more appropriate courses and a number come in to access the engineering diploma at Newstead and the IB, which isn't available elsewhere. That is crucial. But it is not just advice on careers; it is a full programme from year 7 all the way through about understanding your skills and abilities, having an opportunity to see what is available and being engaged in that with as many opportunities as possible. We run a biennial careers convention, for example, so that students can see what opportunities are available for them and encourage them. At that careers convention there are gap year pupils, industry people, other routes such as apprenticeships and so forth available. We do all of that.

But more needs to be done than that in encouraging students to have those opportunities to experience what the world of work is like generically—because schools are rarefied places, not real places—and to have that generic experience in the working environment. We encourage them to work in local primary schools, run community activities and so

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forth just to get out. There are two work experiences in years 10 and 12. In year 12 it is more work shadowing. What does it feel like to be in this profession or role? I don't know how Georgie feels about it, but I think that work shadowing experience of just walking in somebody's shoes for some time is immensely valuable.

Jim Wade: Maggie made a point about perverse incentives. I am sure these are unintended consequences, but a really good example of that are league tables. We are now measured on our destinations. If you take my school, last year, of the year 13 students, 50% chose to go into higher apprenticeships. Most of those students had offers at universities, and a significant number had offers at Russell Group universities but have chosen instead higher apprenticeships with organisations like Rolls-Royce, Bentley or JCB itself. In the league tables we will now get a low score of the percentage of students going to university because they won't count. That is appropriate; that was what those youngsters wanted to do. Rather than study engineering at Sheffield or Southampton, they chose to do a higher apprenticeship. As to the point Maggie made, potentially there is a perverse incentive for me to sit down with those students and say, "Oh no, you don't want to do a higher apprenticeship; actually you want to be doing that," because that would look better for us.

Q101 Chair: So all of these are higher apprenticeships that can lead to a degree.

Jim Wade: Currently, they will not count in the league tables.

Q102 Chair: So, on day one of a student going to university, it counts even though that student hasn't even started studying, but on day one of somebody starting a higher apprenticeship, which can lead to exactly the same qualification and they can be paid while doing it, it doesn't count.

Jim Wade: Correct.

Q103 Chair: That sounds a bit perverse.

Jim Wade: I wouldn't disagree with that statement.

Maggie Galliers: We could also add that the points score for vocational qualifications in the league tables at key stage 5 has been downgraded this year. It will appear that the value added is less than it has been in the past, but the value added is exactly the same.

Q104 Pamela Nash: From the information you have given me I would take it that in-school careers advice throughout school, if it was supported, is what would be preferred, but later on it might be better to seek independent advice. But obviously your students have only been able to access the system we have had in the past. How can we fix the situation that we have at the moment? Is it something that has to be co-ordinated by national Government? Is it something that local authorities and schools are adequate to sort out themselves?

Liz Allen: There are resourcing implications, as there always are. It is the timing that is unfortunate. At a time at which careers advice and guidance is being

delegated to schools, our funding is being cut by 1.5%, or 3% in the sixth form. If you are in my position—I don't know if it's the same for you, Jim—having to trim about £60,000 a year from the school budget, at the same time as having to create discrete careers advice and guidance in the school, is a tricky one to manage. It is the coincidence of those things. I accept that both are absolutely necessary, but I have to be extraordinarily creative in making it work.

Maggie Galliers: One of the things that we have done in Leicester is to offer NVQ training in impartial advice and guidance to existing schoolteachers. They come in their own time and we go out to visit them to try to help with this, but you can't get away from the fact that a school will have its own environment foremost in its mind and you need somebody who can scan the whole horizon for opportunities.

Jim Wade: It is quite a difficult one, which I suppose is why you have asked the question. In essence, in terms of delegating the responsibility to the school, there is some sense in that in so far as the Connexions provision was always very patchy, because the resource that was ever put into it was very small, whereas youngsters are at the school, in my case, for 40 hours a week; I know that is slightly unusual. Therefore, the school is in a good position to give them guidance. They have tutorials, mentors and that kind of thing within the school. Going back to the point Maggie made, the question is how you can make sure that is impartial and that youngsters get the kind of advice that enables them to move on to the right programmes of study.

We talk about budgets and all the rest of it. I said jokingly to our careers adviser that I thought she was a bit too successful last year because she got nearly a third of our 16-year-olds on apprenticeship programmes so they didn't come into the sixth form. That is the type of tension that exists probably within any school environment. I don't necessarily disagree with delegating that responsibility to schools, but there is a real tension in trying to make that independent advice and guidance to make sure youngsters go the right way.

Q105 Chair: It must be predicated on the teachers having the right continuing professional development; otherwise they won't know about the jobs that are out there.

Jim Wade: Yes. It is such a big task given the number of courses that colleges have on offer, the apprenticeships provision and so on and the right things that youngsters need to do. It is a very professional role.

Liz Allen: The director of careers education and guidance at Newstead is a non-teaching role. It is just impossible to be both a teacher and a careers guide because you need to be expert, and you need to have that opportunity, as Maggie said, to do the training but also to keep in touch and network.

Q106 Pamela Nash: That is a very important point. We heard from Kirsty earlier about the great work she is doing in going into schools and inspiring young people to follow in her footsteps. Last week I visited SELEX Galileo in Edinburgh and heard from their

apprentices who were doing similar work as well. In your experience, what role do companies have in educating young people about potential careers in engineering? Is there anything else they could be doing other than supporting their apprentices to go into schools?

Liz Allen: By far the best work that engineering employers need to do is supporting things like the Engineering Education Scheme and providing mentoring teams to students on schemes like that where there is an in-depth relationship on a project in mentoring. This is where there are real projects and they are working together. The ambassadorial role of going in and talking is important, but being part of the same team and working on real stuff is what inspires students, rather than forever building bridges out of straws. That is hugely successful in primary schools, so it is that engagement in the learning process.

Maggie Galliers: I would endorse that. Some of the big companies are especially good at doing that. In Leicester, we live in an area where we have a lot of small and medium-sized enterprises. We have to be realistic about how much we can ask of companies. We have got to supplement that with targeted campaigns. I am aware that in Macclesfield, for example, at the moment there is a “Girls Can Do It Too” project specifically linked to engineering. We need to draw together the resources of the schools, colleges and industry to come up with some creative ways in which we can do some of the very important things that Liz has been talking about.

Liz Allen: A fellow engineering specialist school in Chelmer Valley has near to it an engineer who works on his own in a garage making very fine medical instruments for operation procedures. He says the same thing. “If I come into school, that’s a day’s work gone,” but he allows students in the school to go and sit in his garage. They are mesmerised and inspired by this man. They just need the experience. What small and medium-sized companies can do is allow students to do that shadowing. “Can we sit here and watch what you do?” is as valuable.

Jim Wade: In terms of business development, our whole curriculum is predicated on it being designed by our engineering business partners. We have found that they are absolutely passionate about what they do, and the engineers, to be perfectly honest, are really keen to come in and do the work. Looking back on my experience of what I’ve done before, too often we have asked businesses to come in and do a little bit here or there, give a lecture here or there or make a particular input. We very rarely say to them, “We want you to own part of the curriculum. We want you to co-construct the curriculum alongside us and be part of that.” That is the bit that, often, really inspires them, when they feel that real ownership of it as well as engaging with the young people.

Q107 Stephen Mosley: We have had some very positive feedback from the engineering community about university technology colleges. Mr Wade, as the principal of one of the five, what do you think are the key benefits of UTCs?

Jim Wade: In terms of what we provide for our young people, the first thing is having the opportunity to

construct a curriculum that is a holistic experience for the young people, taking our engineering themes and using those as some of the vehicles for delivering some of the rest of the core subjects.

The other thing is that, because it is all in one place and a big investment has gone into our schools, we have been able to coalesce industry involvement in that and create a real buzz in terms of what happens there and the people involved in it. Because we are so specialist, it enables that to happen.

Finally, we set ourselves up almost to be a shining beacon and something you should aspire to. Somebody said you couldn’t have one in every community. Maybe you can to a certain extent, but you could have a shining beacon that engineering is something you should look to do. Last year we were over-subscribed almost two to one in terms of our places, and hopefully even more will subscribe this year. That means a lot of youngsters don’t get in, but we are quite encouraged that a lot of youngsters are inspired to think that engineering should be 40% of their week at ages 14 to 16. Maybe it generates a little spark in them to think about what they might do back at their school and maybe that is what they will do at a college, sixth form or something like that in the future.

Q108 Stephen Mosley: Can I ask Liz Allen and Maggie Galliers for their thoughts on UTCs?

Jim Wade: Shall I leave the room?

Liz Allen: No. I agree with everything Jim said. If I had another headship in me, that is where I would be going.

Maggie Galliers: I reiterate what I said earlier. UTCs are beacons in their communities. Colleges have been very glad both to sponsor and collaborate with UTCs, but we have to accept that engineering is a very resource-intensive aspect of curriculum. We need to offer value for money, and we have some ready-made resources in colleges. The more we can do to open those up, either by direct enrolment at 14 or collaboration thereafter, it could help to open up the world for people.

Q109 Stephen Mosley: We have had some concerns that the focus on UTCs might lead to less focus on engineering in other schools. Is that a fair issue?

Liz Allen: I would hope the Government wouldn’t say, “We’ve got a few of them, so we’ve sorted that.” I don’t think they have that kind of approach. I do think they could make more use of the group of specialist engineering schools—the remainder of the Specialist Schools and Academies Trust. I think there are 64 or 65 of us, and we are well distributed across the country. Our philosophy is very similar to the UTCs. We use the engineering specialism as the core of the curriculum, but it is an inspiration across the whole curriculum. It is not resourced in quite the same way as the UTCs but the philosophy is the same. It would be a shame if that group of engineering specialist schools literally faded away into oblivion because the discrete funding is no longer there.

Maggie Galliers: You might be interested to know that we are working on a project with the Royal Academy of Engineering to create some new materials

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and staff training opportunities called “My Science”, which we hope will help to alleviate that problem.

Jim Wade: It will be interesting to see what the competition does over a longer period of time. Youngsters have to leave their school at the end of year 9 and come to my school at 14. I can’t tell you that my colleague head teachers are always entirely happy about that. You might argue that, if they don’t want those youngsters to come to me, one way of resolving it would be to say, “We’ve got an engineering provision here. Don’t go to the JCB Academy.” We might almost be the spur for other people to compete with us perhaps.

Q110 Stephen Mosley: There were quite a few “mights” and “depends” in all three answers. Are we seeing any reduction in engineering in other schools because of this? I guess that locally to your school we might be, but we have only got five at the moment and they are mainly concentrated in the West Midlands. In terms of specialist engineering schools across the country, are they seeing any negative effects from this at all?

Liz Allen: I can speak only for Newstead and we are not. I don’t think there is any concern among engineering specialist schools about the UTCs, because philosophically we are at one and there isn’t an issue there at all. We have UTCs and a couple of engineering academies opening up in the Greater London area, but they are not impacting Newstead because it has its reputation for engineering.

Jim Wade: I know that there are very few schools choosing to offer the diploma now, given that that has been reduced in its numbers. Because of the push on the English baccalaureate and the expense of offering engineering as a course, most schools are making the fairly logical decision not to offer that to youngsters at 14. Yes, there is a significant reduction in the amount of engineering available to youngsters aged 14 to 16.

Q111 Stephen Mosley: You are going to be able to talk about the diploma in a minute. I know Georgie will probably be pleased because it is one of the issues that she asked us to question you about. In terms of opening more UTCs, I know the plan is to open 34. The Baker Dearing Educational Trust suggested that the Government should set the target of at least 100 before the next general election. Do you think that the Government should commit to opening more? Do you think the programme should be speeded up or slowed down?

Jim Wade: With all these initiatives, the key is to make sure that the quality is there for the young people. I was head of my previous school for eight and a half years. When we set up the JCB Academy, one of the things I was conscious of was that day one, when the students walked through the door, had to be a fantastic and high-quality experience. We can’t learn on the job. Those youngsters are choosing us at the start of their GCSEs and they have got only one shot at that. Therefore, we had to get that right from the day those students walked in, in 2010.

The only caveat I have about UTCs is that, like any Government policy, it can’t be that the target is to

open this number by this date, because it is about making sure that the quality of the experience for those young people is fantastic when they walk through. If you set a target of having this number by this date, the danger is that you run for the target rather than ensure you have the quality. I think 100 is a reasonable number, but my caveat would be that it is about making sure that the quality for the young people from day one is there.

Another small caveat is that we had 20 months. I was in place from January 2009, and we opened in September 2010. That is not the funding they are getting to set up UTCs at the present moment. Clearly, that makes it much more of a challenge to make sure that when you open on day one there is that quality for students.

Liz Allen: I would build on what is already there. There are over 60 engineering specialist schools, philosophically inclined, which are heading in the right direction and want to continue. That would be a really good place to start looking to see whether there is a future in developing the UTC concept within those schools.

Maggie Galliers: Colleges could be a resource for this. If I may build on the “target” point, at the moment we are seeing some radical change to the educational landscape and an atomisation, if you like, in some senses with academies, studio schools, UTCs and so on. We have to understand that, where new provision is put on an area, the demography remains the demography. If students go to the new school on the corner and don’t go to the old school, that causes surplus places in other schools. That is something that has to be managed through.

Q112 Chair: Mr Wade, following on from that, you have a fair amount of very hands-on support and interest in the creation of the school, not just through your industrial sponsors but the Minister himself, Lord Adonis, on a hands-on basis. It is not realistic to expect that in the roll-out of others, is it, or is it necessary?

Jim Wade: There are two necessary bits. The first is real involvement of the business community. I think that is absolutely crucial. The other bit that is crucial is the right kind of time frame. The early political support of the JCB Academy was critical because it was the first. If it hadn’t had that support coming through, it would have been very difficult for us to have gone through the Department for Education’s processes over that period of time. Clearly, there is a unit now within the Department for Education that is focused on free schools and UTCs. That process exists now, whereas it didn’t perhaps five or six years ago.

Q113 Jim Dowd: As Stephen mentioned, can we move on to engineering diplomas? I know you have made more than one reference to it so far, but perhaps we could pull it all together. Would I be incorrect in assuming that you are less than enamoured with the changes that have taken place in the diploma in the recent past and what effect do you think it has had on teachers, parents and the students themselves?

Jim Wade: If you look at the work that youngsters do at our place, I have to spend about 14 hours a week on

the technical block. The vast majority of that technical block is the diploma, for which they get only one GCSE in terms of the league table. It is the core of what we do, so we are not going to stop doing it. Probably, for us, it also doesn't make a huge difference in terms of who chooses to come to us. The young people at the school do feel that engineering has been downgraded. You can argue whatever you want in those terms, but that is how they feel about it. They feel that the qualification they now do has less worth than it had before. It is the same qualification; it is the same things youngsters do, but that is how they feel about it.

Q114 Jim Dowd: Is the content still the same?

Jim Wade: The content is still exactly the same. From what George Osborne said last Friday, it might be replaced, but there is no guarantee that it will be here beyond a couple of years, so there are concerns from parents. We will carry on doing it, but hardly any other schools will do so unless they are very specific and passionate, like Liz's school.

The other issue for us is that, for the advanced diploma, there haven't been any changes to level three, but the concern that we have had from parents is about doing the level three diploma because it's the engineering diploma. They have changed the key stage 4 diploma, so are they going to change what happens to the level three qualification? We have had huge amounts of concerns about that from parents. Therefore, for our students currently at our academy that is not too difficult a sell for us, but for students outside that is very difficult.

An unintended consequence of what has happened at key stage 4 is having a big impact post-16 as well. I just think it's a real shame. I am on camera and I can say this. One of the things we said to Government was, "Why not make one exception?" Yes, we knew; everybody knew. There were loads and loads of qualifications out there that didn't have a huge amount of value, but why not look like you are really supporting industry? Why not look at rebalancing the economy just by making one single exception? How fantastic you would have looked if you had done that. Anybody you speak to, whether it is industry, FE, HE or schools, is saying that we had a qualification of value that pretty much is going to disappear, and I think that's a shame.

Maggie Galliers: I think there are two strands here. One is the amount of teaching time that the diploma takes. My understanding is that it is about 40% of the teaching time, but the Wolf recommendations are that no more than 20% of teaching time should be spent on vocational qualifications, so there is a tension there. There is certainly a tension in terms of the league table issue. While I support Jim in terms of the engineering diploma having the proper worth within those league tables, I would argue that there might be more than one exception, but that is not to say that we ought to overvalue things that don't deserve it.

Liz Allen: I get very angry when the engineering diploma is described as a vocational course; it just is not. Georgia spoke well about the importance of communication, and in this we need to get our vocabulary absolutely right. I have a vocation to be a

head teacher. I have vocational qualifications, which are two degrees and a teaching certificate. We take the phrase "vocational qualification" to mean what you do if you are not bright enough to do an academic course. In your terms of reference you ask whether we need academic or vocational courses. No; we need applied learning courses. That's what we need. We need courses that are high impact in terms of knowledge and understanding that then require the application of that in a real environment to improve things, as Kirsty said. That is what the engineering diploma is. The Government can make an exception because it's an exceptional programme. It doesn't fit into an academic or vocational niche. Like Jim, I hope they have the confidence to make an exception, however they do that. They might need to rebrand it—that might be the process we are in—as long as the rebranding keeps employer confidence, which the engineering diploma certainly has. That employer engagement is crucial. I hope we move from thinking of qualifications as being either academic or vocational, because neither term means anything.

Q115 Jim Dowd: We heard from the previous panel of students how much value they placed on the diploma as participants. Mr Wade, as I understand it, you are saying that your numbers remain the same because that is the backbone of the establishment. What about you, Ms Allen?

Liz Allen: We are just going through our progression for year 9 students to see what they are going to do at key stage 4. I think the level two engineering diploma numbers will hold up for all the reasons that Georgie said. All students are required to do a DT subject, so they will choose it as that subject. I am concerned about it because it requires a considerable amount of additional time commitment. Our college programme is in twilight time—after-school time—and students commit to do that additional time. I am concerned about that. However, students are doing the course because they value it.

I agree with Jim that there are real issues about level three engineering. We need an effective strategy to continue to promote that because it is so valuable. I think HE has a role in that. Students and staff have this view now that what they feel is a highly regarded course has been nationally devalued, and employers feel very much the same way about it. That is a shame. I hope we can put in some kind of rescue plan to make sure that we don't lose the value.

Q116 Jim Dowd: That is the very next point I want to come to. Is the feeling that it is not just the qualification that is devalued but it is more revealing of the Government's attitude towards engineering and associated subjects?

Jim Wade: Yes. I don't know whether we will go on to the EBacc.

Q117 Jim Dowd: That is the next lot of questions.

Jim Wade: I am sorry; we keep jumping ahead. What has value is what is measured. As a society we tend to give value to what somebody is measuring and putting in a table and publicising, whether it is GDP figures or whatever else it might be. Because there are

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no technical subjects within that, it sends a very stark message to those young people and their parents who may be considering technical education as a route. You then link that to what has happened to the engineering diploma. Intentionally or not—I don't believe it is necessarily intentional—that is the clear message I pick up from talking to parents, students and so on. They are passionate about what their sons and daughters are doing, but there is a feeling that the outside world is “agin” them in some way. Given that we are talking about rebranding it and rebalancing the economy—all those kinds of things—that can't be the message that we want to send out, but I think it is the message we have sent out.

Q118 Jim Dowd: There are only 20 out of 650 Members of Parliament who have a STEM background anyway. The bias is very much elsewhere. Ms Allen, you said you hoped the matter could be saved or resolved. If you were able to, how would you go about doing that?

Liz Allen: I know that the advisory group of the Royal Academy of Engineering is just beginning to talk about that. If we take the science approach at key stage 4, although there are chunks of content, there is a notion of a single additional and triple structure to science. Perhaps we can look at engineering in a similar way. My anxiety in saying that is that I don't think the engineering diploma can be chopped into three bits, but to have a similar approach might be a route out of the current situation where it is single accreditation. It might be a way of showing a kind of accrual process and give a narrative that would allow the engineering diploma to have its true value.

Jim Wade: It is really difficult. The trouble is that the new structure for GCSEs, particularly if they are going to be EBC GCSEs, will be linear assessment at the end of two years. However you chopped up the diploma, if you made it fit that process, you would end up with a qualification that wouldn't be engineering; it would be a theoretical study where the youngsters at the end of two years would regurgitate some knowledge in an exam hall. That wouldn't give you that mix of practical and theoretical learning that you are using to solve problems, which gives you the employability skills to make those steps in terms of your life. Therefore, there is a danger that we take what is great about the engineering diploma and try and get it to fit what will be the new structures for assessment and compliance in relation to GCSEs. I have a worry to a certain extent. We have already made the decision at our governing body that, if that is the route it does go down, we will stick where we are. Even if it gets no league table points, we think that what we do is so good at this moment.

Q119 Jim Dowd: Even though it is less popular with students outside a specialist establishment like your own.

Jim Wade: I think it wouldn't be done by students outside an organisation like our own, because it is our mission, it is our passion. We will stick with what we believe. Our mission statement is about developing employability skills in young people. We have a list of employability skills that we look to deliver. If you

look at the centre skills framework in terms of employability skills, the diploma is a really good vehicle for delivering that set of core competencies. That is why, for us, it sits behind the rest of it. My concern is that, if we replace the engineering diploma with some kind of GCSE engineering-type structure, that won't be fit for purpose. If you look back at the other engineering qualifications, like the applied GCSE in engineering, again, it wasn't a particularly popular or successful qualification. I know the Royal Academy is involved in the development and that might help, but I do have some real concerns about that.

Liz Allen: I am a little more hopeful than Jim that the current view that everything will be linear at GCSE will have to be modified. I have geographers, musicians and arts and drama teachers saying this is a nonsense. I have a feeling we will come to a reasonable view on where engineering can sit.

Jim Dowd: Governments being reasonable! Whatever next?

Q120 Stephen Metcalfe: I want to pick up a little bit more about the EBacc and your wider views, first, on its aims and, secondly, the impact it will have on a wider range of subjects outside the core five subjects. Are you concerned that schools will focus on doing well in the league tables for the EBacc at the expense of everything else?

Liz Allen: You are presented with two—dare I say it?—confident school leaders who have experience enough and commitment enough to say we will do what is right for our children. Therefore, I doubt if Jim, and certainly Newstead, have made any alteration to their curriculum at all since the EBacc announcement. I am just not interested because it doesn't fit with our philosophy of what a whole learning programme is at key stage 4.

However, there are schools whose reputations may be more fragile and whose leaders are less confident. I have a colleague who works in a school that has already completely redesigned its key stage 4 programme and increased the amount of time in the curriculum for English, maths and science at the expense of languages and the arts. It is absolutely dire that that should happen, and I am sure it isn't the Government's intention. I am concerned that we do not have sufficient confident schools to do what is best for their children, and that is a huge concern.

Maggie Galliers: League tables are a key driver for many heads, particularly those that are in fragile circumstances or very competitive environments. One of my association's concerns about the EBacc is that although such a set of curricula might be very suitable for many students and you would hope that standards would get driven up through a vehicle like that, there will, we think, be quite a high percentage of students for whom that kind of learning may not be the most appropriate route. Learners that we often pick up at 16, who have not been able to successfully achieve at GCSE, achieve very successfully when they are put in a technical and applied environment. If the EBacc is to be for 100%, it means that some will sift through. We are not sure how much currency a statement of achievement would have, nor how the experience of

perhaps failing will impact on willingness to stay on at school and in options post-16. It will have consequences, but it is difficult to predict exactly what they will be.

Jim Wade: One thing recent history shows us is that if you wish to manipulate the education system, there are two main levers. One is league tables and the other is to give them a little bit of money. They will leap through all kinds of things for little bits of money and also for league tables. Those levers have been very effective in changing schools' behaviour. There is no question that it has changed schools' behaviour.

My real concern is the message that it sends out to young people about what is important and what has value. My other concern is my own experience. Both of my children are at university and they chose to do A-levels in the things in which they had success at GCSE. If all the brighter students at a school are encouraged to do all the EBacc subjects, there will be things they won't be taking as a result. The likelihood is that more of those youngsters will go on to take A-levels and advanced study within those subjects.

In talking to all our partner organisations, it is clear to me that, if you look at the technical skills gap in engineering, it is those very people that we need to be filling those technical skills jobs; it's not the youngsters who can't get the EBacc. Looking at the incentive that now exists within the system, if you are running a school and you are likely at any point to be under threat from Ofsted, or there is pressure from other schools in terms of league tables, you will do your damndest if you are head teacher of that school to ensure that every single child who could get that does so. That will warp those youngsters' choices, and it will warp post-16 choices as well in relation to those youngsters. We have a skills gap at the moment, and we will have a bigger one if you want my own view in terms of that. We always look at targets, measurement and all those kinds of things. It is often the unintended consequences, not the well-meaning decisions, that have the biggest long-term impact.

Liz Allen: I have a huge concern that, in time, it will have a dramatic effect on school communities and will impoverish them hugely. The rich life of a school is its engagement in its music, art, creative subjects, into which category I put design and engineering. If you strip those out of a young person's entitlement to curriculum, you end up with a very impoverished environment, and it is a very unwise thing. The really healthy things in a school are the great collaborative subjects and team efforts, and we would lose those at huge peril.

Q121 Stephen Metcalfe: Is there a message therefore that you would like to send, since you are in this forum? Is there a change you would want to see that would combine the aims of the EBacc but with a more practical application or inclusion of some of the subjects you are talking about?

Maggie Galliers: We would advocate that it is worth considering a tech-bacc route that might be a kind of wrap-around, taking in the core subjects of English, maths and science—they would have to be core to everyone's experience—with the ability to broaden

that out into other kinds of subjects that are of a more applied and technical nature.

Jim Wade: From a personal point of view, we know that English, maths and science are at the core of what we do. There would also be a strong push in having a practical dimension to that—having some kind of extended project dimension in terms of what you are doing. If I go much further, I am going to describe the Tomlinson diploma, which was suggested quite some time ago. If you want rigour and to have young people with an entitlement that is both broad and rich, that strikes me as a much more effective route to go down.

Q122 Pamela Nash: We covered work experience quite extensively earlier. Mr Wade, in the written evidence submitted by your school you mentioned that some of the schools in your local area will not be offering work experience next year. Can you tell us more about that, and why that is the case?

Jim Wade: Since the requirement to do it has been removed, in my area various schools have made the decision not to offer work experience. Apart from a small minority, the bulk of students will not be doing work experience. It has made our lives a lot easier; it is much easier to get placements than it was when we were competing against everybody else, but there are several pressures pushing schools down that route. There is pressure from the league table pressure, because obviously you are out of school doing work experience. There is an organisational and cost issue in that we pay for the health and safety checks at the moment. My school pays about £5,000 to an outside company to do those health and safety checks.

Q123 Pamela Nash: Annually for all students.

Jim Wade: Yes. All our students do one week every year, so if you are with us for four years you do four weeks.

Q124 Pamela Nash: But the cost in terms of checks would be £5,000 per student.

Jim Wade: No, per annum. We pay an outside organisation that goes round and does it. It was the old Connexions service, but it is a part of that. You have financial pressures, which Liz mentioned earlier on; you have league table pressures and organisational issues. To do work experience is a difficult, time-consuming and costly thing for a school. Therefore, some schools will make the decision that, if youngsters want to do it, perhaps it is up to their parents to do it in the holidays, but it is not an entitlement.

Q125 Pamela Nash: That is particularly worrying to me. I never heard anyone argue against work experience being something worthwhile for a young person.

Jim Wade: It was argued against in the Wolf report, which I presume is where the change in Government policy has come from.

Q126 Pamela Nash: Do you think this change in policy has been a mistake?

Jim Wade: I think it has been an error. If all schools are on a level playing field, nobody has to go and do

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work experience, but if the school down the road from you has their youngsters in school for an extra two weeks maybe that is going to make a bit of difference, including the points made earlier about EBacc and all the rest of it. If your budget is being cut by 1.5%, and 3% for the sixth form, per year, and you have to find money for that as a potential service, you can see why some schools, now they don't have to do it, are making that decision. Don't listen to us, but the three young people before you earlier talked about their work experience as being fundamental to their career decisions. Therefore, if that is something that lots of youngsters cease to do, we will have even more youngsters who make inappropriate decisions. They will go to university courses or post-16 courses and find they are doing the wrong thing, and that is a huge waste of the young person's time and the country's resource.

Maggie Galliers: I couldn't agree more. The sort of person who is going to be inspired by engineering needs to get some practical hands-on experience, whether it is in a work placement or perhaps in a realistic working environment like a college, but I would endorse that it is not just some but many schools who are cutting back now on work placements. That is certainly the experience in my area.

Liz Allen: I would agree. It is something we hold dear. What are we educating young people for if it isn't preparing them for the workplace? It would be utterly ridiculous if they didn't have that experience as part of their learning package, but I say that as a school that is confident and philosophically inclined to do it. Many schools don't have that privilege.

Q127 Pamela Nash: You mentioned that a third of your students last year went into apprenticeships rather than A-levels. How popular are apprenticeships in your school?

Liz Allen: Not at all. There are very conservative attitudes to progression.

Q128 Pamela Nash: Is that something you seek to change?

Liz Allen: Absolutely. There are now more opportunities because particularly the bigger employers are giving much more flexible and creative routes into industry and business. We would rather have students at 18 than postgraduates; we would rather take them through their own programmes. Particularly with the introduction of university fees, sandwich courses—a flexible learning year in industry, and these sorts of things—and programmes like those of National Grid are becoming much more attractive, and students are looking much more creatively at their options. But it is slow to happen because, as I said, it is socially a very conservative area. Parents expect girls, in particular, to go through the traditional routes, but it is breaking down.

Q129 Pamela Nash: You said a third went into apprenticeships. Is that a marked rise in recent years? Do you think tertiary fees have been part of that as well as your excellent careers guidance?

Jim Wade: We started in 2010, so that is our first cohort through. Because we have such a high degree of employer involvement, our youngsters have been very aware of what is out there in terms of apprenticeships. A lot of our youngsters come to us because they want to go into engineering; otherwise why apply and step through the door at 14? That was a route that naturally a lot of them would have been looking to go down. Therefore, there is that kind of link between us and the employers. Our careers education and guidance person comes from an apprenticeship background. She has got to know all the employers very well and therefore has guided our students, when an apprenticeship comes up on the website, to apply for it, go for the interview and encourage them in that direction.

Q130 Pamela Nash: Do you think gender is an issue in your school?

Jim Wade: Yes, gender is an issue.

Maggie Galliers: Of the 220 apprentices aged 16 to 24 that we service at our college, only 18 are female, despite strenuous efforts.¹ If we could get a pre-apprenticeship pathway going, that would be a big help to make apprenticeship more attractive to certain kinds of learners.

Jim Wade: We will be less boy-heavy next year, only because the Department for Education, after three years of pushing, has finally agreed for us to do positive discrimination. As Georgia said, we have only 10 girls in the current year 10, but 30 girls applied, and we use random allocation. We randomly selected out, as you do if you throw a dice, two thirds of the girls. We eventually persuaded the Department for Education that that was barking, so they have agreed for us to positively discriminate in favour of girls.

Q131 Pamela Nash: Is that next year?

Jim Wade: That is the 2013 intake.

Chair: That is not the end of the lesson, so you can't duck out to playtime just yet. It is the beginning of the parliamentary day in the Chamber, but it is the end of our questions. May I thank you very much for what has been a fairly long session, which has been extremely informative? We hope you carry on delivering successful students for the world of engineering for a long time in the future. Thank you very much for coming.

¹ The witness later clarified that, the number of female engineering apprentices is 2 but the number of female engineering students is 18

Wednesday 21 November 2012

Members present:

Andrew Miller (Chair)

Caroline Dinenage
Jim Dowd
Stephen Mosley

Graham Stringer
Roger Williams

Examination of Witnesses

Witnesses: **Dr Bill Mitchell**, Director, BCS Academy of Computing, **Nigel Fine**, Chief Executive, Institution of Engineering and Technology, and **Dr Matthew Harrison**, Director of Education, Royal Academy of Engineering, gave evidence.

Q132 Chair: Good morning, gentlemen. Thank you for coming in. We have a very busy agenda, with three sets of witnesses this morning, so we are going to steam on, but it would be helpful if the three of you would be kind enough to introduce yourselves, for the record.

Nigel Fine: Good morning. My name is Nigel Fine. I am here in two capacities. I am the chief executive of the Institution of Engineering and Technology, which has 150,000 engineers and technicians around the world, and is also a large scientific publisher. I am also here representing the other 36 engineering institutions that, together with the Royal Academy, Engineering UK, the Engineering Council and the Institute of Physics, form E4E, the body that articulates our position on engineering education.

Dr Harrison: Hello. My name is Matthew Harrison. I am director of engineering and education at the Royal Academy of Engineering, the national academy for engineering.

Dr Mitchell: Hello. I am Bill Mitchell. I am from BCS, the Chartered Institute for IT, and I am director of the Academy of Computing, the Learned Society arm of BCS.

Q133 Chair: Thank you very much. First, Mr Fine, you mentioned E4E, but I would be interested in a response from all of you. Obviously there are a very large number of learned societies in the engineering sector, but what is it that E4E has achieved and can achieve that you could not have done alone as individual organisations?

Nigel Fine: We do an awful lot individually, as you know, but the ability to bring the profession together through a single co-ordinated voice and to articulate exactly what the profession's position is on matters of education, learning and skills, to be focused in that communication and to be joined up in our approach to disseminating that information to a wider audience, is very much at the heart of what E4E is doing.

As for whether it is making progress, I think that it is. It is certainly making a larger community aware of the importance of skills and of the skills shortage in the engineering profession, and the things that we—the Government, industry and professional engineering institutions—must do collectively to address the problem. I shall take one particular example: the Engineering Diploma, of which we are extremely supportive. E4E has been extremely focused in working with the Government and other

organisations to get it back into the educational syllabus, because we think that it is an important part of what young people need to have as part of their learning experience.

Dr Harrison: That is one great example. I would like to offer another. The first thing that E4E did was to look at what is happening with STEM in the further education system. For nearly 10 years, and rightly so, successive Governments have had a focus on science, technology, engineering and maths. It has happened in schools, with a focus in schools, and we have seen numbers rising in A-level physics, A-level chemistry and A-level maths, which is excellent, and there has been a focus on higher education—but further education, which provides so much of the skills base for this country, was omitted. As institutions, we just couldn't find out how many folk were studying STEM qualifications in the FE sector. The Government couldn't tell us either, so the first thing that E4E did was to make a very coherent case on the need for data. That produced a thing called the FE STEM data project, which brought real clarity to that important part of the education system.

Dr Mitchell: The reason why I see it is as really important is the fact that we have a unified voice on various topics. The most important example from my point of view is that, 18 months ago, it looked very much as if the Government were likely to withdraw ICT altogether from the school curriculum. Obviously, the BCS saw that as a very bad move, but working with E4E we were able to put forward a unified position, saying, "It's not just the BCS. There are 36 professional bodies that all believe you should not remove ICT from the curriculum." It was extremely important to have that unified voice, all putting together the same message. The fact that we could all meet and talk together meant that we could sort out what the message was before we presented it to the Government.

Q134 Chair: Just so that we understand the scale of things—Mr Fine, you mentioned the number of people who are IET members. When you were speaking as E4E, how many members were you representing collectively?

Dr Harrison: Not quite half a million.

Q135 Chair: Not quite—but it is a pretty large number.

Dr Harrison: It is a very large number.

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Q136 Chair: Dr Mitchell, in the BCS you have the Academy of Computing. Would you explain its purpose?

Dr Mitchell: The BCS royal charter, essentially, says that there are two purposes for the BCS. One is to promote professional standards, and the other is to promote education in computing. The BCS Academy is very much about promoting the academic discipline of computing for the benefit of society. That is essentially why we have that sort of split in the organisation.

Q137 Chair: Dr Harrison, you have a curious relationship with the Department for Business, Innovation and Skills. You are partly funded through its structures, but you also represent the views of your members. Tell us about that relationship. Is the Department listening to you?

Dr Harrison: We have an excellent relationship with the Department for Business, Innovation and Skills. I think that it comes from our position as independent domain experts. If you want to get good independent engineering advice, a natural place to go is the engineering community. The advantage of the Academy is its fellowship of nearly 1,500 of the most eminent engineers. They are multidisciplinary and independent, so we see tremendous volunteer contributions. As our fellows walk through the door, they take off their corporate or academic hats, and even their institutional hats. They are there to offer independent advice on matters relating to engineering, which in recent weeks has very helpfully come more centre stage because of the real connection between jobs and growth, productive industry and engineering.

Q138 Stephen Mosley: Dr Harrison, in your initial response to the Chairman, you talked about the work that you have been doing on data, bringing together data on learners within the SET environment with engineering. I can see the benefits of that. Who do you think should be responsible for that overall?

Dr Harrison: This is a difficulty. There is good data for schools in the national pupil database. There is good data of a very different type for the FE system, with the Data Service. Then UCAS and HESA have higher education data. What is difficult is that it is impossible to make a link between what happens in schools and what happens in FE and HE, because we do not have a longitudinal tracking ability. Why that might be important is that we, as a profession, have invested for a very long time in reaching out, particularly to young people, and making a case for engineering careers and trying to inspire the next generation. We invest time, effort and cash, and we work in concert with the Government to make sure that those who have had their aspirations raised can get access to the right sorts of courses, curricula and qualifications, and progress. Until we have a real understanding of what works in terms of progression in STEM and, crucially, progression into STEM careers, we as a nation cannot start to make very rational decisions.

Two things need to be done. The first is to make the data more accessible. When we wanted to know more about the FE system, E4E had to push really hard with

BIS to make a positive case and get the stuff released. It is excellent now that it is out, but more people should know more things about it. I'll give you an example. An E4E report looked at the combination of maths and science taken by 16-year-olds. Only half of our 16-year-olds achieve that very important combination of at least a C grade in mathematics and at least two science GCSEs at grade C. It varies strongly around the country, and it starts to look a bit like a postcode lottery, where parts of the country have surprisingly low levels of participation in this combination of STEM subjects and other places are much higher. When we think about the labour market, those are the sorts of pieces of information that parents really need to know, because this is their kids' futures. As for the work that we have done on FE, we have a report coming out next week showing that, for school sixth forms, 49% of qualifications are in STEM subjects. That is brilliant, but in FE colleges, for young people the figure drops to 30%, and for adults it drops to 20%.

The message is really clear: if you are a young person, get engaged with STEM and be successful with STEM, because the chances of re-engagement as an adult are so much lower. It is a real problem for us trying to find sustainable growth in our economy because, of course, it is our adults who provide the muscle to get that growth. Of those adults who are engaging in further learning and training, 80% are outside STEM, and it is that 20% that needs to grow.

Nigel Fine: May I add another point on data? A system was set up—a big investment called the unique learner number—and a large amount of money has gone into that. That would assign a reference number to all children from the age of four, which would stay with them right through their education and through to employment. That would be a magnificent way of tracking progress, and the data associated with individuals as they went through their educational programme, but it has not been launched. It has not been implemented, although a lot of money has been spent on it. We are at a loss to know why the money has been spent, but it is not being used as a system to enable us to capture the data that will help us track the progress of young people through the education system.

Q139 Stephen Mosley: It was called—

Dr Mitchell: Unique learner number.

Q140 Stephen Mosley: That is something for the Minister later, I guess.

Nigel Fine: I think so. We understand that about £15 million to £20 million has been spent on it. It is a lot of money.

Q141 Stephen Mosley: Moving on to careers and the labour market, what do you think the skills gap is in the UK? What sectors are worst hit, and what evidence do you have to back that up?

Nigel Fine: The IET publishes a report every year called *Skills and Demand in Industry*. We have been doing this for six years now, so we have very good historical information regarding the skills gap in industry today. The positive news is that employers

are actually quite optimistic about the future, and are looking to recruit engineers into the work force. The problem that they have is finding engineers to fill the jobs that they have, and that they expect to have increasingly in the future. The challenge is to ensure that the young people coming through have the skills—mostly around practical experience—to enable the employers to want to use them and to get them to work effectively in the jobs that they have. We have evidence that there is a demand, but there is a problem in filling the roles that there are today.

Dr Mitchell: There are lots of shortages of skill in the IT world. Probably one of the most alarming is that 90% of companies cannot recruit people who can deal with cyber-security. That is a big problem. The Cabinet Office reported last year that £27 billion a year is lost in cybercrime. That is a huge area, and there is a critical shortage of people there. I know that GCHQ is absolutely desperate to find people with the right skills, and it struggles a lot. You could look in other areas. For example, you could talk to the folks at Tech City. There was a report by Demos last year that included a quote from one of Tech City's entrepreneurs: "There just aren't enough Computer Scientists in the UK. And we need Computer Scientists, we don't need—what do they call it—ICT trained people. We need real Computer Scientists who do software engineering and programming." That is just one example from an entrepreneur.

This is alarming, because other research shows that companies that are IT-intensive are 25% to 30% more likely to grow in terms of employment. At the moment, I imagine that that is rather important. There are other data from EUROSTAT showing that, roughly, the percentage of the UK work force that has specialist IT skills has been bumping along at a relatively constant rate, whereas if you look at the European countries, in all 27 of them the percentage of the work force that has IT skills has been slowly but steadily increasing, even through the recession. If you look at Germany, the rate of increase is significantly higher compared to ours, in terms of the proportion of the population in the work force with specialist IT skills. If you also look at data from BIS, it shows that the number of jobs that are going to require specialist IT skills is increasing at four times the average rate of other jobs in the economy. That suggests that there is a growing skills gap in the IT profession.

Q142 Stephen Mosley: Okay, if we have a skills gap—it seems that all of you think that there is—how are we currently filling it?

Nigel Fine: There are a number of things that we are doing. Really, you have to get back into the educational base. It is all about inspiring young people to stick with STEM subjects, which will give them the options to choose a variety of careers, with engineering, science and computer science being among those options. If we do not encourage our young people to do the STEM subjects, they will not have the basic capabilities to go on to do programmes of education and careers that require STEM education. There are a lot of things that we are doing. The profession has a number of programmes. For example,

the Big Bang Fair—Andrew, you came along to that a couple of years ago in Manchester—is organised by the whole profession. It includes industry as well, with Government support. It ensures that young people, and their parents and teachers, who are big influences on young people deciding on their careers, can have a great experience, and come along and understand what it is that engineers and engineering are all about. Statistics show that when young people have been through those programmes—they are really not about marketing, but about helping to fill the skills gap—there is an increasing awareness, and a positive awareness, of the value of the engineering profession and a career in engineering. We run another programme called Tomorrow's Engineers. Again, the engineering profession is coming together with industry in an outreach programme around the country, putting on a series of events that bring engineering into the lives of young people, to explain the variety of engineering activities that there are and the diversity of opportunities. The programme is all about inspiring people.

Q143 Stephen Mosley: Those are all long-term plans. In the short term, if you are an employer looking to employ skills now, where do you go? How do you fill that gap now?

Dr Harrison: We have a university system that attracts students from around the world because it is seen as world class, and engineering is a prominent part of that, which is fantastic. We also have more than 650 providers of engineering education and training in the FE system, which is a very large number, but they are not as visible to a lot of employers. We have rising numbers of apprentices, which is excellent, but if you look at the apprenticeship programme and its rapid development, the big rises are coming in areas outside engineering and outside STEM. As an employer, you have a graduate choice that is well understood. Employers understand our university system and engage really deeply, so you see employers, particularly large employers, finding a synergy between the investments that they make in research in our universities and the skilled people that they seek, and that is really great. We also have an apprenticeship system that is growing—but in between those two there is very little that is codified. As an employer, if you are too small to already have a deep relationship with a university, based on your research, and you are possibly too small to see apprenticeship as affordable and practicable, then you are into direct recruiting. Our English system has lost its focus on the rather simple thing of young people going to school, getting qualifications and a broad education, and then transferring to work. It is in that area that we could do more.

Nigel Fine: May I give two more examples? The profession spends an incredible amount of time accrediting university programmes to make sure that they are delivering the training and experience that will make graduates suitable to go into workplaces. It is a very important part of what we do in the UK to try to ensure that there is a good match between supply and demand. One other example is that the profession, including the IET, works with industry to

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put together an opportunity for young people who want to study certain programmes where there is a shortage of skills. They are incentivised to do that—which means that there are grants to support them during their education, and work experience during their summer vacations so that they get the experience, and money to support themselves through their studies. That is a very positive interaction, in this case between the IET and the power industry, to get young people to study power engineering, where we have a skills shortage. That is happening today.

Chair: The noise outside has now subsided, but apparently it was the Chancellor of the Exchequer. We could have gone out and lobbied him, perhaps.

Q144 Graham Stringer: Dr Mitchell, may I take you back to something you said about a skills gap in computer science? Are the signals coming from the marketplace and the academic world helpful? My impression is that there are now fewer academic courses in computer science, and that salaries and wages are at best static, if not going down. Is that a fair comment? If it is, why is that the case?

Dr Mitchell: There is a difference in the kind of degree you can do. Students who have done a computer science degree with a placement year—so they have spent a year in industry—are generally much better paid. The stats, roughly speaking, are that graduates who go into industry after a placement year start at about £26,000, which is a good starting salary. For people who have not done that placement year, the starting salary tends to be much lower—maybe nearer £20,000. We find that employers really want people with deep expert knowledge who have the experience to apply that knowledge and turn it into business ability. One of the problems in the UK is that, if you are a fresh graduate and you have not had a placement year, it is quite hard to get an entry-level job. We have seen over the years that more of those low-level, low-skilled IT jobs have been outsourced—but that does not mean that the highly skilled jobs have been outsourced. Generally, if you are an organisation that is project-managing some outsourced IT function somewhere overseas, you will need some incredibly highly skilled people back at base who can project manage that and make sure that it actually delivers the business needs that you have.

There is a dilemma if you are a fresh graduate without industrial experience. At the moment, in a recession, companies are looking for people who have that experience, so you find it harder to get a job, while the ones who have done the placement year immediately find that they can get into work. Ironically, having spoken to lots of people at universities, I can tell you that one of the most difficult things at the moment is to persuade students that they actually want to go on a placement year. I do not know whether that is linked to the fact that tuition fees are now much higher, and they would have an extra year of debt if they did a placement year, or whether there are social pressures—for example, if your friends aren't going on a placement year, you don't want to go on a placement year either.

Dr Harrison: I would like to build on that, with further evidence. In our “Jobs and growth” report we

looked at the signals coming from the labour market for folks working in science, engineering and technology. It turns out that those who work in IT technology occupations in the labour market enjoy a 33% wage premium compared with the labour market as a whole. That is a huge percentage. The reason why employers are willing to pay that premium is that they can have really productive people, and the really productive people have that magic combination of the qualifications and the deep experience. Students who are competing to enter those occupations are competing against deeply technical and deeply experienced people. We have to do more to help our young people transition into a labour market that is built on very high levels of productivity. That is a really big ask. They cannot have a gentle start to their IT careers; they are thrown into a fast-moving profession, and enormous demands are placed on them. It is not surprising that employers favour those who have deep experience, because they are paying for that privilege.

Q145 Graham Stringer: Dr Harrison, how is the Royal Academy reworking the higher diploma in education, and when will it be available to students? How will it have changed?

Dr Harrison: There is a long back story to the 14-to-19 diplomas. I shall cut it short by saying that Principal Learning, the main technical core of the diploma, is still available now. Last night the latest list of qualifications that count for school league tables was released by the Department, and there it is: Principal Learning in engineering is there, and it is offered by multiple awarding bodies, which is a sign that there is still real value in it, and that folk want it, and—

Q146 Graham Stringer: If you do not mind my interrupting, may I ask you roughly how many schools, either as a percentage or as an absolute number, are still doing it?

Dr Harrison: The peak was 500. I do not have the latest data, but the number is falling quickly. It is falling quickly because there is no incentive for schools to offer a large qualification irrespective of the outcomes for the young people. They are devoting a day or a day and a half of curriculum time and getting the equivalent of 90 minutes in league table recognition—and we know how much the league tables matter to schools—plus the fact that Principal Learning was always designed to be taken alongside core subjects such as English, mathematics and science. It is a big ask for a school to take on such a large thing. To get to your question, Principal Learning is there, and the schools will continue work with it while we, as a broad coalition across the profession, including employers and teachers at colleges and schools, look at producing a more flexible alternative. We are taking the large qualification, retaining its content, retaining the deep employer engagement and retaining its progression value, so that employers will recognise students who have done the diploma as the sort of students who would benefit from an apprenticeship. We have employers who go out looking for diploma students

to recruit on to their apprenticeship programmes. We want to preserve all of that, while giving schools the opportunity to offer all four of these linked qualifications, or perhaps three or even two, very much alongside the core subjects, and alongside the English baccalaureate if that is what they want to do.

Q147 Graham Stringer: When will that be available?

Dr Harrison: We will finish our work in May 2013, so it will be available for first teaching in September 2014.

Q148 Graham Stringer: I suspect that I know the answer, but how has the downgrading of the Engineering Diploma affected perceptions, both those of students and generally? What has been its worst impact?

Dr Harrison: We see its impact in the numbers. We never had the time for the diploma in engineering to prove itself, because it was only in its second year when the Diploma Aggregation Service was removed. The diploma stopped at that point. We do not know where it would have got to, but it was climbing rapidly. It hit a peak, and now it is clearly dropping off. But I think that the impact was wider than that, because we have seen a drop-off in students studying other practical technical STEM subjects, such as design and technology. My concern is that the wider signalling that there should, rightly, be a focus on the basics of maths, English and science, which we would applaud, also means that the other subjects—the extra ones that fit in the English baccalaureate—are a higher priority for schools than technical STEM subjects. That is what has caused the real change, and we see that change in the falling number of students taking IT-type qualifications, the falling number of students taking design and technology qualifications, and the falling number taking engineering.

Nigel Fine: May I add that the professional engineering institutions and the employers like the Engineering Diploma? They recognise that there is an increasing need for people who have a bias towards vocational and practical training, with skills to fill the demands that industry has. The Engineering Diploma in its full form was seen as a very good way of giving a career path to those people who had a bias towards practical and vocational education and skills development—but it was not given long enough. That is the fact, and therefore all the things that Matthew said are absolutely right. As a product, in its original form, it gave a complete overall view of the things that young people needed to do to make them ready for a worthwhile career. That was very much at the heart of the original diploma.

Chair: We want to take this a bit further. Caroline?

Q149 Caroline Dineneage: Yes, and I want to ask more about the E-bac. A lot of our witnesses have said that they fear for the provision of subjects such as D and T and ICT following the introduction of the E-bac. I wondered whether the panel have any views on the Government's decision to replace the GCSE system with the E-bac, and whether there are any concerns that that might reduce provision of D and T

and ICT and those sorts of skills—and, indeed, whether there is any evidence that that is already happening.

Nigel Fine: There are some very good points about the E-bac. Clearly, the focus on maths and science is very much at the heart of engineering, so encouraging young people to stick with those subjects for longer is important, but we recognise that young people need some way of applying the academic subjects in a practical manner to understand how they can be used for practical purposes. That is why we would like to see time made for the practical programmes—D and T, ICT and the Engineering Diploma—that would be seen as complementary to the more academic parts of the proposed E-bac, which we think would then give a much more rounded education.

Q150 Chair: Do you mean within the E-bac?

Nigel Fine: If it could be within the E-bac, that would be helpful—but we want some way of making sure that the learner has the opportunity and the ability to apply practically some of the learning from the academic subjects in the E-bac as proposed.

Dr Harrison: There are some fairly straightforward solutions to some of the concerns that other witnesses have expressed. I can give you a concrete example. As a broad coalition of organisations, we have made a strong case for the inclusion of computer science in the E-bac. It is an example of a rigorous subject with valuable and valued qualifications that lead on to educational outcomes in further and higher education, but which also underpin jobs and growth. The signalling value of showing a little bit of flexibility, yet staying within the E-bac's core ethos of getting the basics right, which we all applaud—but being sufficiently flexible to see technical and practical alternatives to, say, the humanities or the modern foreign language—would have enormous benefit.

We have started to see—we welcome this—recognition by the Government that there is a connection between what happens in schools, and jobs and growth. Both the Chancellor of the Exchequer and the Skills Minister, when opening and launching the apprenticeship centre at Rolls-Royce, made a very clear statement about their support for the Academy's work in redeveloping the diploma in engineering into a suite of qualifications. They could have said much the same thing about computer science. It is about our community owning the domain, taking a deep interest in what is taught and the qualifications that are on offer, and then working with the Government to insert them into an accountability framework for schools. That has a great combination of focus on the basics with focus on progression value beyond the age of 16.

Dr Mitchell: For computer science, the reality is that the E-bac is here. It is a performance measure, and head teachers are very much focused on those performance measures. Computer science, as far as schools are concerned, is a new, intellectually challenging and rigorous subject. That means that not all students will get grade C, so without a strong incentive to encourage those head teachers to embrace computer science, it simply won't get traction in schools. We are working at the moment with about 500 schools that are keen on the idea of introducing

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computer science, but we have about 3,500 state-supported secondary schools, and altogether there are about 5,000 or 6,000 if you include the independent sector. In order to get at least half of those offering computer science, all those head teachers need to believe that it is going to help make their schools successful if they introduce what they see as a new “hard” subject into the curriculum. Without computer science in the E-bac, we are going to struggle to get the numbers of schools to take it up that we need for the economic and societal well-being of the UK.

Q151 Caroline Dinage: Is there any evidence to show what proportion of students who successfully completed the Engineering Diploma would have achieved an E-bac?

Dr Harrison: The rate-determining step would have been the modern foreign language. When the E-bac was first announced, lots of folk, ourselves included, went to the existing school league tables to see how many schools would have got it in the previous year. The answer was 17%, and the rate-determining step was how many students took French, German, Spanish and so on at GCSE. That is the answer. To be more helpful, if we are trying to estimate how many students might have achieved the E-bac, there are two ways of doing it. If you look at vocational pathways to higher education—the E-bac position is about progression through education and on to higher education—15% of engineering undergraduates have gone through vocational routes, so you could argue that perhaps 15% of diploma students might have attained at that sort of level. The other way to look at it is to look at the students who achieved the highest grades in the diploma, and around 25% of students achieved the top grade or the next one. With some confidence, I would have estimated that around 20% to 25% of students could do that.

We have frequently made the case that Principal Learning, and now the qualifications that we are working on, sit naturally alongside a focus on maths, English and science. When schools are encouraged to include something like computer science or engineering as part of an E-bac, you get access to the full spectrum of students in the school. One of the concerns about subjects that are often thought to be vocational is the assumption in the minds of some that vocational means “only for students who will not be fully successful at academic subjects at 16.” We have always made the case that engineering could and should make sense to the full spectrum of students, including both those who are using it only as an interesting context for their maths and science, and those who are seeking higher education in engineering or an apprenticeship and so forth.

Chair: We have already talked, Dr Mitchell, about the skills gap. We want to push you a little further on that.

Q152 Jim Dowd: I apologise for missing the first part of the session; it was a combination of gridlock at the Elephant and the inexplicable closure of Bridge street by the police. It made my morning even more complicated that it normally is on a Wednesday.

I noted, Dr Mitchell and Dr Harrison what you said in response to Graham and Caroline, but do you

believe that there is a skills gap in ICT? I assume that you are going to say yes. What steps need to be taken to address the problem in the UK? What is wrong with the current provision in ICT education?

Dr Mitchell: In terms of the skills gap, what matters is how competitive the UK is. If all the other countries stopped doing IT immediately, we would not have a problem. President Obama said last year that if America wants to stay the top nation in the world it will have to out-compete and out-educate every other country on the planet. We are not the United States of America, but if we want to stay affluent and be regarded as one of the leading nations, we too have to out-compete and out-educate all the other countries in order to stay ahead. There is a problem with ICT in that context. How do we stay ahead of the race? When it was originally envisaged, 10 or 12 years ago, the ICT curriculum was very much focused on the skills people needed to use software in business. At the time that was a perfectly reasonable idea. However, it did not take account of the fact that all the other countries on the planet were also introducing that kind of curriculum. What we need is a curriculum that gives people an understanding of the computational principles, the foundations of computing, so that they can be innovative and invent new ideas—and then turn them into products.

There are two sides to this. You need the deep technical knowledge to be able to invent new technology, and you need to develop skills. You are not going to become a skilled project manager when you are 12, but you need to start developing the business skills at that stage that are going to be helpful later on in life, so that you can become an entrepreneur and invent great new things. It is interesting to look at what has happened to Nokia over the last few years. Back in 2000 it had something like a 40% share of the mobile phone market. Now it has something like a 25% share of the mobile phone market, and it seems to be the case, at least according to its own CEO, that one of its problems is that it cannot write software. Its operating system, which was one of the core things within its mobile phone platform, has had to be ditched, and it now uses the Microsoft Windows operating system. That is a really good operating system, and a very good product, but it is not the company’s own. It has lost the ability to innovate and invent new products, which has resulted in a massive collapse in its market share.

Dr Harrison: I want to add another risk warning. Our evidence shows that the wage premium for IT occupations is going up all the time because we have a shortage of folks. My concern is that we, as a nation wanting to compete internationally, need to attract inward investment. If we continue to have a paucity of skilled people, external people looking at the UK as a place to invest will say, “Well, there aren’t enough people who have the skills that we require in this area, and as a result the wages are going up. It looks like a place with not enough people and high wages. Do you know, I’ll go and invest somewhere else?” There is a deep risk to our country if we cannot get enough IT workers. Because of the pervasive nature of IT occupations—they turn up everywhere: in hotels and leisure, in retail, in engineering and in the health

service—no sector of our economy is safe from the charge that the UK looks an unattractive place to invest, because we do not have the skills, and as a result the wages are getting higher.

Dr Mitchell: I would add one thing. One very positive thing is happening at the moment. The DFE has asked the Royal Academy of Engineering and ourselves to co-ordinate the development of a new ICT curriculum. It specifically said that it should be based on the findings in the Royal Society report this year. That report said that what we need in schools is a mixture of digital literacy, information technology skills and a deep understanding of computer science. There is a ray of hope on the horizon. If that curriculum does turn out in the way that we have so far put it together, there is some hope in the long term for improving our skills base.

Q153 Jim Dowd: Those were two very comprehensive responses. That has the great merit of meaning that I do not need ask many more questions. But just on the point that you mentioned about trying to get computer science included in the E-bac, you said that you were making progress of a kind with 500 schools or so. First, do you regard that as satisfactory and promising? Secondly, given the fact that everybody says that we need these skills in Britain, in the new technological society if not before, why is it so difficult to get them into the education system?

Dr Mitchell: Five hundred schools is great, but it is completely inadequate for the needs of the UK. It is great for the kids that go to those schools; they will have a wonderful time learning about computer science, which is a tremendously exciting and creative subject. I would argue that every single school in the country needs to be offering computer science as an option at GCSE level. For the UK, we need to be better than other countries in terms of our education. It is not good enough for the status quo to carry on.

Q154 Jim Dowd: Is that the history of development in the technologically advanced countries? Some of them, even in the far east, a generation ago had nowhere near the technological might that they have now. Is that the path that they followed—increased education, increased innovation, increased production and increased technology?

Dr Mitchell: The number of engineering, computer science and IT graduates coming out of India and China has grown exponentially. However, one of the issues in India, for example, is the quality of engineering graduates. There is some evidence to suggest that an awful lot of the engineering and computer science graduates in India are “unemployable”. At the same time, if even a quarter of them are highly employable, that number is still larger than the entire output of the UK in terms of engineering graduates.

Dr Harrison: I shall add some detail to that. Our international competitors have done two things. In the Pacific Rim, they have got the basics right. They have primary education right for all their students. They have high expectations of all their students, and they have moved into getting secondary education right. They are getting schools right with the basics. Then

they started to create their contribution to a world-class university system.

We have so much that is already right in the UK. We are in a slightly different position. We have a world-class university system, and we are dealing with getting the basics right in schools. Our problem is more one of progression, because nine out of 10 kids give up science at the age of 16. Nine out of 10: that is shocking. When you look at the patterns across the country, they are uneven, and in some places the percentage is even higher. Our problem is not so much about the basics or about higher education; it is about getting a higher proportion of our 16 to 19-year-olds to stay with science, technology, engineering and maths. That is why having an inspiring computing curriculum from 14 to 16, with qualifications that match, is really important. That is why having engineering qualifications—and creative subjects such as design and technology, and art and design—alongside maths, science and English is important. It encourages our young people to stick with subjects and combinations of subjects that give them access to the best wages.

Nigel Fine: May I add to that? All that is good, but one problem that we have not really touched upon is our woeful inability to give career advice to young people. Career advice is not good in this country. Parents are not giving good advice. One in three parents do not know about engineering or engineering careers. Teachers are supposed to have a bit more insight, but one in five teachers in the STEM area may advise against engineering because they do not understand engineering or what it does. It is a big issue to take all the good stuff that we do, and all the evidence about what engineers and engineering do to help this country, and put it in a better way as career advice to teachers, parents and learners. That is what we are missing, and we need to do more of it in this country.

Jim Dowd: I think you’ll find that a lack of understanding and an appreciation of what engineering does is not limited to the teaching profession.

Chair: We have a lot to do in about one minute. Roger.

Q155 Roger Williams: I have a question on the perennial concern about diversity in engineering. Perhaps, Dr Harrison, you can tell us how much funding the Academy has received from BIS since the spending review in 2010. Was it new money, or was it a continuation? Will you make a very quick assessment of what it has delivered?

Dr Harrison: As part of our grant settlement with BIS, we have a Diversity in Engineering programme that is funded to the order of about £250,000 per year over the four-year spending review period. It funds a job-share post to work across the institutions, and it is funding some pilot activities in individual institutions to look at particular issues—for example, the rate at which engineers, female engineers for instance, progress from being members of an institution to being chartered registrants and then to being fellows of the institution. Another example is a coalition of engineering institutions looking at creating an

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apprenticeship programme that has diversity as part of its construction—a programme built to be more attractive to a wider range of people.

Q156 Caroline Dinage: Dr Harrison, in your submission you stated that the proportion of engineering apprenticeship starts has been dropping since 2007. Could you provide any figures on that?

Dr Harrison: It is a mixed picture. We see rapid growth in apprenticeships as a whole, but with different rates of growth among young people, 19–24-year-olds and the over-25s. I do not have time to find the figures, but from memory over the last two years we have seen growth in the order of 30% in engineering apprenticeships, whereas apprenticeships as a whole have had growth of about 60%. So there is growth, but there is a dilution of the proportion of apprenticeships that are in engineering, and in STEM more widely. Why this matters is complex, but one of the reasons is this. When we look at the outcomes from apprenticeships, they are fantastic in terms of wages. The return to the individual and the return to the employer is fantastic. That is based on historical data, when engineering apprenticeships were a very large proportion of the total. Now we have apprenticeships right across the board, which is welcome, but they are also in much lower-wage occupations, so as we go forward, the premium that young people, particularly, get from apprenticeships will of course drop, because a smaller proportion of them are doing apprenticeships in high-wage occupations. That is important, because we need to preserve the real value in the word “apprenticeship”—Apprenticeship with a capital A. It describes high-level—predominantly level 3—long-duration programmes that include both general education, advancing people’s English and maths, and also more occupationally specific stuff.

Q157 Caroline Dinage: Could this be explained simply because the level of apprenticeships in other subjects has gone up as a result of the wider popularity of apprenticeships, or is there another reason? Does the number of engineering apprenticeships look lower than other apprenticeships just because there has been such a huge growth in other areas? I did a morning apprenticeship with Costa Coffee; there has been a growth in apprenticeships in such areas, where presumably there were not many before. Is that the reason, or are there others?

Dr Harrison: Of course that is one of the reasons. But the reason why we might be concerned is that some of that growth has been in relatively short duration

and relatively low-level apprenticeships, and the outcomes of those are so different from the outcomes of three and a half year level 3 engineering apprenticeships. We are not measuring like with like. I am encouraged by the growth in engineering apprenticeships, and particularly by the growth of advanced and higher-level apprenticeships, but we have to preserve the value in the apprenticeship brand, which is about long duration high-level programmes that absolutely underpin the productivity of the firm that employs them.

Q158 Caroline Dinage: To your mind, is there any other reason why the number of engineering apprenticeships has fallen?

Dr Harrison: It has not fallen—

Q159 Caroline Dinage: Or has not grown as much.

Nigel Fine: You have to look at the market in two ways. The large organisations, such as BAE Systems and Rolls-Royce, are over-subscribed by young people wanting to do their apprenticeships. In fact, statistics say that is harder to get an apprenticeship with some of those organisations than it is to get into Oxbridge. However, we have a big SME market in this country, and SMEs are finding it a bit more difficult to fund and support apprentices. They need apprentices, and we need to find ways of helping them to recruit and train apprentices in a way that is complementary to what happens with the large organisations, which are set up to do this. The other thing to say about apprentices is that the professional engineering institutions are really supportive of apprenticeship. We see it as a route to becoming a professional technician, and that in itself is a route to continuing on to becoming a professional engineer. We should look at this as a process of development of individuals through their learning; it does not necessarily stop at their being technicians. In terms of improving social mobility, technicians going through to professional engineering is a wonderful way to describe how young people with more of a vocation towards practical capability can actually progress into the professions.

Chair: That is a very powerful message on which to end this session. There is lots more that we would like to ask you, but there is not sufficient time. If there are other pieces of information that you would like to feed in, particularly on that last theme, we would be interested to hear from you. Thank you very much indeed for your attendance this morning.

Examination of Witness

Witness: **Carole Willis**, Chief Scientific Adviser, Department for Education, gave evidence.

Q160 Chair: Good morning. Thank you for coming to see us formally. We have had an informal discussion, but just for the record I would be grateful if you would introduce yourself.

Carole Willis: Thank you. My name is Carole Willis. I am the director of research and analysis and the Chief Scientific Adviser at the Department for Education.

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Q161 Graham Stringer: Can you tell us how you ensure that the Department for Education policies are evidence based?

Carole Willis: I can. There are three key aspects to my role, which are fundamentally all about ensuring that the right robust evidence is being fed in to inform Ministers' policy decisions. I do that by ensuring that evidence is generated from within the Department, and analysis is undertaken. We have a very large set of admin data around attainment, which we feed in and analyse, looking at the potential impacts of different policies. I ensure that information is brought in from outside the Department, both in the form of external research that is commissioned by others, and from our own research programme, which commissions different pieces of work on different policy questions. I also ensure that we bring in a range of different external experts to help and advise on particular issues. That is the external role of gathering the evidence and feeding it through to Ministers. I am also responsible for 200 professional analysts within the Department, who work across all the policy and delivery issues within the Department, helping to ensure that policy is driven by and informed by the best available robust evidence. Finally, personally I have a direct role in advising Ministers and advising senior policy officials around the evidence base and issues around different policy questions.

Q162 Graham Stringer: You are familiar with our predecessor Committee's report, *Early Literacy Interventions*, in which we criticised the methodology of the Department for not using randomised control trials. Our position was supported in the scientific literature. Have you changed your attitude towards randomised control trials since then? The view of this Committee was that you were not taking the best available evidence in order to determine policy, and that you rolled out *Every Child a Reader* before doing the proper investigation?

Carole Willis: If I recall rightly, my response at the time was that we could get a long way with carefully matched comparison groups in order to analyse some of these issues. We are looking very carefully at randomised control trials, and I have been discussing this with the Secretary of State, who has been very interested in some of the work that the Cabinet Office has been doing with Ben Goldacre around randomised control trials. They have just produced a paper called *Test, Learn, Adapt*, which tries to dispel some of the myths around randomised control trials. The Secretary of State has seen it, is very interested in it, and has been challenging us on whether we should be doing more RCTs. We are going to build a process into the research approvals process that I chair, to look in all cases, for all of our research, every time a question comes up as to whether we could adopt a randomised control trial approach. I would say that things are very much shifting in that direction, and that there is a real appetite for looking more carefully at the most robust ways of analysing the evidence.

Q163 Graham Stringer: What are the myths surrounding randomised control trials?

Carole Willis: I would need to double-check that leaflet and send it back through to you—but there are concerns about it being too costly, too time-consuming.

Q164 Graham Stringer: With respect, those are not myths, are they? They are the normal currency of everyday decisions in Government: "This is expensive; we can't afford it," or, "This takes a long time. We'd like to know the answer." That was the whole problem of the original report, was it not, that you wanted to roll out *Every Child a Reader* without getting a proper evidence base?

Carole Willis: I really need to refresh my memory on all of that evidence, but the concern there, as in a number of such situations, is about implementing something that is seen to be useful to a range of different schools, and everybody wanting to do it. There is something about trying to help schools to understand that it is really important that we test out these things properly, so that we can get their buy-in to identifying a control group of schools that are willing to take part in that type of research. That is one of the big challenges.

Q165 Graham Stringer: You have partly answered the next point that I was going to ask about. If you are not going to use randomised control trials, how do you gather evidence and check the effectiveness of policies? It seems to me that what you are saying is that rather than gather the evidence we are rather keen on jumping the gun, for political reasons.

Carole Willis: I don't think that that is what I said at all.

Q166 Graham Stringer: That is my interpretation. What you are saying is, "We want to roll them all out together." I am not saying that you are taking the political decision, but you are advising Ministers who do have political pressures on them.

Carole Willis: My *raison d'être*, my key rationale, is to ensure that the range of different evidence is presented to Ministers to inform policy decisions, and to try to set out clearly the relative robustness of different types of evidence. I see it as a very broad spectrum. At one end you have RCTs and at the other you have stakeholder views, and you have everything between. Trying to pull together the range of that information, whether it is administrative data, carefully constructed research activity or information from outside the Department, and presenting all of that and feeding it into the policy decision, is absolutely crucial. It is what I spend my whole day trying to achieve.

Q167 Chair: What was the range of data that you presented to Ministers, apart from the Wolf report, that resulted in the downgrading of the Engineering Diploma?

Carole Willis: Alison Wolf pulled together a lot of information, and that is the key basis for all the reforms to the performance tables. That included a lot of academic evidence, so there is 15 or 20 years work looking at the labour market returns for different kinds

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of qualifications—people like Anna Vignoles, Lorraine Dearden and Steve McIntosh.

Q168 Chair: That is one source. What about the Royal Academy, IET or BCS, which have just been before us? They have wildly different views. So you gave one source to the Minister?

Carole Willis: No, absolutely not. Alison Wolf looked at the full range of evidence.

She had over 400 responses to her inquiry. She also looked very carefully at the international evidence. On an ongoing basis, the Department is actively involved in working with a whole range of external organisations. I am an economist by background, not a hard scientist, so it is even more important that we draw on the expertise of organisations such as the Royal Academy, the Institute of Physics and the Royal Society of Chemistry. There is active engagement with those organisations on an ongoing basis.

Q169 Chair: This “evidence-based policy” that we are talking about does not square up to all the evidence that we have received that condemns the decision to downgrade the diploma. How can that be squared with what you have explained to us?

Carole Willis: The Wolf review highlighted the fact that there are a number of vocational qualifications that young people have been taking, which have no value in the labour market and in some cases negatively harm their prospects compared to not having done that qualification at all. The reforms to the performance tables are aimed at identifying the most robust set of vocational qualifications that young people can take to give them the best possible opportunities going forward in the labour market.

Q170 Graham Stringer: We hear a lot of statistics on this Committee, but I was a bit surprised by the fact that you have 200 analysts looking at these figures. Is it absolutely necessary to have 200 analysts? Can you tell me how large the current research budget is, and whether it is going to stay the same in cash terms, diminish or increase over the next financial period?

Carole Willis: Two hundred professional analysts is by no means the top of the table across different Government Departments. There are lots of other Departments—

Q171 Graham Stringer: This is an even bigger problem than I thought it was, then.

Carole Willis: Personally, I would like to see more, but we live in financially constrained times. As important as the number of analysts is how they are used. The Committee will have seen the publication last week of the DFE review that the permanent secretary commissioned, and alongside that we have been doing a thorough review of analysis, research and data within the Department and thinking about how that can be used most effectively in policy development, how we can get analysts working really closely right from the outset on a consistent basis on all of the different policy issues, and how we can ensure that the right evidence and data is more easily accessible to the full range of people within the

Department. In terms of your question about the research budget, my research budget is £9.5 million this year. We are just about to go into the next business planning round, where I will be looking very carefully, including consulting external academics, at what the evidence gaps are within the Department that we need to address over the next year or so, and I will be presenting advice to Ministers about what we should be doing, what we should be spending money on, and therefore how much we should be spending on research going forward.

Q172 Graham Stringer: Do you expect it to increase or decrease?

Carole Willis: I have not done the work yet. It is a demand-driven approach, including demand from me, so there is no “right amount” of research. We need to look carefully at the evidence gaps, and what needs to be undertaken to fill those.

Q173 Chair: I asked you about the ubiquitous condemnation of the downgrading of the Engineering Diploma. Your response was about vocational qualifications more broadly. Now can you give us the answer: where was the evidence that said that the Engineering Diploma, per se, should be downgraded? Was it based upon a proper risk assessment? Did you look at the way in which students and parents would be disincentivised?

What was the evidence on which the decision was made?

Carole Willis: It is worth reminding the Committee that the Principal Learning qualification, within which the core part of the Engineering Diploma lies, still appears on the list of 140 vocational qualifications that will count in the performance tables going forward, alongside a number of other engineering qualifications, and indeed a wider set of STEM qualifications. It is still there; it is being offered by awarding organisations and it is seen as a high-quality course of study. All those qualifications were worth varying amounts in terms of their previous equivalents. They are all now treated as one GCSE, but the criteria that we used to identify that list were consulted on. They were an attempt to identify that range of the highest-quality qualifications. They included the criterion of it being at least the size of a GCSE. Part of that is about the concern that schools were offering those kinds of qualifications to people simply in order to push their way up the league table rather than thinking about what was in the best interests of their students.

Q174 Chair: Does the fact that there seems to be a reworking of the diploma suggest that a mistake was made in the first place?

Carole Willis: I am really pleased that the Royal Academy of Engineering has developed work with awarding bodies and engineering employers to develop those four qualifications. Potentially, that could even mean a greater range of choice for individuals, and might mean an even greater take-up of engineering. Just to finish on the point about the evidence, there was a full impact assessment

conducted and published around the impact of the reforms to the performance tables.

Q175 Stephen Mosley: I want to move on to university technical colleges. It is quite an open question to begin with. What evidence do you, as a Department, collate on the effectiveness of UTCs?

Carole Willis: There are only five open at the moment, as you will be aware, and we do not have any results from them yet. We will have results from the two that opened in September 2011 when we have developed performance tables at Christmas, or finalised them. I shall be looking very carefully at the attainment within those different institutions. What we collect is quite a lot of information on background pupil characteristics, through the school census. I shall be looking to undertake analysis, controlling for the background characteristics of the pupils entering those kinds of institution, and comparing them with similar attainment levels in other sorts of institution to see whether, and the extent to which, those organisations are adding value.

Q176 Stephen Mosley: If you have not been able to collect the evidence on performance so far, and you plan to open another 34, I think, over the next three or four years, what evidence are you using to decide that 34 is the right number?

Carole Willis: There are a couple of things. The university technical colleges partly grew out of the city technology colleges, which have been open for a longer period, and some of the promising results in those organisations. But, as I am sure the Committee is aware, the core rationale behind those UTCs is to have active engagement from employers and universities to help ensure that the programmes of study that are being completed can enable young people to have the best possible chance of going on to HE and some form of employment. There is that particularly valuable aspect, and that degree of engagement with such organisations.

Q177 Stephen Mosley: What is the main driving force behind this? Is it the employers coming to you and saying, "We want to have a UTC," or is it yourselves looking at a map and saying, "Oh, that looks like a good area." How do you decide where you are going to have one?

Carole Willis: There is a thorough assessment of business cases. It is about university departments coming to us and saying that they want to set up one of these organisations. The proposal is then thoroughly assessed, to explore things such as whether or not there is justifiable additional demand for that kind of organisation in that particular area, and what the educational benefits are going to be.

Q178 Stephen Mosley: Lastly, from what you have seen with the opening of the five so far, have there been any surprising results? Is there anything that you have learned from it?

Carole Willis: It is too early to tell. In a month or so, as I say, we will have the final performance results broken down by institution. We will be able to look at them for a range of different institutions.

Q179 Stephen Mosley: In terms of looking forward, I know that you cannot tell at the moment, but if something came out next month how would that then feed into the process for setting up new colleges?

Carole Willis: I would ensure that the policy team working on those issues were aware of it. If there were any surprises, we would want to look very carefully at what was happening.

Q180 Caroline Dineneage: Can you confirm how many pupils have been entered for the E-bac in total?

Carole Willis: Yes, I have some figures here. The total number of pupils who were entered for the E-bac, including those in independent schools, was 155,000 in 2011–12. In state-funded schools, there were 129,000. That is 25% of students overall entering the E-bac, and 23% in state funded schools.

Q181 Caroline Dineneage: Thank you. The overwhelming evidence that we are getting from our witnesses points to a concern that the introduction of the E-bac is in some way going to limit the number of people that go on to study computer science, design and technology and ICT at A-level and beyond. What evidence do you have to disprove that?

Carole Willis: The E-bac is only supposed to cover part of the curriculum. It leaves about 30% of 40% of time in the curriculum for studying other things. The rationale for setting up the E-bac was partly around international evidence that other high-performing jurisdictions were asking their students to study a similar range of core academic subjects up to the age of 16, before they went on to specialise in other things, and the fact that the progression rates for the E-bac subjects were particularly high. I know that there are lots of other vocational routes to HE and to other engineering occupations, but to the extent that the acquisition of maths and physics A-levels are important, the E-bac students are much more likely to go on to study science A-levels than pupils getting five good GCSEs including English and maths, for example. As a route into engineering, it is quite powerful.

In terms of how it is impacting on other subjects, we have commissioned two independent pieces of research to monitor and try to understand how schools are responding to the introduction of the E-bac. There have been some responses, and some have changed their timetabling options and their curriculum offer. We are expecting to see quite a big increase in the number taking triple science and double science. At the moment, about 64% of pupils take double or triple science, and we are expect that in 2014 to be closer to 80%. It is had some incentive effect. As a consequence of that, some schools are stopping offering other sorts of qualifications, but the intention was never that all pupils would take this. As I say, only 23% are taking it this year, and we would hope to see some further increase going forward. About 49% of students are currently studying E-bac subjects that they will take in 2014, so half the schools are still offering a range of different subjects. It is a signalling device, and it sits alongside a whole range of other measures in the performance tables, and it is really

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important that schools are thinking carefully about what is in the best interests of their students.

One of the young people who came to see you in a previous evidence session was really excited about the design and technology that she had done. That kind of thing is still open for schools to offer. We would expect them to want to try to engage young people in the best way possible, to help maximise their chance of success.

Q182 Chair: But have you not sent the message to schools that that is not core? You might have heard the evidence from some of the engineering institutions that they firmly believe that learning about the application of some of the academic disciplines is very relevant to their needs. Putting design and technology outside the E-bac—hasn't that sent the wrong message to schools?

Carole Willis: As I said, the E-bac is only part of the curriculum, and it has been designed with the evidence from other countries about the kind of things that they are offering that give students the maximum number of chances and options in terms of what they do post-16, and the kind of vocational qualifications they might then choose to concentrate on afterwards—but it does not rule out being able to undertake that range of other things. The Department probably has a very long list of people who all have their own ideas about what should be in the E-bac.

Q183 Caroline Dinagen: I have a final question. Given that the E-bac was only introduced in 2010—
Carole Willis: 2011.

Caroline Dinagen:—in 2011, and that it will be replacing the GCSE system in 2017, are you satisfied that there is sufficient evidence that it is going to make improvements to education?

Carole Willis: Are you referring to the English baccalaureate certificate qualifications?

Caroline Dinagen: Yes.

Carole Willis: There are two separate things. The English baccalaureate is a signalling device. It says to schools, "This is an important set of subjects." The English baccalaureate certificates are a new set of qualifications designed to be more rigorous than the current set of GCSEs in a particular set of subjects. As you will know, there is a consultation under way at the moment looking at those. I am satisfied that there is evidence to suggest that the GCSE system as it currently stands is not working as well as it should in terms of giving students high-quality qualifications that stand them in good stead in the labour market.

Q184 Roger Williams: Turning to work experience, perhaps you could tell us why the requirement for pupils at key stage 4 to do a set amount of work experience has been removed.

Carole Willis: I can certainly tell you about the evidence that led to that decision. Again, it was tied up with Alison Wolf's report, and her extensive review of the evidence, which, she concluded, suggested that work experience is really important. It is a very valuable way for young people to attain the kind of skills that employers need in the labour market, and it is one of the reasons why

apprenticeships have a relatively high rate of return in the labour market. The rationale for her recommendation that that duty be removed from key stage 4 is that it was better undertaken at key stage 5. The study programmes that the Department is working on at the moment expect all young people, unless they are doing an apprenticeship that has that core employment component in it already, will be undertaking some form of work experience, and we shall be piloting that; indeed, we are in the process of trialling the best way to do that with an independent evaluation.

Q185 Roger Williams: Could you tell us whether any other evidence, apart from the Wolf report, was taken into account?

Carole Willis: The Wolf report was very broad in terms of the range of different views that fed into it. The other issue under consideration was around minimising bureaucracy in schools. We have a lot of evidence of schools complaining about all the things that they are required to do, and the bureaucracy involved.

Q186 Roger Williams: There is some suggestion that schools that still believe that work experience is important might not be quite so competitive in academic results, because of that. Obviously, taking two weeks out of a term might have that effect. Would you like to comment on that?

Carole Willis: I am not aware of evidence supporting that. Schools are still free to offer that work-related learning, where they think that it is in the best interests of their pupils. Re-examining all of this, there seem to be two sets of things. One is about the value of work experience and the extent to which it can offer those employability skills—and I think it is right that that is at key stage 5. The other aspect where it can be helpful is helping young people to understand the world of work and to make some career decisions—but there are different ways in which that can be achieved. There is something about information, particularly in the context of engineering and inspiring young people, and there is a range of different ways in which that can be done. Having somebody coming into the school and talking about their experiences, and what it means to be an engineer, can be incredibly powerful for young people, rather than necessarily going out on work experience. I did maths and physics at A-level quite a few years ago, but nobody even mentioned engineering to me at the time, and I had no concept of what that might involve, but if somebody had come in to the school and inspired me, telling me what it was about—

Q187 Roger Williams: Perhaps it would have been valuable if I had been able to put a question to you about diversity in engineering earlier. Does the Department intend to gather evidence about the effect that lack of work experience may have on children at key stage 4?

Carole Willis: The main way in which that would be monitored is in terms of the progression rates for young people. We have just introduced—this year—a new set of destination measures, so we will be looking

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at those quite carefully. Those are broken down by institution, and they look at what routes young people go on to once they have left that particular institution. That is one of the other incentive mechanisms that sit alongside the E-bac. Schools still have a whole set of incentives to offer the range of subjects that their children can succeed in, and which will put them in the best possible position for their further progression.

Q188 Chair: I think that we have covered all the ground that we wanted to cover. Again, in the light of the reference to some of the statistics, if there is any further data that you feel ought to be placed before us before we start drawing up our conclusions, we would be extremely grateful. Thank you very much.

Carole Willis: May I make one further point, about girls and physics? From looking back at all this

evidence, that is one of the key issues that we need to tackle. At GCSE, very similar numbers of boys and girls are taking GCSE physics; there is a slight difference in the numbers. At A-level, the number of girls going into physics drops dramatically. In terms of that academic route through into HE, and the importance of maths and physics at A-level, there is a big issue. We have been working with the Institute of Physics, with the Stimulating Physics Network, to try to address that, and we have seen the numbers of boys and girls taking GCSE and A-level physics go up, but we are still not narrowing that gender gap, and that is one of the key areas that we will need to focus on going forward.

Chair: Thank you very much indeed.

Examination of Witnesses

Witnesses: **Elizabeth Truss MP**, Parliamentary Under-Secretary of State (Education and Childcare), Department for Education, and **Matthew Hancock MP**, Parliamentary Under-Secretary of State (Skills), Department for Education and Department for Business, Innovation and Skills, gave evidence.

Q189 Chair: Good morning, Ministers, and welcome. You are aware of the background to this inquiry. Would you first explain to us how your particular ministerial responsibilities overlap with the objectives of this inquiry?

Elizabeth Truss: My ministerial responsibilities are for the curriculum and qualifications to 16—key stage 2 tests, GCSEs and the development of the EBCs. I also have responsibility for A-levels.

Matthew Hancock: My responsibility is for all learning over the age of 16 outside universities; while Liz takes the lead on A-levels, I am responsible for vocational qualifications.

Elizabeth Truss: And funding.

Matthew Hancock: Everything above the age of 16 other than A-level curriculum design and universities.

Q190 Chair: How do you split your time, Mr Hancock, between the two Departments?

Matthew Hancock: I try to make sure that the people who we serve have a seamless service across both Departments. I am a realist about Whitehall, and it is a day-to-day job to try to bring the two Departments together. I do not specify an amount of time in each Department. I regard myself as the Minister for Skills in both Departments all of the time, no matter where I am sitting. I have a physical office in each Department, but I have one private office that, for instance, reports to me wherever I happen to be. The funding for the provision for which I am responsible comes at around two thirds from the Education budget and one third from the BIS budget. One of my goals is to make sure that the bodies that receive the funding get it in a way that is consistent between Departments rather than having a barrier. I know that that was not a precise answer to the question, but that is because I do not have an answer. I do not record the amount of time that I spend physically in each Department. I am the Minister for Skills wherever I am.

Q191 Chair: Can you tell us how improving engineering skills, in particular, within the UK fits into the Government's growth agenda?

Matthew Hancock: It is critical. Within the industrial strategy that the Secretary of State for Business, Innovation and Skills set out in September, and which we are populating and driving through in different sectors and in collaboration with those sectors, it is very clear that there is the potential for a shortfall in engineering skills over the years to come. Although the number of apprenticeships in engineering is rising, for instance, and the proportion of students taking STEM subjects at university is rising for the first time in a while, it is an area where we know that we need to do more. It is very important. It is important in vocational qualifications, but it is also important that the students who want or might want to go on to do engineering have a rigorous grounding in the basics.

Q192 Chair: Before we move on, do you see vocational qualifications as something different from academic qualifications?

Matthew Hancock: They are inherently different. I see them as equal in value.

Q193 Chair: Do you not see a continuum between the two?

Matthew Hancock: There is something of a continuum, but clearly there are qualifications that are more vocational. Within the vocational category, I would also break it down into those that are general applied qualifications, such as some BTECs in science for instance, and those that are occupational and specifically targeted at success in an individual occupation. Of course, there is a spectrum.

Q194 Caroline Dinéage: I want to talk about the English baccalaureate. In a lot of the evidence that we have gathered, our witnesses have expressed concern that the introduction of the E-bac will underplay the

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amount of emphasis on things such as computer science, design technology and ICT. In one of our evidence sessions, the National Grid said that the English baccalaureate seemed at best to be irrelevant to improving the UK's engineering skills, and that at worst it might exacerbate negative perceptions of engineering careers. I ask first for your thoughts on that, and secondly how you will ensure that the E-bac does encourage schools to concentrate on these subjects that are going to help deliver a future generation of engineers.

Elizabeth Truss: First, I do not think that that is true about the English baccalaureate. What we have seen since we introduced it is that the number of students studying single sciences has gone up, and obviously physics and maths are key underpinning subjects for engineering, so what the English baccalaureate does is highlight the importance of rigorous science subjects. That is positive. The number of pupils taking GCSE triple science has gone up from 48,000 in 2007 to 152,000 in 2012, so we have seen a strong increase in the number of students taking science subjects, which is an important background to engineering.

On the subject of ICT, the Secretary of State has been very clear that we want to see changes in the curriculum, so that students are learning about coding and developing computer programs, and understanding how computers work rather than just using computer packages, which was the previous approach for ICT. We have been very clear that we want to see that developed at primary as well as secondary schools, so that developing technology is very much part of what all students are doing. We are shortly due to release the draft programmes of study for both primary and secondary education, and we will be outlining our plans in more detail then.

Matthew Hancock: Obviously, I would agree. Having a rigorous core is the foundation of success in careers across the piece. Of course, it is possible to combine the EBC with specific engineering qualifications, and we may come on to the testimony by Dr Harrison and the work that we are doing there, specifically on rigorous engineering qualifications. You've got to have a rigorous core. For instance, yesterday we announced that we are doubling the funding in FE and within apprenticeships for English and maths for those who do not have level 2. These sorts of changes in this direction are critical for providing the base off which our future engineers can spring.

Q195 Caroline Dinenege: How do you address the fears of a lot of employers that by not including engineering types of subject, like design and technology and ICT, within E-bac subjects, you might somehow be very much encouraging some schools to focus on those core E-bac subjects to the detriment of other things?

Matthew Hancock: We are clear in the accountability systems that have been put in place—they were revised yesterday—that alongside a rigorous core the value of such qualifications and the ones in development are held in the same esteem. The system is designed specifically to make sure that high-quality and stretching qualifications in engineering are recognised. The critical point is this. They have to

be high quality and stretching. There is no point in recognising poor-quality vocational or engineering qualifications and then trying to argue that they ought to be held on a par. The route to having vocational qualifications across the piece, including engineering qualifications, held in the same esteem as core subjects such as English, maths and the three sciences, is to make sure that they are high quality and stretching. That is what we are trying to do.

Elizabeth Truss: It is very important to employers to see students who understand the underlying principles of what they are doing, who get the basics. So much of the work that we are doing in revising the curriculum for primary education is making sure that students have a good knowledge of multiplication, ratios, logical structures, arithmetic. All those things underlie structures that will be developed to learn things such as computer programming. Coding and computer programming derive from mathematics and, likewise, advanced physics needs a strong basis of mathematics underneath. It is important that students have that ability, that fluency in mathematics. Then they can go on to do things such as programming a computer or develop their work in physics. Yes, those things are important, particularly later in a school career, but we need to get the basics right. Too many students are leaving school without the basics. If you look at the UK's performance in the PISA tests, we are 28th for mathematics and we have the smallest proportion of students studying maths from 16 to 18. Until we get the underlying structure, and the language that engineers and computers programmers use, we are not going to be able to achieve those higher-level skills. It is very important to get the focus right and to make sure that students are fluent in those things. Then, absolutely, these are the careers of the future, which we should be encouraging more people to go into.

Q196 Caroline Dinenege: Finally, with regard to the introduction of the EBC qualifications, are you confident that enough evidence has already been gathered, and is continuing to be gathered, to back up the decision to replace GCSEs in 2017?

Elizabeth Truss: Yes. There were various issues with GCSEs, and I have been working on the development of the curriculum—and, together with Ofqual, on the development of the EBC criteria. We have been meeting experts in areas like physics and mathematics, and other organisations, to develop programmes of study, to make sure that they will prepare students for what we need them to know now, and what we need them to be able to do now. We will shortly be releasing those curricula. It is very important that we are enabling students, as well as to process the information correctly, to think about these subjects. That is one of the things that we are focusing on in the development of the EBC. We are actually testing students on their ability to solve problems and think, which is critical to the kind of skills that you need in engineering.

We are undertaking a wide range of reforms to the primary school curriculum, to make sure that students are fluent, particularly in mathematics and the basics. When they reach secondary school, we are raising the

level of our curriculum to compete with the best curricula in the high-performing jurisdictions, and we are looking at leading examples across the world, at countries that have been very successful and countries that have transformed their systems—countries such as Germany and Poland, that have succeeded in improving their results in the PISA league tables. We are looking at all that international evidence.

Another key focus is on improving the participation of students in maths from 16 to 18. Currently, we have the smallest proportion of students studying maths from 16 to 18 in the OECD. That has a massive knock-on effect for engineering. UCAS has certainly given evidence, and ACME has suggested that, in terms of the number of students having maths for appropriate university courses, we are approximately 200,000 students short. We are trying to develop mid-level qualifications. For students who may achieve a B or a C grade at GCSE, who do not necessarily want to go on and do A-level maths, there is an option that they can keep their mathematics going and learn new and appropriate skills. We have commissioned MEI and Professor Tim Gowers from the university of Cambridge to develop a mid-level qualification in mathematics, specifically with the idea of driving up participation. I have been talking to university groups such as Universities UK about how that might work in terms of the subjects that they are asking students to have. It is very important that we develop that level from 16 to 18, because it is a big missing part in our jigsaw, not just in terms of getting the right students in to study those subjects at university, but making sure that the next generation of primary school teachers have that extra level of mathematics that they can then feed into their teaching, improving the system overall.

Q197 Chair: I am very tempted to ask whether you could answer the questions that Tim Gowers set in *The Sunday Times* three weeks ago, but that would be very unfair.

Matthew Hancock: She has already done it.

Elizabeth Truss: I have to praise Matt here. I asked him one of the questions—Tim Gower’s question about the airport travelator—and Matt was able to answer it straight off. He passed the test with flying colours.

Q198 Graham Stringer: Do you accept that it was a mistake to downgrade the Engineering Diploma in 2010?

Matthew Hancock: I would not describe it as being downgraded. The system was brought in with the overall goal of ensuring that valuable and high-quality vocational qualifications were recognised as such. One of the rules within that system to make it work was that each qualification could count for no more in terms of equivalence than one GCSE. I know that a strong argument was made that the Principal Learning component and the Engineering Diploma should count for more. When I arrived in this job in early September, one of the first things that I did was to get on the phone to the Royal Academy of Engineering and talk about bringing in what look likely to be four separate qualifications that both fit within the

accountability structure and are rigorous and employer led. They will be within the structures as designed, and also do the job of providing engineering qualifications that employers like, and which are rigorous and of high quality.

Q199 Graham Stringer: I am surprised that you do not accept that it was a mistake. It certainly sent out a signal to schools that if they wanted to be higher in the league tables, this was not something that they should be teaching. We heard from the Royal Academy this morning that there has been a flight from engineering courses over that period, and it took George Osborne to announce earlier this month that there would be a reworking of an engineering scheme by the Royal Academy. I do not know what your definition of a mistake is, but if you had a system that was attracting more students, you changed the system so that students were not doing that subject, and then asked for a reworking of it so that you could attract more students, that seems very much like a mistake to me.

Matthew Hancock: I would say that, for the double GCSE in engineering, numbers went up. If you look at the total number of those studying engineering at 14 to 16, there was not the broad decline that you described.

Q200 Graham Stringer: There was a decline in people doing the Engineering Diploma.

Matthew Hancock: My point is that there was not a broad decline in the number of people doing engineering at 14 to 16. Crucially, the accountability structures were brought in for a good reason. It was to make sure that vocational qualifications that are stretching and of high quality are recognised appropriately, and that others that are not, are not recognised in the same way. As I said, one of the things that I have been doing over the past couple of months has been working with the RAE, which led to the announcement that you referred to. I think that that sends an extremely strong signal about both the value that we attach to engineering and the fact that we are going to make sure that we have qualifications that are rigorous and of high quality at the same time.

Q201 Graham Stringer: When do you expect the new diploma to be available?

Matthew Hancock: It won’t be a diploma. It will be four separate qualifications. That, by the way, also increases the flexibility of being able to deliver it. I certainly hope that it is recognised in the list for this time next year. Yesterday, we published the list of recognised 14-to-16 vocational qualifications for the second year running. I certainly hope that they will be in next year, subject to Ofqual signing off the qualifications course.

Q202 Graham Stringer: When you say next year, do you mean the academic year 2013–14?

Matthew Hancock: I hope that the sign-off will be in November 2013, to be taught from the following year.

Q203 Graham Stringer: You don’t think it a mistake, but what message do you think has been sent

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out by those changes in the importance of engineering and vocational education?

Matthew Hancock: I think that the message that we are developing, with the RAE, a high-quality set of qualifications—within the accountability structures that ensure that vocational qualifications are rightly regarded as high-quality, because we recognise the ones that are stretching and high-quality—is a positive message. Certainly, the feedback that I have had since we launched these qualifications has been extremely positive.

Q204 Stephen Mosley: I want to move on to university technical colleges. We now have five open. Three opened in September this year, and two were opened previously. We had Carole Willis speaking to us earlier, and she said that you have not yet been able to do a full assessment of how effective those UTCs are. If you have not been able to do that assessment, how are you learning the lessons for the proposal to open another—is it 24 by 2014 and 34 in total?

Matthew Hancock: There was a goal set out for 24, but there are now 28 in the pipeline in addition to the five that are already open. Of course, it is early days. The evidence from the JCB UTC is very strong. In engineering, it got an extremely high pass mark—unsurpassable, you might say. Also, the news on the engagement with employers and the destinations of its students is terrific. There were several students who had turned down university places in order to take higher-level apprenticeships with JCB and others. In terms of raising the lustre and getting kids into engineering and STEM careers, the first one has been a great success.

Q205 Chair: I went to the JCB academy. It was very impressive—an extraordinary place. We had the head teacher and a young witness here at our last session, and their responses on the Engineering Diploma were exactly opposite to what you have just said to Mr Stringer.

Matthew Hancock: When was that? Was that before or after the announcement?

Q206 Chair: It was about two weeks ago.

Matthew Hancock: Well, the new qualifications are being developed in order to fit into the new accountability structures. There are 28 UTCs in the pipeline. Of course we will keep measuring their success as they come along, but it takes quite a long time to get measures of success. You have to wait to get a full measure of success, because you have to wait for children to go through, but you have to look at all the indicators that you can. We are keeping a very close eye on them, but so far the feedback has been extremely positive.

Q207 Stephen Mosley: Jim Wade, the principal of the JCB academy, is obviously very supportive of UTCs. However, one concern that he did express was that there might be an aiming for targets, in terms of how many of these things are to open, rather than focusing on the quality of them when you open them. Do you have any concerns about that?

Matthew Hancock: No, I do not. The proof of the pudding is in the eating, in that a target was set for 24 and the funding was put aside, but we now have 28 in the pipeline, as well as the five already open. It is because it has been a very successful policy that we have gone further than the number originally set out. That shows that there were more high-quality applications than we were expecting and that we had set as a target, so I am not worried at all about having to sign off on UTC applications because we have to hit a target. On the contrary, it already looks as if we are going to go over it.

Q208 Stephen Mosley: We had a head teacher from Newstead Wood school, a specialist science school. Her concern was that you are focusing a lot of effort on these UTCs—which is great—but she wanted to make sure that you did not forget about the vast mainstream of schools that are teaching engineering and sciences. Are you able to give any reassurance?

Matthew Hancock: Absolutely. We are not forgetting any schools. There is a reform programme across our schools, obviously in terms of new entrants such as UTCs and free schools, but also in terms of strengthening the governance of existing schools through the converter academy process, and then on the curriculum and on making sure that we intervene in schools appropriately when they are not succeeding. That means the tough Ofsted regime, and especially the toughening of what used to be called the “satisfactory” rating, which was anything but. So there is a whole range of things that we are doing, to focus both on getting more good school places and also on improving the places that we’ve already got.

Elizabeth Truss: On encouraging a diversity of provision, one of the other things we are doing is working on the idea of maths free schools, particularly for 16 to 18-year-olds. We have some free schools opening that are specialising in maths and science, such as the Sir Isaac Newton free school in Norwich, which is going to offer an education where all students are doing core maths and sciences. We are also working with universities on maths free schools, to make sure that more students have the opportunity to get up to that really high level in maths and science to get places at top universities. One of the other things, alongside the programme that we are developing for a new course for 16 to 18-year-olds, is that we also have Cambridge university working on developing the curriculum to deepen what we are doing for 16 to 8-year-olds and providing additional material. That is another way in which we are broadening out the curriculum, so that more students are getting that experience of high-level mathematics.

Q209 Jim Dowd: These questions are for you, Mr Hancock. They are about careers advice on engineering. Over the past few weeks, we have received a number of submissions on its perceived quality, and they range, at one end, from virtually non-existent, up to the high end of woefully inadequate. Indeed, barely 30 minutes ago your own chief scientific adviser said that engineering was never mentioned to her as a possible option when she was going through secondary education. What is your

attitude towards the standard of careers advice on engineering generally?

Matthew Hancock: My attitude towards careers advice across the piece, which certainly applies to engineering, is that it should come from a multitude of different sources—it does anyway, of whatever quality—and it should be about inspiring and motivating young adults into what they might want to do, and making sure that they have good high-quality information. That is a big task. Schools have the duty to provide independent and impartial advice. That is relatively new. The guidance is very clear that schools should be encouraging all sorts of advice. One of the best things that engineering companies can do, for instance, is to engage with schools, going in to advise and inspire young people into going into engineering and showing them what is available.

For instance, I was in Tipton academy yesterday. It was set up by the RSA, and it does the international baccalaureate. It also, unusually, does the international baccalaureate careers-related certificate, which combines two IB sections with vocational skills, and also employer engagement. There are kids on that programme who spend a serious amount of time going to local employers and local engineers in order to find out how the work that they are doing in school works on the ground in a real company, and being set real problems. The motivation that comes from that engagement between employers and schoolchildren, especially in a subject like engineering, which to a degree is hands on, where you can see the practical consequences of the work that you are doing, is really powerful.

Q210 Chair: Before you move on, may I ask whether you are going to design into the curriculum enough space and time for teachers to engage in continuous professional development? One of the problems is that many teachers, although they may be inspiring—they may have inspired you to do economics and philosophy respectively—perhaps do not have a full understanding of today's engineering.

Matthew Hancock: I quite agree. Some do; let us not tar everybody with the same brush.

Q211 Chair: It is not about tarring them. Let me be clear: I am not criticising teachers. I am criticising a system that does not provide sufficient space for continuous professional development.

Matthew Hancock: Of course teachers are one source of advice, but my argument is that the implementation of the duty to provide impartial and independent advice is about getting all sorts of people into schools, whether they are teachers or local employers—or, indeed, national employers. Our employers, and especially our engineers, can play a big part, and many of them already do. For instance, STEMNET's STEM ambassadors are going into schools and not only providing advice directly but being a source of logistical support. Going to schools is not part of a company's core purpose, and we should make it easier. That is something that the STEM network does, and it is a really positive step.

Elizabeth Truss: I want to follow up on your point about flexibility in the curriculum. The new

curriculum that we are designing is less prescriptive, so it will give more room for teachers to have the flexibility in how they teach the subjects, to make sure that those subjects are as inspiring and motivational as possible, but will also give teachers the time for things such as professional development. That is part of what we are working on in terms of the design of the new curriculum.

I want to add another point. If you look at the curriculum structure in this country compared to countries such as Germany or Canada, in other countries there is generally a core specified for longer. Traditionally, we have had a relatively narrow core in terms of what we specify to 16, and what we specify to 18. That has meant that students have inadvertently closed the door to particular options fairly early in their school career in subjects such as physics and maths, in the 16-to-18 age group. One of the things that we are seeking to do through the English baccalaureate, as well as reforms to 16-to-18 education, is to encourage students to keep their options open for longer, and to keep studying those subjects. It is often difficult to decide at the age of 14 what future job you want to have. We need to allow students space to think and time to develop what they are interested in and what they do. Too often in the past, students have closed the door early to subjects like physics, which then precludes them from taking engineering later in their school and university career.

Q212 Jim Dowd: I accept the point you make, Mr Hancock, that there are pinpricks of light out there—but the unanimous view that we have received is that there is an overwhelming gloom surrounding careers advice and promoting engineering. Do you think that that could be addressed by a more centralised approach, or are you happy to leave the matter to be locally ignored, as it is at the moment?

Matthew Hancock: We have a centralised duty. That is new, and it needs to be implemented properly. I would urge you to look at some of the evidence on the ground. The Gazelle group of FE colleges is an amalgamation of about 30 FE colleges that all get enterprise, entrepreneurs and local employers into college. They are extremely go-getting and positive about using the curriculum in order to get real-life work experience into what happens in college. The best FE colleges are brilliant at doing this. If you go to, say, the North Hertfordshire college in Stevenage, it works very closely with local employers. In fact, it has a learning company within the college, and the students can plug into that to start their own businesses off the backbone within the college, so it is easy to do it and it gives them space. It is a bit like a mini-Stanford. This is an FE college, and it is a really good example. I come across examples like that in my travels around academies, schools and FE colleges across the country. We need to make that much more widespread, and we need to use the new duty to advise to drive it through, but we should not see it as trying to provide a single point of advice to individuals. Far better is a multiplicity of advice, especially given by inspiring people who can really motivate, because they are doing it themselves.

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I would also add that, of course, apprenticeships are crucial to this. The new destination data being published by schools and FE colleges will include, for the first time, the proportion of students going into apprenticeships, as well as to university. This is really important. We are putting the publication on a level playing field across institutions, between schools and FE colleges, to make sure that people can see—

Q213 Jim Dowd: This is as between degree courses and higher apprenticeships?

Matthew Hancock: Apprenticeships at whatever level and degree courses. Of course, apprenticeships are work experience and a job at the same time. That is the essence of them, and the evidence shows that in many cases higher apprenticeships lead to a value added, over somebody's lifetime, even greater than the value added of going to university.

Q214 Jim Dowd: The sainted Mr Jim Wade of the JCB UCT said to us that he thought that there was a perverse incentive to keep young people on at sixth form so that they would do degree courses, rather than sending them to higher apprenticeships, because although they are of equivalent merit they are not regarded in that way in the calculation of school attainment and league tables. Are you saying that that problem is being addressed?

Matthew Hancock: I am. The new destination data, which was introduced this summer, will publish the destinations both of those who go to university and the proportion who go into apprenticeships. It is a major step forward.

Q215 Stephen Mosley: We have had some fantastic news on increasing apprenticeship numbers over the past two or three years, which is great. However, we have seen some evidence from the Royal Academy of Engineering that those increases in apprenticeships in general mask a decline in the number of apprenticeships in engineering and construction. Do you recognise that as a problem?

Matthew Hancock: We need to do everything we can to encourage apprenticeships in those areas. The number of apprenticeship starts in engineering and manufacturing has gone from 38,000 to 49,000—I shall get you the years for those figures—but I acknowledge that there is more to do. For instance, we have introduced a £25 million higher apprenticeship fund. We need to encourage the design of more higher apprenticeship qualifications, and these are best designed in strong collaboration with employers, and being employer led. I hope that companies will take up the challenge, and the funding is there to help them develop. For instance, they are being developed in space technology and environmental engineering and that sort of cutting-edge apprenticeship. We also have Doug Richard's report on the future of apprenticeships coming out before Christmas, and I expect that that will have a lot to say on this subject.

Q216 Stephen Mosley: Will it say things about engineering and construction specifically, rather than just the general issues?

Matthew Hancock: I expect it to be a wide-ranging report.

Those figures were 37,860 engineering and maths apprenticeships in 2009–10 and 48,970 engineering and manufacturing apprenticeships in 2010–11.

Q217 Stephen Mosley: I thank you for those figures, but they contradict what we have been told previously. That will be quite useful in our report.

Matthew Hancock: I am very happy to write to you with a more detailed breakdown of those figures.

Q218 Chair: But there has been a fall in engineering and construction apprenticeships.

Matthew Hancock: It is important to separate the two. As we know, across the economy the construction sector has not done very well recently. It is crucial that an apprenticeship has a job attached to it, because otherwise it is off-the-job training.

Q219 Chair: You can do something about that. My FE college, which was built a few years ago, is a rather splendid one that is doing fantastic work in partnership with local employers.

Stephen Mosley: Is that West Cheshire college? It has a great computing course.

Chair: The college, when it offered the contract out for tender, required contractors to provide a specified number of apprenticeships. As a procurer, the Government could do an awful lot more to incentivise in areas like construction. What are you doing about that?

Matthew Hancock: We have a pilot.

Q220 Chair: We've done it. You don't need a pilot. Just follow what we have done.

Matthew Hancock: There you are. The DWP is piloting this approach, and in its standard contract it has a schedule along those lines. I am looking with an eagle eye on the success of that, and especially on its implications for value for money. Of course, procurement has to be good value for money, too.

Q221 Graham Stringer: Why is the requirement for pupils to do a standard amount of work experience at key stage 4 being removed? I know that it is part of the Wolf recommendations, but beyond the fact that it is a recommendation, what are the deep underlying reasons for that?

Matthew Hancock: As you know, Professor Wolf is very keen to ensure that, within the occupational space, the experience of school is relevant to employers. In fact, the study programmes that we are introducing from 16 to 18 require work experience. The problem with the 14-to-16 requirement is that it was extremely highly specified, and it did not always work. In many cases, it led to people doing work experience-like activity, but the problem with that is that there is nothing like work experience except work experience. The way that it was designed was complicated and top-down, and it led to a poor-quality experience. Instead, we have freed up the curriculum to make sure that there is the flexibility to provide it. For 16 to 19-year-olds, we are requiring it as part of the programmes of study.

Q222 Graham Stringer: Do you have any idea how many schools have now cut back on work experience opportunities?

Matthew Hancock: I do not have those figures to hand. I am happy to write if we have them, but I would say in answering the question that we have to recognise the difference between genuine work experience, where the employer is engaged and the pupil is engaged, and something that is delivered in order to hit a top-down specification of what work experience looks like from a desk in Whitehall.

Q223 Chair: I have a question for you, Ms Truss, about the primary sector. A couple of years ago, the Royal Society of Chemistry and the Chemical Industries Association produced a DVD, a training pack, for teachers in the primary sector, to help them explain complex scientific concepts using everyday tools. It was especially targeted at teachers with no science background. Why is that not right at the heart of what the Department is doing?

Elizabeth Truss: I would say that it is. We are working on the new primary science curriculum, which is going to be released early next year. One of the things that we are specifically looking at is how to enable teachers in schools to access exciting materials that help to bring the subject to life for primary school children. Absolutely, we are talking to the Royal Society of Chemistry, which you mentioned, and other organisations precisely about those kinds of materials and opportunities, to help teachers who may not have a background in the subject to teach that subject. We are also keen to recruit more specialist teachers into primary school, and we are particularly rewarding teachers of maths, because the demand in the maths curriculum will increase in line with the experience in top-performing international jurisdictions. We are rewarding teachers who have A-level maths to come into primary school teaching. We are very much engaging with organisations that lead in the teaching and understanding of subjects such as chemistry and physics, and making sure that primary schools are able to access those materials more easily.

I believe that we have a massive opportunity with this new curriculum, because when previous curricula were introduced, schools did not have access to high-speed broadband and thus opportunities to access materials not just from the UK but from some of the leading institutions, universities and societies around the world. There is a real opportunity for primary school teachers to take those materials into the classroom and to get children inspired very young. We talked earlier about programming and getting children coding from an early age in primary school, but we also want to get them involved in those kinds of practical science.

Q224 Chair: That leads me to my final question. As you are both here, can you tell us what discussions the two of you have had about one of our previous reports, when we looked at astronomy and the problems of continuing the National Schools' Observatory, which needs engagement between the research councils and education? You two are the bridge between those two areas, and areas like that

where kids really get inspired by using modern technology to access facilities that are literally in the mid-Atlantic. What are you doing to make sure that that is an integral part of the tools available to the primary and secondary sectors?

Matthew Hancock: That sort of thing is vital. I well remember visiting Jodrell Bank as a youngster, and the inspiration that it gave me. Jodrell Bank is a little bit closer to where I grew up in Cheshire than the mid-Atlantic.

Q225 Chair: You went and did economics, for goodness' sake!

Matthew Hancock: I also worked briefly at the particle accelerator at Daresbury, which was very exciting.

May I add a point to my previous answer on new technologies in primary schools? This is a really important point throughout the curriculum. Freeing up the curriculum at all ages allows innovation, and there are huge innovations going on at the moment. India needs to train in basic English and maths half a billion people over the next 10 years. They are thinking really hard about how best to teach people when they have to get up to speed that quickly on that scale. We are already seeing the use of IT in teaching in American universities, with lecture series by the top professors being put online. In the States this is happening at a pace at university level. In emerging and fast-growing countries like India, it is happening in the skills sector at a huge pace. Across the country, here, we need to learn the lessons not only in primary schools but in post-16 education, for which I am responsible.

On the question that you actually asked, obviously the bridge between DFE and BIS is not yet built, but the buildings are very close together.

Elizabeth Truss: It is a virtual bridge.

Matthew Hancock: That is what we spend our time on.

Elizabeth Truss: Matt and I have a lot of conversations about various aspects of the curriculum, and we are developing things like the programme for 16 to 18-year-olds very closely together. Matt spends a lot of time in the Department for Education. Our offices are closely situated—

Matthew Hancock: And we have neighbouring constituencies.

Elizabeth Truss: There is no shortage of interaction between us on all these critical matters.

Q226 Chair: Let me ask the question again. Can we tell the Royal Astronomical Society that you two are going to solve that problem?

Matthew Hancock: We are certainly going to look into it, and work towards—

Elizabeth Truss: In a seamless fashion.

Q227 Chair: You recognise, don't you, that that making that kind of tool available to schools—

Elizabeth Truss: That is what we want. We absolutely want more of those things in schools.

Chair: I am optimistic in looking forward to a

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solution to the problem. Thank you very much for
your attendance this morning.

Written evidence

Written evidence submitted by the Department for Education (DfE) with a contribution from the Department of Business, Innovation and Skills (BIS)

SUMMARY

1. This submission sets out how Government policy supports the development of engineering skills and benefits the engineering industry. It explains how current educational reforms will ensure that more young people leave school with a more rigorous grounding in mathematics and the sciences, create a more educated society in which pupils are able to excel whatever their background and bring benefits both directly and indirectly to engineering.

Reforming the Education system

2. The Government's educational reforms are designed to secure more rigorous academic achievement and to put in place an assessment system which engineering employers will understand and have confidence in. We are revising the National Curriculum to be slimmer and more challenging and which is comparable with those of the highest-performing countries in the world. It will focus more sharply on the core essential knowledge that matters, and leave room for additional subjects and courses without sacrificing academic rigour in the traditional subjects. We expect the next generation of pupils to leave school with a better command of language, literacy and general knowledge, and a stronger understanding of mathematics and science.

3. In launching the new National Curriculum, we have already reaffirmed the primacy of the core subjects of English, mathematics and science throughout primary and secondary education. We have released new draft primary programmes of study for English, mathematics and science in advance of a formal public consultation later in the year. These set out a more systematic approach which supports better subject progression. Along with these new programmes of study, we intend to revise the assessment system to set out our high expectations of achievement in core subjects and to be more transparent.

4. At secondary school, we have equally high expectations of teaching in the key subjects of English, mathematics and science. The English Baccalaureate (EBacc), which was introduced in 2010, recognises the achievement of pupils who have attained a grade C or better across a core of academic subjects—English, mathematics, two sciences, geography or history, and a language (modern or ancient). The inclusion of these subjects in the EBacc will ensure that those who achieve this expectation have a wide variety of options for further study and employment, including in engineering. In addition to complementing high quality technical education by enabling students to study relevant subjects alongside it to the age of 16, the EBacc also provides a firm basis for a wide range of technical routes post-16.

5. It is encouraging that there is continued growth in the number of pupils taking GCSE triple science—from 43,014 pupils in 2004 to 134,998 in 2011. We are, however, concerned that GCSEs have failed to keep pace with the standards expected by our international competitors. Qualification reform is therefore necessary to ensure our examinations are recognised as being on a par with those in the highest performing jurisdictions.

6. In 2010 the Government commissioned Professor Alison Wolf of King's College London to carry out an independent review of vocational education. Her review confirmed the importance of a thorough grounding in English and mathematics for equipping young people with the skills and knowledge employers need. In future, therefore, we will expect young people who have *not* achieved at least a GCSE grade C in English and mathematics by age 16 to continue to study those subjects post-16. We are also looking at how we might encourage more successful pupils to continue to study mathematics post-16, given that many employers and universities expect students to have high levels of mathematical knowledge to complete their courses in related subjects, such as engineering, analytical professions and the sciences.

7. The Government is also encouraging more students to study qualifications such as A level Physics and A level Further Mathematics which enhance their prospects of studying and doing well in engineering related subjects at university. This includes the expansion of the work of the Stimulating Physics Network and the Further Maths Support Programme (delivered by the Institute of Physics and Mathematics in Education respectively) so that they reach more schools and widen participation in these subjects especially among under-represented groups such as girls and those living in disadvantaged areas.

Ensuring a skilled teaching workforce

8. We are improving the quality of teaching by reforming and modernising initial teacher training and in-service professional development of teachers. The development of Teaching Schools will produce a supply of high quality and technically competent teachers, enabling the best schools to challenge and support the others. This support will extend beyond a good induction to the profession; Teaching Schools will also enable existing teachers and managers to update their knowledge and sharpen their leadership skills. There will be 500 Teaching Schools by 2014, many of which will lead on science and mathematics.

9. The Government's plan to improve Initial Teacher Training published in November 2011 focuses on the recruitment of high quality science and mathematics teachers. We have introduced bursaries of up to £20,000

to attract the best graduates in physics, chemistry and mathematics into teaching. In addition, we are refocusing generalist ITT science courses onto the specialisms of physics, chemistry and biology, and working with the Institute of Physics (IoP) to support a teacher training scholarship) worth £20,000, and a pilot ITT course in physics and maths.

10. The Department for Education is allocating up to £135 million over the current spending review period to improve science and mathematics education. This funding is primarily focused on improving the quality of teaching by providing professional development opportunities for science teachers and technicians through the network of science learning centres and increasing accessibility to good quality professional development opportunities for mathematics teachers.

Reforming vocational education

11. The reforms set out above will raise standards in English, maths and science which are the bedrock of success in any further study or training. The Government is also reforming vocational education to improve its quality and rigour and to provide young people and employers with the skills they need.

12. Professor Wolf's Review of vocational education made a number of recommendations for improving vocational education for young people. The Government has accepted all of Professor Wolf's recommendations and is taking forward a programme of work to implement them. Two of the findings were that most young people need a foundation in academic subjects on which to build their vocational education, and that too often vocational qualifications were being used by schools as alternatives to core subjects regardless of their value to pupils or employers. Professor Wolf saw employers themselves leading the way to provide qualifications which reflect the true needs of their industries. There will be some young people who want to specialise before the age of 16 and who wish to take vocational qualifications alongside GCSEs in English, mathematics and science. The Government's task will be to encourage industry to collaborate to create the kind of training these young people need to be successful in their chosen field.

13. In order to strengthen the quality and credibility of vocational education in general, we have reformed the school performance tables to give appropriate recognition to a range of vocational qualifications, but removed false equivalences between them and the traditional academic subjects. It is important for the future that engineering (among other industries) can confidently identify specific qualifications that are designed to meet the needs of industry. One indicator of the success of vocational qualifications will be how well they support young people in finding employment.

14. Following the reforms, there are 140 high quality qualifications which will count as equivalent to one GCSE in the 2014 Key Stage 4 performance tables. Of these, nine are in engineering. These include the two "Principal Learning in Engineering" qualifications at levels 1 and 2 which represent the core of the current Engineering Diploma.

15. At a roundtable meeting convened by the Department of Business, Innovation and Skills on 8 May and chaired by John Hayes in his role as Minister for Skills in both DfE and BIS, engineering organisations agreed with awarding bodies to develop new qualifications that reflect the quality and attractiveness of the Engineering Diploma and its Principal Learning component. Work on these new qualifications is already underway, involving the Royal Academy of Engineering, employers, University Technical Colleges and awarding organisations.

Diversification and autonomy in the education system

16. The growth of University Technical Colleges (UTCs), studio schools and free schools support the Government's aim for greater choice, autonomy and flexibility in how pupils are educated. University Technical Colleges are being developed in partnership with universities and employers. The specialism of each UTC is based on demand from industry in the local area with employer sponsors contributing to the design of the curriculum. Up to Key Stage 4, a broad and balanced academic curriculum is taught 60% of the time and 40% of the time is allocated to the technical specialism(s). Beyond 16, it is the reverse, with young people spending the majority of their time focusing on technical education. The Government is on target to deliver its commitment to have at least 24 UTCs open by September 2014; there are currently two open with a further 32 in the pipeline. Nearly 300 companies representing a variety of sectors (including construction, advanced manufacturing and various forms of engineering) are already involved in sponsoring or partnering UTCs.

17. Studio Schools will allow young people to prepare for work while gaining core qualifications. Studio Schools will work in partnership with a wide range of employers (including engineering organisations) and provide school leavers with hands-on experience of the workplace alongside study, and access to the qualifications which students need for employment, further education or university. These could be GCSEs, A Levels, BTECs or NVQs. We expect that Studio Schools will help to meet demand from employers for workplace skills.

18. The Government also intends to set up a number of specialist mathematics free schools for 16–18 year olds. These schools will be supported by strong university mathematics departments. Under their leadership, these schools will provide the most able students with the best possible preparation for further study in mathematics and related disciplines.

Improving the quality of apprenticeships and supporting employers

19. The number of Apprenticeship starts in Engineering and manufacturing technologies increased from 37,860 in 2009–10 to 48,970 in 2010–11. In April 2012 the Government introduced incentive payments of £1,500 for small employers to take on their first apprentice aged 16–24. The total number of incentive places available in 2012–13 is 40,000. We are also improving the support that the National Apprenticeship Service provides to Small and Medium sized Enterprises (SMEs) to ensure that this is tailored to the needs of these businesses.

20. It is important that apprenticeships meet the needs of the changing economy and deliver required qualifications and skills including for the engineering sector. The Government has asked Doug Richard (founder of School for Startups) to undertake a review of apprenticeships in England to ensure that the future needs of the economy are met effectively. The Review will examine how to build upon the achievements of apprenticeships in recent years and consider what the core components of an apprenticeship should be in order to meet the needs of employers (large and small), individuals, and the wider economy. It will also examine whether the qualifications undertaken as part of an apprenticeship are sufficiently rigorous, and valued by employers. The report is due to be published in autumn 2012.

21. The Employer Ownership pilot offers all employers in England direct access to up to £250 million of public funds over the next two years to design and deliver their own training solutions. Through the pilot, employers will be able to develop training solutions to help them develop high level technical skills including for the engineering sector. Some applicants are looking to design a coordinated approach providing education and training both on site and in colleges and other training providers to speed up the process of training qualified people.

June 2012

Written evidence submitted by the National Grid

1. SUMMARY

1.1 Engineering is at the heart of National Grid's business. As we transition to a low carbon economy the need for people with engineering skills to develop, deliver and utilise new technology is becoming more acute. This need is shared across the UK and global energy industry. In response we are investing significant resource to address skills issues and playing an active role through engagement with schools in encouraging young people to consider careers in engineering.

1.2 There is need for a strong Science, Technology, Engineering and Mathematics (STEM) skill base foundation in schools, colleges and universities. Like many engineering companies, National Grid has a strong need for skills ranging between Level 2 and graduate level. We see many examples of good practice in engineering education, but we are concerned that there is not sufficient "strength in depth" in the UK's STEM skill base.

1.3 We note that work experience for Key Stage 4 (pre 16) students is no longer a requirement of schools. We would encourage policymakers to ensure that pre-16 students do get opportunities to see industry at first hand—particularly STEM-based occupations—in order to ensure that students form an accurate picture of careers like engineering, ahead of making A Level and/or other post 16 choices.

1.4 We are concerned that a decision was taken to equate the Engineering Diploma Principal Learning with just one GCSE. In our view the Diploma was one of the better engineering qualifications and when well taught alongside mathematics and science, is a good foundation for entry into employment, or progression to engineering courses in FE or HE. Looking ahead we are concerned that the Engineering Diploma will become a less attractive qualification to schools as the course requires time equivalent to several GCSEs but will only count as "one" success in performance tables.

1.5 National Grid is a strong supporter of the University Technical College movement. We want these schools to develop innovative technical curricula and to set a standard in technical education that will help all schools to improve. As exemplars they are important and we welcome the Government's investment in them.

2. ABOUT US

2.1 National Grid owns and manages the grids to which many different energy sources are connected. In Britain we run systems that deliver gas and electricity across the entire country. In the North East US, we provide power directly to millions of customers. We hold a vital position at the centre of the energy system. We join everything up.

2.2 That puts National Grid at the heart of one of the greatest challenges facing our society; supporting the creation of new sustainable energy solutions for the future and developing an energy system that can underpin our economic prosperity in the 21st century. First and foremost this is a scientific and engineering challenge. Decisions around the future of our energy infrastructure—it's cost, local impacts, objectives and risks—will of course involve most of society, but whatever the energy policy choices we make, we will be dependent on

engineering skills to implement them. Engineering education is therefore an issue of strategic national importance, and something National Grid continues to invest and involve itself in.

3. NATIONAL GRID'S INVESTMENT IN UK ENGINEERING SKILLS

3.1 Engineering is the creative and practical application of science and mathematics, and is increasingly vital, both to support the Government's policy of re-balancing the economy and as a pre-requisite for modernising the nation's infrastructure.

3.2 National Grid takes the skills agenda seriously and a number of senior personnel lead or contribute to external working groups in order to share our thoughts and develop skills policy. The groups we have contributed to include the CBI's education and skills policy group, Royal Academy of Engineering working parties, the IET's Education Policy Panel, the National Skills Academy for Power and Energy and Utility Skills. We liaise with several qualification Awarding Bodies, providing advice and an employer's perspective on curriculum content and qualifications.

3.3 At Board level, National Grid CEO Steve Holliday chairs the Business in the Community Talent and Skills Group and was the inaugural Chair of The National Technician Council, a body designed to promote and recognise the status of technicians, and their essential role in delivering growth and innovation for "UK plc". Nick Winsor, Executive Director, chairs the IET Power Academy.

3.4 National Grid is also providing financial support to the Queen Elizabeth Prize for Engineering to recognise and celebrate the best in engineering achievements, to bring the excitement of modern engineering to the fore and inspire the engineers of tomorrow. The Prize is supported by all of the main political parties.

4. QUESTIONS POSED BY THIS INQUIRY

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

4.1 National Grid is currently recruiting more than 450 people per year with engineering skills, around half of which are trainees entering our apprentice, foundation degree and graduate training schemes. We are able to fill our vacancies currently, but this does not mean that we are generally satisfied with the adequacy of the engineering skill base in the UK. We currently screen some 25,000 applications in order to get some 280 trainees. Our observation is that the number of applicants with the competence and qualities we seek is not appreciably greater than the number we recruit, which implies a significant underlying weakness in supply for the skills we require.

4.2 Generalisation about the weaknesses we see is difficult, but the most common comments from our assessors include lack of required, basic qualifications (eg mathematics and English); lack of evidence of technical skill, particularly technical skill applied in a real, practical situation, and lack of evidence of "employability" skills such as teamworking.

4.3 Our observation is that applicants may have formal qualifications, but are unable to evidence the ability to apply knowledge to new situations, or to demonstrate any experience of working with others to solve technical problems. Again, generalisation is difficult, but it seems to us that school and college leavers have often been taught how to pass narrow exams, but have too little ability to "join up" learning from more than one subject area, or to work from first principles to solve a novel problem.

4.4 National Grid also works extensively within schools to help explain and promote engineering as a career choice. Our programs¹ last year allowed us to have meaningful engagements with some 3500 school students and through this work we also gain an insight into the processes and priorities driving education. Our observation is that engineering is seldom taught or represented well in schools, and that this is a direct consequence of the way in which curriculum and qualifications are organised. Very few schools seem to join up the components of engineering, ie mathematics, science (particularly physics) and design/technology. These are usually taught as separate, isolated subjects rather than the complementary disciplines that are required in real-world engineering projects.

4.5 Despite some notable exceptions, it seems to us that where "engineering" does appear on a school timetable, it is too often the fallback option for apparently less able students, more often male, who do not engage well with traditional classroom teaching of mathematics and science. This observation leads us to the second part of the question relating to academic vs vocational approaches.

4.6 Engineering is *both* academic and vocational. Increasingly we require new employees, at all levels, to have a good understanding of the mathematical and scientific principles behind the technology they are working on. It is this basic knowledge that allows new technology to be selected, understood, operated and exploited properly, and for new problems to be solved from first principles if necessary. This learning—usually called "academic"—is often weak in students who opt for "vocational" courses.

¹ We engage with schools via a portfolio of programs, mainly but not exclusively focused on Science Technology Engineering and Mathematics (STEM) activities. We host visits to our sites, run two week-long engineering work experience courses, send ambassadors into schools to give talks and run STEM sessions, and take part in third party schemes such as EDT's Engineering Education Scheme. Further details are at <http://www.nationalgrideducation.com>.

4.7 Of course academic knowledge alone is not enough. There is a large gap between the theory taught to “academic” pupils and practical applications. Bridging that gap requires experience of equipment, tools, testing, instrumentation and the practicalities of safe and economic design and operation.

4.8 For example, consider a technician with the problem of “how can I make this motor run better?” It is useful if he/she starts with an understanding of the basic parameters that determine how a motor works—the academic knowledge that the force developed depends on electrical current flowing, the magnetic field strength inside the machine, and that friction and air resistance detract from performance. He or she might then assess how these parameters could be varied in the situation at hand and then choose an option.

4.9 However, the outcome is likely to be better if he/she also has an appreciation of the practicalities of the tools and test equipment at his/her disposal, how to interpret drawings and data sheets, how to select components from standard ranges, and the likely time and cost of each option. Ideally he/she would also then have the practical skills to carry out some modification. It is this combination of academic understanding and practical application that delivers efficient solutions.

4.10 From our point of view, the distinction between “vocational” and “academic” is almost always unhelpful as it often implies a different standard of attainment: academic is somehow “cleverer”. There may well be a need to distinguish between learning styles to suit different groups of student—some need to learn through a more immediate “hands on” approach—but the distinction should be about the route taken to attaining competence, not the final destination.

4.11 Our comments above relate mainly to the generality of the skills base being laid down in mainstream schools. We do see exceptions, and there are pockets of excellent practice. These are too few though: the average standard, and in our experience the “strength in depth” available, is not what we perceive the economy needs going forward.

4.12 Our observation is that students from college and university have had more opportunities to combine academic and practical work, often through projects required as part of their course. This is valuable and does help them when applying for jobs. Improving the engineering skills base probably requires these approaches to be applied earlier and more widely in a student’s educational journey.

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?

4.13 The impact remains to be seen, but we are concerned that the balance of impacts will be negative.

4.14 We agree with many of the reforms proposed by the Wolf Report, and indeed with many aspects of the Government’s broader education reforms. We want to see schools delivering high standards in mathematics, English and science, and we agree that qualifications that are not respected and valued by industry and/or HE should have no place in schools. We do believe that most students benefit from a broad education, and we recognise the value of an appreciation of languages, geography, history, sport and broader school learning such as PHSE. We would like to see more students studying STEM subjects, but these should be high quality with a balance of academic and practical skills as described above.

4.15 If the impact of some of reforms is to reduce the number of qualifications (but not learners) associated with “engineering”, particularly those lacking a reasonable academic content, then this is welcome. We generally prefer a simple, clear qualifications system with fewer, meaningful qualification titles. The Baker Dearing Trust’s *Respected* document² is a good basis for a new focus on the best engineering qualifications.

4.16 We believe that the decision to equate the Engineering Diploma Principal Learning with just one GCSE was wrong. The Diploma was one of the better engineering qualifications and, when well taught alongside mathematics and science, was a good foundation for entry into employment, or progression to engineering courses in FE or HE.

4.17 Our concern with the decision is twofold: firstly it seems inconceivable that many schools will continue to offer a course that requires time equivalent to several GCSEs but will only count as “one” success in performance tables. Downgrading the Diploma seems likely to eliminate a respected and valued qualification in a subject vital to the nation’s future.

4.18 Secondly, and importantly, we are concerned at the general message this sends about the engineering sector and technical learning. Our observation is that schools’ decisions are driven very heavily by Ofsted frameworks and/or performance tables, both of which are steered by government policy priorities. The Government may intend that schools freely choose curricula and qualifications best suited to their particular students, but in the short run at least, “top down” messages are very significant, and the Government should be seen to be 100% behind engineering education.

4.19 Looking ahead, we urge Government to do more to ensure engineering is represented well in mainstream schools. We would like to see a positive momentum for change, led from the top, similar to that seen with ICT. Government have rightly recognised the weakness of much current ICT provision and the contrast with

² “Respected”, Technical Qualifications for use in University Technical Colleges. Baker-Dearing Education Trust / Edge Foundation / Royal Academy of Engineering, 2011 http://www.utcolleges.org/media/56815/respected_hires%2029.9.11.pdf

the need for more rigorous computer science. Engineering needs similar treatment signalling both its priority and the need for a substantial raising of standards.

4.20 The English Baccalaureate seems to be at best irrelevant to improving the UK's engineering skill base. At worst it may exacerbate negative perceptions of engineering careers (see below) and discourage schools from offering technical subjects such as Design Technology and electronics. We understand the Government's argument that E.Bacc will not be a performance measure and that schools will be free to offer a range of subjects to suit their students' needs. However our observation is that schools' decisions are heavily influenced by top-down signals and we see no merit in risking E.Bacc incentivising a shift away from technical subjects.

Could the Government and others do more to raise the status of technical subjects? What more should be done to attract and retain a more diverse technically skilled workforce?

4.21 We think these two questions are strongly linked.

4.22 Our 2009 Report *Engineering our Future*³ described issues relating to perception of engineering and engineers, and the impact this has on young peoples' career choices. One of the main findings was that young people struggle to visualise themselves as engineers, either because they have no idea what being an engineer involves or, worse, they have an impression that it is a menial job, typically for men in overalls. A particularly worrying finding was that too often teachers are no better informed, and may even reinforce negative stereotypes.

4.23 Raising the status of technical subjects requires effort to change perceptions about where those subjects may lead. If we can do this then technical education becomes inherently worthwhile and appealing to a more diverse range of students.

4.24 We believe the employers have a duty to help schools explain engineering and to show students the positive opportunities that a technical education can open up for them. National Grid does this and we would encourage all STEM-based companies to work more with education.

4.25. Employer engagement with schools is a two way process. We find that most schools are willing in principle to engage with employers, but in practice many do not make the time to do this well. As discussed above, schools focus first and foremost on the priorities set by Ofsted and the performance tables. Allowing opportunities for employers to showcase engineering and technical subjects is not seen as a priority. Government could help by ensuring that curricula and/or Ofsted frameworks do incentivise schools to make the effort needed, for example, to take students on visits to company sites.

4.26 We note that work experience for Key Stage 4 (pre 16) students is no longer a requirement of schools. There may be good pragmatic reasons for this, but we would encourage policymakers to ensure that pre-16 students do get other opportunities to see industry at first hand—particularly STEM-based occupations. Students do not get an accurate picture, a visualisation, from media and popular culture, and poor choices of A levels or other post-16 options can effectively rule out a STEM-based career. Choices at 16 represent the biggest narrowing of the engineering skill base of any stage in a student's educational journey.⁴ It is vital that those choices we well informed and that employers have the opportunity to contribute.

4.27 We are a strong supporter of the University Technical College movement, and have been actively involved with the JCB Academy, Aston University Engineering Academy and the recently-approved Warwick Manufacturing Group (Warwick University) UTC. We want these schools to develop innovative technical curricula and to set a standard in technical education that will help all schools to improve. As exemplars they are important and we welcome the Government's investment in them. However it is the take up and standard of technical education in mainstream schools that will provide the broad foundation for STEM skills that the UK economy needs going forward.

June 2012

Written evidence submitted The JCB Academy

1. As an educational institution we will leave it to others to comment on the needs of employers.

2. RECENT CHANGES

2.1 The removal of the key 14–16 engineering qualification (Higher Diploma in Engineering) from the league tables in any meaningful way has led to a drastic reduction in the number of young people following a technical route pre-16. This by definition will mean a lower take up for this age group.

³ Engineering our Future. Inspiring and Attracting tomorrow's engineers. National Grid, 2009. http://www.nationalgrid.com/NR/rdonlyres/63EF4A6E-C6DB-4D0C-A749-D1500C465B3B/36759/7315_engineeringthefuture_brochure_32_p11.pdf

⁴ Engineering UK (2011), Engineering UK 2011—the state of engineering, Engineering UK http://www.engineeringuk.com/what_we_do/education_&_skills/engineering_uk_11.cfm.

2.2 The move towards a more “classical curriculum” as envisaged with the English Baccalaureate has led to a warping of the courses followed by young people in England. This has seen a move towards English Baccalaureate subjects and a move away from those subjects which have a technical bias.

2.3 It could be argued that the above would not matter if post-16 qualification choices were made as part of a well informed careers and education and guidance process with a full knowledge and understanding on technical careers. However, advice for those wishing to follow technical careers is often limited and ill informed due to the background of those providing the advice. Therefore in this scenario it is very likely that those who are able will make post-16 decisions based upon those areas in which they have achieved success pre-16. In the 14–16 curriculum, making a curriculum choice in a technical field gives a student the option of changing direction at 16 if they find the technical field does not interest them. However, this becomes more difficult for those making a choice 16–18 where such courses tend to lead directly to a vocational career. Given students will have had little experience pre-16 of technical education few will choose this route post-16. Technical education is for able students who will go on to provide the bedrock of a technologically orientated economy of the future. The government changes have made it significantly less likely that these young people will choose technical educational routes into employment

2.4 In addition to the above, the requirements to offer work experience have also been removed. As such, many schools in our local area will not be offering work experience to students from next year. This was often an opportunity for young people to gain an insight into the world of work and see the range of opportunities available. It is our fear that with the significant reduction in work experience placements this will once again reduce the number of young people following technical careers.

2.5 Unfortunately we have a tendency within the English education system to give value to what is measurable and therefore although in theory the change to measure every pre-16 qualification with a value of one makes no difference to the value of the qualification, this is clearly not the case in the eyes of young people or parents. We are continually being asked about the downgrading of the Diploma. The government have chosen to send the clearest and loudest message possible that technical qualifications have little value. Indeed our experience is that parents of students entering the sixth form are also concerned about the value of advanced level qualifications which fall under this heading.

3. Unable to comment as unaware of the policies being followed in Wales, Scotland or Northern Ireland.

4. In our opinion the government could make a significant difference to how technical qualifications are valued by taking positive actions. Given some of the statements above, current actions (intended or otherwise) have led to a situation where technical education has even less status than in the past. This could be addressed by:

- 4.1 Funding technical education at a different rate pre-16 to encourage schools to take up these subjects.
- 4.2 Ensuring the apprentice programme continues to have high status and is not undermined by non-technical apprenticeships in areas such as “customer service”.
- 4.3 Having a policy across government that values skills and ensuring that the messages (words and music) which come out of BIS and the DfE are the same with respect to this issue.

DECLARATION OF INTEREST

The JCB Academy is the first UTC and as such has an interest in both promoting and delivering technical education.

June 2012

Written evidence submitted by The Royal Academy of Engineering (with the National Committee for 14–19 Engineering Education)

ABOUT US

1. Founded in 1976, The Royal Academy of Engineering (the Academy) promotes the engineering and technological welfare of the country. Our fellowship—comprising the UK’s most eminent engineers—provides the leadership and expertise for our activities, which focus on the relationships between engineering, technology, and the quality of life. As a national academy, we provide independent and impartial advice to Government; work to secure the next generation of engineers; and provide a voice for Britain’s engineering community.⁵

2. This submission has been prepared with input from the National Committee for 14–19 Engineering Education (the Committee). The Committee is convened by The Royal Academy of Engineering and has members drawn from more than 50 engineering organisations. These include engineering employers, universities, FE Colleges and training providers, schools, sector skills councils, professional engineering institutions, learned mathematical societies and organisations that promote STEM subjects in schools. The

⁵ www.raeng.org.uk

Committee has its origins in the Engineering Diploma Development Partnership. The 14–19 Diploma in Engineering (now the Principal Learning qualification in Engineering) has strong support from engineering employers, universities, FE Colleges and schools so when the government support for the Diploma Development Partnerships was withdrawn the Committee was convened by the Academy in response to repeated requests from the engineering profession. The Committee is not funded by Government. It operates entirely on voluntary effort and engineering employers have chosen to invest time and effort in it. It is fully independent of any single organisation.

3. The active programme of work in the Committee for nearly two years since its creation is evidence that the engineering profession cares about 14–19 engineering education and is willing to invest time and effort in getting it right. 14–19 engineering education is seen by the engineering profession as an important foundation before progression to engineering Apprenticeship, engineering study and training in the FE & Skills sector and engineering higher education. Together, these provide the engineering skills base for the UK.

DETAILED SUBMISSION

4. The current engineering skills base is complex as engineering skills are deployed in all sectors of the economy; including but not limited to those readily associated with engineering such as manufacturing, energy and utilities, construction, transportation, IT and communications.⁶ Based on a very detailed inspection of the 2011 Labour Force Survey data undertaken by the Academy, there are 730,000 self-declaring “engineers”; 700,000 Level 3+ self-declaring science, engineering, technology (SET) Technicians/Associate Professionals’, 880,000 skilled engineering trades-people. This makes 2.3 million skilled people in the engineering-related skills base—8% of the UK workforce. The engineering workforce is highly productive—producing one fifth of the national GDP and half of UK exports.⁷

5. The engineering skills base is differentiated; it includes engineering post-graduates, graduates, higher intermediate (eg HNC/HND qualified) and professional engineering technicians⁸ (associate professionals and skilled trades).⁹ However, the job roles are not necessarily delimited by qualification—so, for example, in some skilled trades the graduate share of jobs is now as high as 15%—and 27% in some associate professional roles.¹⁰ This may or not reflect requirement of the jobs and may, indeed, be building up further problems for the future as full-time engineering undergraduates are not trained to be productive in these practical and employer-specific commercial roles.¹¹

6. A 15% average wage premium (compared to the labour market as a whole) is paid to people who work in engineering occupations.¹² This is not limited to graduate engineering occupations and additional premia are found for people holding STEM qualifications (generally at Level 3 and 4+) in those occupations. Association with higher wages is evidence that engineering skills are valuable and therefore meet the needs of employers.

7. The existence of a wage premium suggests that the demand for engineering skills exceeds supply. The engineering workforce is aging¹³ and the median age of registered engineers and engineering technicians is rising each year. In addition there are stark shortages of higher skilled (QCF level 3 and 4) technicians with 450,000 required (mostly in engineering) by 2020¹⁴ and well documented shortages of skilled people a variety of engineering sectors such as computing,¹⁵ power electronics¹⁶ and railway engineering.¹⁷

8. Royal Academy of Engineering calculations, using a combination of UKCES predictions for 2010–20¹⁸ and LFS occupational population data for 2009 suggest 820,000 *SET professionals* will be required by 2020 (80% of these required in engineering). This is based on a 7:1 ratio of replacement demand to expansion demand (reflecting the age profile of engineers in the labour market).

9. Engineering employers value both academic and more vocational routes as exemplified by the engineering professions accreditation of engineering degrees as well as the approval of selected vocational and occupational awards which can contribute towards achieving Technician registration.¹⁹ Additional evidence is found in the active involvement of engineering organisations in 14–19 engineering education in general and its support for

⁶ The distributed nature of engineering (and STEM more generally) skills throughout the UK economy is shown in Fiona Dodd, Jon Guest, Andrew License (2011), *The current and future science workforce*, TBR / Science Council www.sciencecouncil.org/content/science-workforce

⁷ Engineering UK 2011, Engineering UK, 2011

⁸ Definitions of the Level 3+ *Professional* technician are offered by the Technician Council—www.professional-technician.org.uk

⁹ Mason, G. (2012). *Science, Engineering and Technology Technicians in the UK Economy*. London: Gatsby.

¹⁰ Ibid

¹¹ Ibid

¹² Charley Greenwood, Matthew Harrison, Anna Vignoles (2011), *The labour market value of STEM qualifications and occupations*, Institute of Education/Royal Academy of Engineering www.raeng.org.uk/news/releases/shownews.htm?NewsID=701

¹³ Engineering UK (2011), *Engineering UK 2011—the state of engineering*, Engineering UK

¹⁴ Technician Council www.professional-technician.org.uk

¹⁵ NESTA (2011), *The Livingstone and Hope Review, Next Gen. Transforming the UK into the world’s leading talent hub for the video games and visual effects industries*, NESTA

¹⁶ BIS (2011), *Power electronics: a strategy for success, keeping the UK competitive*, BIS

¹⁷ Franklin & Andrews (2008), *Project Brunel, transport industry resources study*, Franklin & Andrews

¹⁸ UKCES *Working futures 2010–20*, UKCES, December 2011.

¹⁹ <http://www.engc.org.uk/education—skills/accreditation/accreditation-and-approval>

the 14–19 Diploma in Engineering (now the Principal Learning qualification in engineering) in particular. This has received much media attention in recent months with the strong endorsement from employers, professional engineering institutions, universities and the Royal Academy of Engineering²⁰ being well known in government. A list of vocational awards in STEM subjects, deemed to be respected by the engineering profession and the STEM community more widely has been published jointly by the Baker-Dearing Educational Trust, the Edge Foundation and the Royal Academy of Engineering.²¹

10. There have been many changes to the schools and college landscape in England in recent months and years that affect the engineering skills base. However, we shall restrict our attention here to: the implementation of the *English Baccalaureate*; changes to the recognition of 14–16 vocational qualifications in school performance tables; changes to the National Curriculum; greater focus on apprenticeships; introduction of University Technical Colleges.

11. As stated in the Committee’s submission to the Education Select Committee inquiry into the English Baccalaureate—The English Baccalaureate does nothing to promote practical and technical experience outside of mathematics and science and as a result does not do enough to support productive industry in the UK, particularly technician routes.

12. The changes to the recognition of 14–16 vocational qualifications implemented recently by the Department of Education do nothing to develop a positive identity for the best vocational qualifications as valuable components in a general and practical education for 14–16 year olds. Whilst the Committee welcomes the fact that the changes now identify a short list of qualifications that meet published criteria for quality and rigour, the fact that each one can only count as “one” in performance tables and that only two vocational qualifications can be counted overall reinforces the popular but misguided impression that vocational qualifications cannot be intrinsically worthwhile. This is a damaging outcome because vocationally-related STEM qualifications, particularly those in engineering, that are vital to UK industry, that provide learners with excellent progression opportunities within and outside of STEM, prepare them properly for future work in vital sectors of the economy and are therefore *valuable*. The changes implemented by the Department for Education over recent months do nothing to encourage uptake of such important qualifications—particularly by pupils also able to attain well in academic qualifications such as those included in the English Baccalaureate.

13. Government needs to ensure and monitor that all young people have the opportunity to choose appropriate vocational qualifications and/or mix vocational qualifications with academic qualifications. This freedom of choice would require that the new Academies and Free schools are incentivised so that they can provide these vocational routes and not simply opt for the English Baccalaureate route for all their students.

14. Technology’ in schools is taken here to represent both Design & Technology and ICT. ICT (and Computing more generally) has moved centre stage over the past few months through a series of events helped by the speech by Eric Schmidt, chairman of Google in August 2011 in which he roundly criticised the UK’s education system and said he was “*flabbergasted to learn that today computer science isn’t even taught as standard in UK schools,*” The speech was widely reported. On 13 January 2012, the Royal Society published the *Shut Down or Restart?* report²² continuing a discussion about computing in school started in the Livingstone & Hope *NextGen* report.²³ Both reports make it clear that the current ICT curriculum in English schools results in a pedestrian approach that overemphasizes mundane learning about IT tools such as word processors, and does not promote the acquisition of the broader computing knowledge and rigorous engineering skills that would keep Britain at the forefront of a global digital economy. In the same week, the Secretary of State for Education, Michael Gove, announced far-reaching changes to the ICT national curriculum, in a speech at BETT²⁴ and subsequently the DfE announced a consultation exercise on the future of the ICT curriculum.²⁵ On 11 June 2012, the disapplication of the programmes of study for ICT in England was confirmed by the Department for Education.

15. The depth of feeling expressed by some in industry over ICT and computing has been seen elsewhere for D&T.²⁶ The subject struggles to shake of a dreary image, the quality of the experience provided in schools is patchy and generally the subject is in need of modernisation.²⁷ D&T teachers recognise this and are keen to work on reforms to the subject.²⁸

16. Both ICT and D&T provide, in different but complementary ways, unique opportunities for pupils to gain justified confidence in their abilities to *make things that work*. This worthwhile outcome from practical STEM learning is particularly valued by the engineering profession.

²⁰ Purpose statement for 14–16 engineering, 28 November, the Royal Academy of Engineering, www.raeng.org.uk

²¹ A list of qualifications at Level 1 and 2 can be found in “Respected”, Technical Qualifications for use in University Technical Colleges. Baker-Dearing Education Trust / Edge Foundation/Royal Academy of Engineering, 2011.

²² <http://royalsociety.org/education/policy/computing-in-schools/report/>

²³ http://www.nesta.org.uk/home/1/assets/features/next_gen

²⁴ <http://www.education.gov.uk/inthenews/speeches/a00201868/michael-gove-speech-at-the-bett-show-2012>

²⁵ <http://www.education.gov.uk/schools/teachingandlearning/curriculum/nationalcurriculum/a00202110/ict-curriculum-consultation>

²⁶ Ingenious Britain—the Dyson report, 2010.

²⁷ Meeting technological challenges, Ofsted, 2011.

²⁸ Manifesto for Design & Technology, Design and Technology Association, 2011.

17. The greater focus on Apprenticeships by both the current and previous governments is welcome. However, analysis of the trends easily seen in public data²⁹ shows that whilst there has been excellent growth overall, the *proportion* of Apprenticeship starts, at both Intermediate and Advanced levels, that are in engineering or construction has been dropping since 2007–08. In terms of apprenticeship completions, this dilution is particularly acute amongst under-19s undertaking Advanced apprenticeships in engineering. The concern is that public policy makers might view the strong growth in apprenticeships overall as “job done” for promoting growth whereas a detailed inspection of the data shows that the engineering and construction apprenticeships, those most readily connected with a sustainable, rebalanced economy, are not growing as rapidly as the headline figures suggest. Government is urged to work with engineering employers to find new ways of stimulating further uptake of engineering and construction Apprenticeships and to ensure that training providers are incentivised to prioritise them.

18. The Committee and its members continue to provide deep support to University Technical Colleges through curriculum development, assistance with teaching and learning, and CPD for UTC teachers. UTCs provide an exemplar of what excellent 14–19 technical (most commonly engineering) education looks like. However these excellent institutions can only make a certain contribution to the engineering skills needs of the country as their number will always be limited. Therefore, more needs to be done to raise the status of technical subjects in more general schools and colleges. The Department for Education has a significant role to play in helping create a positive identity for the technical qualifications it endorses for inclusion in school performance tables. This must go beyond merely including them on a list—the Department for Education must ensure that everything necessary for their expansion is secure. This includes: awareness amongst school leaders, positive messaging from the Department for Education and securing sufficient skilled teachers. Currently, this is being left entirely to Awarding Bodies and to the engineering profession. Government should play its part.

19. Technical STEM qualifications are a significant component of the FE & Skills system.³⁰ However the value (to the individual, employers and the economy) of level 3–4 vocational and occupational learning is not widely promoted and employers say they find it difficult to keep up to speed with qualifications which are under seemingly constant revision. Therefore, employers, those commissioning contracts and other customers are looking for an over-arching sign that skilled trades and associate professional workers are deemed to be competent. Professional registration can provide this and the engineering profession sees voluntary registration as a solution. However, in the somewhat stratified UK social context, professional registration at Technician level has remained fairly invisible for nearly 50 years. The first thing required to remedy the situation is raising awareness of the science and engineering registered Technician standards and the raising of aspiration and recognition through Technician registration (RSciTech, EngTech and ICTTech)—work already started by the Technician Council.³¹ However, the engineering profession cannot do this on its own and Government must engage with the engineering profession to promote Technician registration to the wider public as well as to employers—and enable through procurement.

20. More needs to be done to attract a more diverse technically skilled workforce. Only 6% of people in engineering occupations are women and only 5% are from minority ethnic groups.³² The origins of this lack of diversity may be based in young people’s attitudes towards engineering as a career choice—so drawing on less than half of any cohort. For example, only 37% of 12–16 year olds and 31% of 17–19 year olds in the UK see engineering as a desirable career.³³ This varies with gender.³⁴ Another survey found that in the UK only 18% of young women but 50% of young men might be willing to become engineers. However, it may also be based on “reality”—lack of retention of a more diverse workforce in some engineering firms—which perhaps points to a need for more widespread culture change in business practice. A compact is required between Government, employers, schools & colleges and the engineering profession to create a positive identity for engineering careers and to ensure that this is cast inclusively. On a practical note, the profession is still waiting for Advanced Apprenticeship average pay scales to be widely publicised. It was noted by the Equal Opportunities Commission some years ago that the invisibility of substantial difference in training pay between, for example, social care and electrotechnical Advanced Apprenticeships hampered informed choice-making.

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²⁹ www.thedataservice.org.uk/statistics/statisticalfirstrelease/sfr_supplementary_tables/Apprenticeship_sfr_supplementary_tables/

³⁰ Matthew Harrison (project leader) 2011, FE STEM Data Project July 2011 report, Royal Academy of Engineering www.thedataservice.org.uk/statistics/other_statistics_and_research

³¹ www.professional-technician.org.uk

³² Royal Academy of Engineering analysis of the Labour Force Survey data.

³³ Engineering UK (2010), The 2010 engineers and engineering brand monitor, Engineering UK.

³⁴ Becker, Frank Stefan (2010), “Why don’t young people want to become engineers? Rational reasons for disappointing decisions”, *European Journal of Engineering Education*, Vol. 35, No. 4, 349–366.

Written evidence submitted by Newstead Wood School

Newstead Wood School is an 11–18 selective converter academy. A specialist Engineering school (also specialising in Languages and a Gifted and Talented Lead School).

1. Newstead Wood School endorses the submission sent by Matthew Harrison on behalf of The Royal Academy of Engineering's National Committee for 14–19 Engineering Education, of which the headteacher is a member.

2. The headteacher was also a member of SEMTA's Engineering Diploma Development Panel and Newstead was a Gateway School, leading Diploma delivery at Level 2 and Level 3 in the London Borough of Bromley.

3. Newstead is a highly selective girls' school with a mixed Sixth Form. It became an Engineering specialist school in 2004, with a mission to "fly the flag" for able women in engineering and to emphasise the importance of applied learning in mathematics and science with creativity, problem-solving and ethical decision-making, to design solutions to technical, environmental and energy challenges.

4. The Engineering Diploma is the Key Stage 4/Level 2 programme of choice at Newstead. Its joint delivery with Bromley's F.E. College allows students to turn their maths/science knowledge into direct practical applications. The work place projects and work experience give students direct industrial experience. Employers' evaluations are very positive: students are able to design affective work place solutions and are, therefore, a welcome temporary addition to the workforce (no Newstead student is content with filing or making tea!).

5. The Engineering Diploma Level 2 is, therefore, more than a vocational STEM course. The level of mathematical and scientific knowledge it requires to work at its best, is GCSE A grade; students need excellent communication and team-working skills; they need to be quick thinkers and learners and creative problem-solvers. In other words they need to be engineers. The skills and scope range beyond those of a single GCSE.

6. The concept of University Technical Colleges is one that Newstead endorses. However, they will not provide national coverage and there will remain a need for Secondary Schools to be committed to engineering learning programmes with a high tariff. Schools like Newstead are committed to this principle and need a prestigious, high value Diploma to give credibility.

7. The Engineering Diploma at Level 3 is a complete F.E. learning programme. Newstead has offered three learning pathways to our Sixth Form, traditional A levels, the Engineering Diploma Level 3 and the IB, so that students could personalise their journey from Key Stage 4 into H.E. The proposed change in tariff to the Diploma (along with under-funding of the IB), is closing down the learning pathways, leaving nothing more than 'A' levels: an impoverishment of diet for creative and very able young people, who are the leaders and shapers of the Future.

June 2012

Written evidence submitted by the Association of Colleges

EXECUTIVE SUMMARY

1. 2010–11 data shows that Colleges deliver qualifications in Engineering and Manufacturing to 177,000 individuals each year, equipping them with the engineering skills to help them progress to university or into work.³⁵ These College programmes are at all levels, from Entry Level to Degree.

2. A recent survey of Colleges by AoC showed that 74% of Colleges expect the number of 16–18 year old students taking engineering courses to increase in the next two years³⁶ and 48% of Colleges expect the numbers for those aged 19+ to increase.

3. We believe that the Government should look again at the range of subjects accredited in the E-baccalaureate and in particular should consider adding art and design & technology through which students can develop their creative and innovative skills.

4. It is not feasible for the Government to open University Technical Colleges in every area of the country however all 14 year olds, regardless of where they live, should have an opportunity to take vocational qualifications alongside the core of maths and English.

5. The Education Secretary recently changed the equivalences given to some vocational qualifications in the performance tables and we understand the rationale for that decision. We think, however, that vocational qualifications should be given some accreditation in the school performance tables.

INTRODUCTION

6. The Association of Colleges (AoC) represents and promotes the interests of Colleges and their students. Colleges provide a rich mix of academic and vocational education from basic skills to higher education degrees.

³⁵ AoC analysis of Individualised Learner Record, 2010–11—learner responsive dataset.

³⁶ AoC survey of STEM provision in FE Colleges, February 2012.

AoC represents 345 Colleges in England incorporated under the Further and Higher Education Act 1992, including 94 Sixth Form Colleges and 251 Further Education Colleges.

7. Colleges play an important role in diversifying the education system, in providing a breadth of high-quality choices for young people and in preparing them for higher education and adult life. Colleges educate 853,000 young people aged 16 to 18 almost twice as many as schools.³⁷ This includes 185,000 young people taking A-levels.³⁸ Colleges also train approximately one quarter of the total 457,000 apprentices.³⁹

8. In addition, they have a role in the education of those of compulsory school age, including 55,000 14 to 15 year olds taking part-time courses and 3,000 studying full-time.⁴⁰ 33 Colleges are now involved in sponsoring Academies of which 20 are the main and sole sponsor.⁴¹ Colleges account for 33% of entrants to higher education.⁴²

9. This submission focuses on the potential impact on engineering of the three key developments in education for those aged 14–19, namely:

- The introduction of the English Baccalaureate as a performance measure.
- The introduction of University Technical Colleges.
- The impact of changes to KS4 performance tables.

We will also examine the workforce issues.

COLLEGES AND ENGINEERING

10. We welcome the opportunity to contribute to the Science and Technology Select Committee's Inquiry into Engineering Skills. Colleges have a significant role in this area:

- 2010–11 data shows that Colleges deliver qualifications in Engineering and Manufacturing to 177,000 individuals each year, equipping them with the engineering skills to help them progress to university or into work. These College programmes are at all levels, from Entry Level to Degree.
- Engineering staff in Colleges work very closely with employers to assess, train and teach students using up to date skills and knowledge. The links that some Colleges have with employers have developed over decades. Colleges that have developed specialisms in this area continue to work with employers to develop and strengthen their relationships.
- Colleges have a strong social mission. Many play a leading role in helping women to develop careers in engineering and in encouraging a more diverse recruitment base for the industry.
- Colleges employ professional engineers as lecturers and managers.

11. Data from the Individualised Learner Record shows that in 2010–11 Colleges delivered 223,000 qualifications in the Engineering and Manufacturing Technologies subject areas. Of these 3% were A levels (mainly in Electronics, Design and Technology and Engineering) and 84% were vocational qualifications which include qualifications in performing engineering operations, motor vehicle and plumbing. There were 49,000 new apprenticeships in engineering and manufacturing technology in 2010–11.⁴³

12. 22% of these qualifications were at Level 1 or below, 30% at Level 2, 30% at Level 3, 4% at Level 4 and above and 14% at other levels.⁴⁴ These qualifications were delivered to 177,000 students, of which:

- 7,000 to students under age 16.
- 74,000 to students 16–18.
- 96,000 to students age 19+.

13. In addition to Engineering qualifications, Colleges delivered 335,000 qualifications in science and mathematics, and 247,000 qualifications in Information and Communication Technology (ICT) which can also provide progression into further study or employment in engineering and manufacturing.

14. Colleges have taken action to improve their quality and performance. Further Education Success rates in engineering have risen from around 75% in 2005–06 to 78.5% in 2010–11.⁴⁵

15. However, College engineering departments need sufficient scale in terms of activity. It is sometimes possible for big companies to take over training themselves but there is a risk that this will make it uneconomic for their local College to sustain engineering courses for smaller businesses elsewhere in the supply chain.

³⁷ AoC analysis of Individualised Learner Record, 2010–11—learner responsive dataset.

³⁸ *ibid.*

³⁹ AoC analysis of Individualised Learner Record, 2010–11—employer responsive dataset.

⁴⁰ AoC analysis of Individualised Learner Record, 2010–11—learner responsive dataset.

⁴¹ DfE list of open Academies at May 2012.

⁴² UCAS data on applications and acceptances for 2011 entry in England.

⁴³ The Data Service, Apprenticeship Programme Starts by sector subject area.

⁴⁴ Level 2 is the equivalent of five GCSEs grade A*–C; level3 is the equivalent to A-level and level 4 is equivalent to a certificate in higher education.

⁴⁵ The Data Service, FE Success Rates by sector subject area.

16–18 YEAR OLD STUDENTS

16. The number of 16–18 year old students has risen and there has been a rise in the numbers taking STEM subjects (ie 54,000 young people now doing A level mathematics in Colleges⁴⁶) but many of these choose to progress to other university courses.

17. The current Department for Education formula used to fund the education of 16–19 year olds has a cost-weighting factor for vocational provision which has higher costs and is “resource intensive” for example in engineering. It is important that funding reflects the real cost of delivering high-quality vocational education, which is higher than for academic subjects and needs to take into account the practical nature of delivery, the cost of providing industry standard facilities, meeting health and safety standards and of attracting and keeping staff with industry experience. Government is currently reviewing this formula and we hope that high-cost provision is not disadvantaged.

STUDENTS AGED 19 AND OVER

18. The number of adult students in Colleges has fallen significantly since 2005. This has affected all subjects including engineering.⁴⁷

19. In 2013, the Government will introduce a system of loans for students aged 24 and over who wish to take a qualification at Level 3 and above.⁴⁸ This is a significant change and a collective effort will be needed to sustain student demand and the necessary supply of skills.

THE IMPACT OF RECENT DEVELOPMENTS IN EDUCATION POLICY

20. A recent AoC survey of its members showed that 74% of Colleges expect their 16–18 student numbers for engineering courses to increase in the next two years⁴⁹ and 48% of Colleges expect the numbers for those aged 19+ to increase.

21. The survey asked about the impact at Level 3 and above of recent developments in education policy, and responses showed that:

- 67% of Colleges think that the Wolf Report will have a positive impact on STEM provision.
- 53% thought that the reduction in vocational qualifications in schools would lead to an increase in take-up of STEM subjects in Colleges.
- 39% thought that changes to responsibilities in relation to careers guidance would lead to a decrease in STEM in Colleges.⁵⁰

THE ENGLISH BACCALAUREATE (E-BACC)

22. In addition to English, Maths and Science, the only subjects to be accredited in the E-bacc are history or geography and languages. There is no technical or vocational equivalent nor are there any current proposals to accredit other subjects.

23. While we support opportunities for more young people to study languages, history and geography through to age 16, we also know that for many students their chance of accessing further education or apprenticeships is more likely to be enhanced with a different mix of subjects. We believe there should be rigorous vocational qualifications that have a strong practical element and cater for those who prefer an applied learning style.

24. Many of the 58,000 14–15 year-olds studying full or part-time at College do so because of the opportunity it offers them to access vocational courses with practical hands-on facilities. Colleges help them to gain vocational qualifications that enable them either to go into further education or to gain apprenticeships and work-based training. This can lead directly to employment. This provision has been praised by Ofsted.⁵¹

25. Requiring all students to take GCSE courses in humanities and languages will not allow sufficient time to teach practical and technical courses and could increase student disaffection with mainstream education. It could also add to the growing number of young people not in education, employment or training.

26. We believe that the Government should look again at the range of subjects accredited in the E-bacc and in particular should consider adding art and design & technology through which students can develop their creative and innovative skills.

27. The E-bacc is narrowing the curriculum options for 14–16 year olds. While it is right that young people wishing to study an academic higher education course are encouraged to do the right GCSE and A-level subjects it should be remembered that the majority of young people do not go to university, sometimes because they don't wish to. By reducing vocational options, schools could see a significant group of young people

⁴⁶ AoC analysis of Individualised Learner Record, 2010–11—learner responsive dataset.

⁴⁷ Although some adults were trained through Train to Gain and now apprenticeships, overall there has been a fall in adult provision.

⁴⁸ The loans will be known as “24+ Advanced Learning Loans”.

⁴⁹ AoC survey of STEM provision in FE Colleges, February 2012.

⁵⁰ The Government, through the Education Act 2011, placed a statutory duty on schools to secure independent careers advice.

⁵¹ HM Chief Inspector's Annual Report, 2009–10, Paragraph 525.

disengaging from education and potentially dropping out where they don't see the relevance of the curriculum to their future work plans. This will be particularly important when the education participation age increases to age 18 from 2015.

28. While employers may welcome a broad indicator of academic achievement, there are concerns that the E-bacc does not accredit the sort of personal and employability skills, such as teamwork, project work, communication and time management, that employers say are essential in the modern workplace.⁵² Equally, those that offer opportunities to young people often want practical skills and experience in addition to good English and maths. This is not accredited by the E-bacc either.

THE IMPACT OF THE INTRODUCTION OF UNIVERSITY TECHNICAL COLLEGES (UTCs):

29. We welcome the advent of University Technical Colleges and Further Education Colleges are involved in the majority of the UTCs that are either open, opening this year, or in development. Some are specialising in engineering provision. For example, the Bristol and South Gloucestershire UTC (led by City of Bristol College, University of the West of England and major employers such as Airbus and Rolls Royce) will specialise in engineering and environmental technology and will open in September 2013.

30. However, it is not feasible for the Government to open University Technical Colleges in every area of the country and we feel all 14 year olds, regardless of where they live should have an opportunity to take vocational qualifications alongside the core of maths and English. This should be, in part, to address the problem of a large number of young people beginning to disengage from the school system early on in their secondary education.

31. Young people have to make choices about their future GCSE programme in Year 9 and we believe that College should be an option open to them at this stage. Alison Wolf supported this in her review of vocational education and recommended direct recruitment at age 14 to Colleges. This was accepted by Ministers, and AoC and a group of College principals are now working with the Department for Education to make this a reality by 2013.

IMPACT OF CHANGES TO SCHOOL PERFORMANCE TABLES

32. Evidence suggests that schools respond to signals given by Ministers through performance tables. In some cases, this can be argued to be beneficial. From the 2006 performance tables, the main measure of GCSE achievement included English and maths, leading schools to place more emphasis on attainment in those subjects. However, an earlier decision in 1997 to give some vocational qualifications the equivalent of four GCSE grades led some schools to focus on these subjects at the expense of other subjects.

33. The Education Secretary recently changed the equivalences given to some vocational qualifications in the performance tables and we understand the rationale for that decision. We think, however, that vocational qualifications should be given some accreditation in the school performance tables.

34. The decision to reform equivalences has led to the downgrading of the Diploma which was the curriculum of choice in the first UTCs. The Engineering Diploma in particular is highly regarded by employers and Colleges.

CAREERS ADVICE

35. To enable young people to make an informed choice about which subjects to study and which route to take, we strongly believe in independent objective advice related to future educational and employment interests. We have very significant concerns that the recent changes to careers advice and guidance, placing a new duty on schools to secure independent and impartial advice but with no funding to support this are neither manageable for schools nor enforceable, and risks leaving many young people with poor or limited careers advice at age 14.

36. A recent AoC survey found that half of schools which have their own sixth forms are providing GCSE pupils with "poor, limited or no access" to information about courses available in their local Further Education or Sixth Form College. We fear that the new rules will not improve this situation.⁵³

WORKFORCE

37. Feedback from Colleges is that Engineering lecturers are drawn from industry, often come into FE Colleges from careers later in their working life and qualify as teachers through an in service route. Younger engineers may teach part time whilst working in the industry.

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⁵² Oral evidence given to Education Select Committee inquiry into English Baccalaureate , Q58, 22 March 2011.

⁵³ AoC survey of FE and Sixth Form Colleges, March 2012, available at www.aoc.co.uk

Written evidence submitted by Semta

ABOUT SEMTA

1. Semta is the Sector Skills Council (SSC) for Science, Engineering and Manufacturing Technologies. We are licensed by government to address the sector's skills needs, providing expert support to companies of all sizes to improve their performance and growth. Semta's combined subsectors employ 1.33 million people in nearly 122,000 establishments across the United Kingdom.

EVIDENCE

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

2. Higher level skills are vital to the success of Advanced Manufacturing and Engineering employers (AME). Semta's employers have clearly articulated in their 2010 Skills Assessment (Semta 2010) a need to move up the value chain to skills at level 4 and above for themselves and their UK-based supply chains in order to remain globally competitive and innovative.

- The main drivers for future skills requirements in these sectors are:
- the introduction of new technologies or equipment;
- new legislative or regulatory requirements;
- development of new products and services,
- the introduction of new working practices; and
- increased competitive pressure.

3. Managers, craft and professional occupations are the most likely to be affected by the need to acquire new skills or knowledge. In 2009, there were over 8,000 higher-level vacancies in the AME sectors in England. A recent survey⁵⁴ found that 31% of high tech manufacturing firms "had recruited people from outside the UK owing to a lack of suitably qualified people from within the UK". Overall 9% of establishments in the AME sectors in England reported higher-level skills gaps in their workforce compared to 7% of establishments for all sectors in England. This equates to over 51,000 people in total with higher-level skills gaps in the AME sectors in England.

4. In addition to these skills gaps, the UK's workforce is ageing and this ageing workforce is an added factor to the growing evidence that the sector needs more young people to join the AME industries via Apprenticeships. 14% of the AME sectors' workforce, in England, are over 60 years old, compared to 12% of the workforce in all sectors. The number of young people entering the AME sectors has been an issue for a number of years. Only 8% of its workforce in England is aged 16–24 compared with 14% in all sectors in England.

5. If the AME sectors are to achieve world class standards there is a need to raise the overall current skills aspirations across the industries. Currently, 38% of the current workforce in core higher-level technical occupations is under-qualified for the role being performed. Therefore there is a potential upskilling requirement to NVQ Level 4 and above for around 111,000 people across core technical occupations, comprising:

- 45,000 Managers.
- 42,000 Professional Engineers.
- 24,000 Technicians.

6. These needs are in addition to the annual requirement for training over 7,000 new recruits across higher-level technical occupations into AME sectors in England.

7. Skills gaps and shortages are a key barrier to closing the 15% productivity gap with the UK's main competitors. Apprenticeships are well respected as a brand by employers in the AME sectors with a range of provision being available predominately at levels 2 and 3. Semta has developed a new Higher Apprenticeship at levels 4 and 6 leading to Incorporated Engineer status which aims to help address progression to higher level skills.

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

8. To meet growing employer demand for higher level skills, the current range and style of pathways leading into higher education and the qualifications being offered need to be maintained and expanded, particularly the applied and vocational routes such as Higher Apprenticeships and Diplomas. The value of these routes for employers lies not only in the technical skills developed, but also the employability skills such as team work, communication and innovative thinking skills. Employers not only want proficiency in core engineering disciplinary knowledge (maths, physics and chemistry) but also the ability to apply this knowledge to real engineering situations.

9. Semta was awarded Pathfinder Funding by the National Apprenticeship Service to lead the development of a new higher apprenticeship framework in Advanced Manufacturing (AMHA), which was issued in 2012.

⁵⁴ The GE High Tech Manufacturing Index and Report 2011.

Semta's aim was to develop a flexible, employer-led framework to support the development of higher level skills in new and existing technology areas.

10. The AMHA operates at levels 4 and 6. The need for level 5 provision for SMEs is currently being tested. The Level 6 framework includes a range of options such as a full Bachelor of Engineering degree. It is based on a variety of pathways to accommodate the needs of different sectors. It allows greater focus on higher level technical skills- as opposed to leadership/supervisory skills. The framework also links to professional accreditation.

11. Semta welcomes the establishment of University Technical Colleges (UTC's). If structured well and teachers are given the requisite professional development in work-based teaching in Engineering, they could be an important vehicle for producing the high quality skilled people our sectors need. Semta is actively building links with UTCs such as the Black Country UTC based in Walsall and the WMG Academy for Young Engineers at Warwick.

12. It is also important to recognise that employer demand is neither homogenous nor static. There is a great deal of variation, not only between small and large employers, but within and between sectors and sub-sectors and size of company.

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?

<i>Devolved Administration</i>	<i>Approach</i>	<i>Strengths</i>	<i>Weaknesses</i>
Wales	<p>Apprenticeships: Pathway to Apprenticeship—introduced in 2009:</p> <ul style="list-style-type: none"> — Provided training for young people who were not employed but had the potential to be an apprentice in the sector (Min Grade C GCSE in Maths, English & Science) — Covered Welsh Baccalaureate Qualification which met the Level 2 Apprenticeship frame work requirements plus a project — Five weeks true work experience with an employer with a view to providing an apprenticeship at the end of the work experience process — Over 900 young people have been trained with over 80% carrying on with engineering either with an apprenticeship or further education. <p>http://wales.gov.uk/topics/educationandskills/skillsandtraining/apprenticeships/pathway/?jsessionid=082BPW3BQ9qXn5hBBgwYD9SYQG59fTwKxLdMy0sYgjc4ldxdfgd!-1822353977?lang=en</p> <p>Young Recruits programme—introduced in 2009 this programme subsidises the wages of the apprentice for 12 months if they do not normally recruit apprentices</p> <p>http://wales.gov.uk/topics/educationandskills/skillsandtraining/apprenticeships/youngrecruitsprogramme/?lang=en</p> <p>Shared Apprenticeship—This pilot programme completes in September. It has provided support for 90 apprentices placing them with small companies (hosts) who are then supported by other companies by providing the breadth of training which a single SME couldn't provide. Going forward the training providers were asked to bid for places at the latest tendering round.</p> <p>http://wales.gov.uk/topics/educationandskills/skillsandtraining/apprenticeships/shared/?lang=en</p>	<p>Support for SSCs</p> <p>Welsh Government support industry needs by working with Sector Skills Councils, using the SSC to provide options and solutions to skills issues for example the Sector Priority fund provides a route to pilot new ways of delivering for industry eg Semta TMT project piloted the development of the provider network to deliver short courses developed</p>	
	<p>Updating the skilled workforce:</p> <p>Work Force Development Programme</p> <p>This programme supports employers by appointing an independent training advisor to work with the employer to develop a skills action plan and to source funding support to deliver the action plan. The advisor also has an option to apply for discretionary funding if other sources of funding cannot be found this is part funded by Welsh Government and the employer.</p> <p>http://wales.gov.uk/topics/educationandskills/skillsandtraining/freeskillsreview/?jsessionid=GNgLPW4CYQbhpLvyk9G2sLF5YJIPSDlvrggDw5dw6Y;jjjMv19JLl-1822353977?lang=en</p>		
	<p>Jobs Growth Wales:</p> <p>The programme caters for young people that are job ready but have had difficulty securing employment. It provides unemployed young people aged 16–24, with a job opportunity for a six month period paid at national minimum wage. Participants will be paid at or above the national minimum wage for a minimum of 25 hours per week. Young people will be employed for the duration of the programme and the jobs created must be additional to, and not replace, positions that would otherwise be filled.</p> <p>http://wales.gov.uk/topics/educationandskills/skillsandtraining/jobsgrowthwales/?lang=en</p>		

<i>Devolved Administration Approach</i>	<i>Strengths</i>	<i>Weaknesses</i>
<p>Skills Growth Wales: The scheme aims to assist 200 companies create over 3,000 jobs over a three years. To be eligible for support companies must demonstrate that they have a credible growth plan which will lead to the creation of employment opportunities within their company. The plan could include a new market, new products, new services, new contracts or planned investment. Approved companies will be able to access funding up to an average of £2,500 per individual for training that will directly help bring about the growth. There is also a requirement to take up accredited training programmes or modules that lead to qualifications. http://wales.gov.uk/topics/educationandskills/skillsandtraining/skillsgrowth/?lang=en</p>	<p>jointly by the employer and the provider, these programmes were recognised either by unit certificates or the Quality assured Life Long Learning pillar of the Credit and Qualifications Framework for Wales.</p>	
	<p>Sector Panels Welsh Government have set up Sector Panels for their priority Sectors, made up and chaired by employers who provide advice and support to Welsh Government on issues affecting business including skills.</p>	

<i>Devolved Administration Approach</i>	<i>Strengths</i>	<i>Weaknesses</i>
<p>Scotland</p> <p>Support for Employers in Scotland via Skills Development Scotland</p> <p>ScotAction</p> <p>ScotAction is the Scottish Government's skills support package for leading Scotland out of recession and on to economic growth. It is an integrated package combining new and improved measures to help individuals and businesses through the recession and will provide skills assistance—including wage subsidies in some circumstances—for training for work, training in work and training from work to work to help Scottish people and businesses survive the downturn and thrive when the economy starts to recover. Types of intervention include:</p> <p>Employer Recruitment Initiative</p> <p>Available to employers who offer Modern Apprenticeships (MAs) to young people who may otherwise find it difficult to secure a job or MA can receive up to £2,000 towards their training costs. To qualify for this incentive, businesses must employ an individual who has been unemployed or faced barriers in the past.</p> <p>Adopt an Apprentice</p> <p>This scheme helps deliver on the Scottish Government's guarantee to apprentices to find them alternative employment so that they can complete their Modern Apprenticeship (MA). The scheme gives an employer £2,000 lump sum payment to help with wage costs of taking on a redundant apprentice for at least 12 months.</p> <p>Safeguard an Apprentice (applied only to Construction and Engineering sectors)</p> <p>Following consultation with sector skills representatives, the Safeguard an Apprentice programme is coming to an end last December while support through Adopt an Apprentice continues.</p> <p>The Safeguard programme, part funded by the European Social Fund (ESF), was introduced in November 2009. It was set up to support construction and engineering businesses unable to continue to employ their Modern Apprentices during the acute phase of the economic downturn. Funding was provided in order to allow the apprenticeships to be completed. Following a steady reduction in demand, the programme closed in December 2011. Programmes such as MAs, the Adopt an Apprentice scheme and Flexible Training Opportunities continue to respond to employer needs as articulated through industry bodies.</p> <p>Flexible Training Opportunities</p> <p>The Flexible Training Opportunities (FTO) fund gives businesses the opportunity to apply for up to £5,000 towards employee training costs. SDS will refund up to 50% for training courses up to a maximum of £5,000 per business. The training can be allocated to any number of employees up to a maximum of 10. For example, a business can opt to put 10 employees on courses with a value of £500 each, or alternatively, put one employee through 10 courses, with all variations in between.</p> <p>Low Carbon Skills Fund</p> <p>This is available to employers adopting processes around carbon reduction, renewable energy and/or energy efficiency. There is potential for receiving 50% of training costs. Employers employing <250 can apply for up to £12,500 towards training costs—based on up to 25 training courses costing a maximum of £500 each.</p> <p>www.skillsdevelopmentscotland.co.uk</p>	<p>There are fewer agencies to deal with. Most funding for Skills Related initiatives will be channelled through Skills Development Scotland, most workforce development will be channelled through Scottish Enterprise and colleges/ University is through the Scottish Funding Council.</p>	<p>The Scottish Government and its agencies have identified five key economic (industry) sectors and engineering is not seen as one of them. The Scottish Government view Engineering as an “enabling” sector as it sits across a range of sectors. However, this does cause some concern with employers in the sector as there is a belief that if you are identified as</p>

*Devolved
Administration Approach*

<i>Strengths</i>	<i>Weaknesses</i>
<p>Modern Apprenticeships The Scottish Government has made a pledge to create 25,000 Modern Apprenticeships place in each year of the life of this Parliament (125,000) in total. Engineering is supported well (both in terms of numbers and financial commitment) through MAs by the Scottish Government. Currently, the Government is out to consultation on creation of Professional and Technical Apprenticeships (which will sit at SCQF level 8 and above)</p> <p>Accelerated Modern Apprenticeship in Engineering Senta (through funding from Skills Development Scotland and the Scottish Funding Council) developed and piloted and Accelerated MA in Engineering. The AMA is aimed at older employees who have experience of engineering (eg semi-skilled or unskilled but experienced workers). The programme was piloted with BAE Systems and Babcock Engineering Services and their respective training providers. The programme proved successful and 12 candidates went through an MA in approximately 18 months.</p> <p>Northern Ireland The Skills Strategy—“Success through Skills—Transforming Futures” The Department for Employment and Learning launched “Success through Skills—Transforming Futures”, the updated and revised Skills Strategy for Northern Ireland, at its Annual Skills conference on 25 May. The Strategy looks at the current skills base, examines the skills we will need in future to grow the Northern Ireland economy and highlights areas for action. This document is a ten year strategy which sets out the long term direction of travel by highlighting four strategic goals. On 6 March 2012, the Employer Engagement Plan was published. There are several programmes within Success Through Skills: Training for Success Training for Success is designed for young people aged 16–18 (up to 24 years for those requiring additional support) and provides training to give them the tools and skills they need to get a job. This training provides young people with relevant qualifications as well as the required personal and behavioural skills to progress into work. This programme is part financed by the European Social Fund. Programme-Led Apprenticeships It is acknowledged that the present economic situation has made it increasingly difficult for would-be apprentices to find paid-for employment whilst completing their training. The Programme-Led Apprenticeships (PLA) initiative is an intervention measure during these times. What is PLA? PLA gives 16 and 17 year old school leavers (and up to 24 years for those requiring additional support) the opportunity to gain a full apprenticeship qualification in a chosen skill area. They access this through a combination of in-house directed training and work-based learning placement opportunities with an industry-appropriate employer. The PLA provision is running parallel to the “employer-led” ApprenticeshipsNI programme. Steps to Work (StW) Steps to Work (StW) offers a number of different choices around work related activities that can be fitted to suit applicants needs when it comes to finding employment</p>	<p>a key industry sector then you would be viewed more favourably by the Government agencies.</p> <p>Support for SSCs Employers have indicated that the image of engineering apprenticeships has been impaired with the introduction of “Programme led apprenticeships”. Apprenticeship recruitment should be placed with employer led organisations offering employed status.</p> <p>There is increasing positive engagement with SSC’s in NI. The collaborative network also engages closely with Colleges and Universities.</p>

<i>Devolved Administration Approach</i>	<i>Strengths</i>	<i>Weaknesses</i>
<p>What are the Benefits?</p> <ul style="list-style-type: none"> — Personalised advice and guidance to help make the right choices. — Help to find and remain in work. — Re-training while remaining on benefit plus receive a weekly Training Bonus. — The opportunity to gain a recognised qualification. — The opportunity to improve existing skills. — Opportunities for work experience. <p>Who is eligible?</p> <p>Anyone over 18-years-old, lone parents aged 16 and over, who is not working or working less than 16 hours each week is eligible. You will be able to participate in StW if you are claiming benefit or if you are not working and not claiming benefit.</p> <p>Apprenticeships NI</p> <p>This is an employer led programme with no age restrictions and was introduced in September 2007 to replace the Modern Apprenticeship programme within Jobskills. Apprentices will be employed and earn a wage from day one. They will work alongside experienced staff to gain nationally recognised qualifications within the ApprenticeshipsNI framework. Apprentices work a minimum of 21 hours per week, 80% of this with their employer and the remaining 20% off the job with a Training Supplier. These are contracted by the Department for Employment and Learning, (DEL) and they usually provide the knowledge and skills while the employer provides the hands on practical experience.</p> <p>Specialist organisations can provide additional support if required.</p> <p>There are two ApprenticeshipsNI programmes, level 2 and level 3. These are standalone programmes and progression, if appropriate is encouraged from level 2 to level 3. A framework which has been developed by DEL and the appropriate Sector Skills Council (SSC) determines the outcomes for each apprenticeship.</p>		

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

13. Semta recommends that the government considers its approach to 14–19 education, particularly at the incentives it provides to schools and colleges to offer STEM subjects and to students to study them (particularly the league tables scoring system).

14. We provide further comment and background information below on the Diploma in Engineering to support our view that it is a rigorous and fit for purpose qualification valued by employers and the broader engineering community alike.

15. Some would argue that engineering needs to be promoted from as early as age 11 upwards if future skills needs are to be met. We would certainly support further work to promote engineering and STEM subjects more generally at the secondary level. The work of organisations such as STEMNET, using an extensive support base drawn from the engineering community, should continue to be supported. We believe that it is the “structural” reforms (league table performance lists, funding incentives etc) within the system which are needed alongside the “hearts and minds” promotion if a true sea-change is to occur.

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. The recent downgrading of the Engineering Diploma and other vocational qualifications such as the Young Apprenticeship (YA), including the Performing Engineering Operations qualification (PEO) from five GCSE’s to one GCSE will have a negative impact on the uptake of STEM subjects in particular and to the skills base needed in the immediate future.

17. These changes will not only affect perceptions of the qualifications and of engineering as a rewarding career, but also the progression opportunities for students to move onto apprenticeships. For example, the removal of funding for the YA programme for Engineering has had a big impact on engineering skills progression. Some 80%–90% of YA learners went onto post 16 apprenticeships in engineering. They were highly sought after by employers because of the skills they had mastered through the PEO qualification and the time they had spent gaining work experience in the employer’s premises. The PEO qualification is a competency skills-based qualification that ensures learners gain basic engineering skills in a safe, sheltered environment.

18. The downgrading of GCSE equivalence for other engineering qualifications will also impact progression opportunities for young learners into engineering. Many learners achieved the PEO outside of the YA programme as well as other vocational QCF qualifications from Edexcel, EAL and City & Guilds. Several thousand learners in total each year would have achieved these qualifications. These QCF qualifications are components of post 16 apprenticeships, which provided the progression opportunity at the end of Key Stage 4. Many awarding bodies are having to produce “schools versions” ie non QCF qualifications for engineering, to be included in the 2014 Key Stage 4 performance tables. This will remove opportunities for skills progression and cause potential confusion in the market for employers as there will be two versions of very similar qualifications but on different frameworks. This modification is not possible for the PEO qualification to make it suitable for key stage 4 performance tables and therefore schools will not offer it.

19. Semta recommends an exemption for the PEO qualification so that it can be included in the 2014 Key Stage 4 performance tables, even if it can only be allocated a single GCSE equivalence. This exemption has already been granted for important qualifications in other disciplines such as science. Semta also recommends that the new “schools versions” of engineering qualifications are carefully marketed and identified as having limited progression opportunities for gaining genuine engineering skills.

20. In addition, Semta believes it is important for the committee to understand the background to the development of the Engineering Diploma and the time and commitment from our employers and the broader engineering community alike to create a qualification, which would build on best practice from design and technology courses and the GCSE in Engineering.

21. Semta led the development of the *Statement of Content* of the Diploma in Engineering during the period 2005–07. This development process involved around 600 large and small employers including Rolls Royce, JCB, Toyota, NPower, Centrica, Vodafone, Shell, and key engineering community stakeholders including Engineering Specialist Schools, Head Teachers Network, the Royal Academy of Engineering, Engineering Professors Council, Engineering Council UK, Engineering Subject Centre, University and Colleges Admissions Service, Engineering Employers Federation, the Dyson Foundation, New Engineering Foundation, the Design and Technology Association and professional institutions such as Institution of Mechanical Engineers, and the Institute of Engineering and Technology.

22. The statement of content had the support of all those involved in the development process and the key awarding bodies. At its heart was an agreed concept of applied learning which would bridge the gap between vocational and academic learning. A consensus was built across the engineering community stakeholders that the Engineering Diploma would apply “*academic concepts and theories...to engineering situations and organisations*”.

23. The thematic structure of the content centred on the following 4 themes, with maths and physics embedded in each:

- *The Engineered World.*
- *Discovering Engineering Technology.*
- *Engineering the future.*
- *Analytical Methods for Engineering (Level 3).*

This was done to:

- provide a school curriculum offer that was an improvement on traditional craft competence routes and which would also enable progression to professional levels;
- provide a relational learning experience for widening participation and diversity and enable the delivery of an inclusive curriculum which could be delivered flexibly for local context.

24. This proved to be particularly successful in the first few years of delivery where the average female participation rate was higher than the current rates for female engineers and in some consortia as high as 35%. In 2009–10 there were 5,500 learners on L1 and L2 eng diploma.

25. Semta and the Engineering Diploma Development Partnership Steering Group (EDDP) were very concerned to ensure that the content developed was fit for purpose for entry into engineering degree courses. Semta established a Higher Education Working Group, comprising engineering admissions tutors from Russell Group universities such as Cambridge, Manchester and Loughborough as well as representatives from the full spectrum of higher education institutions offering engineering courses. The purpose of this group was to critically review and input to content development, particularly mathematics and physics, to ensure it would be fit for purpose for entry into engineering degree courses.

26. This group agreed that the content of the Diploma at level 3 needed to cover the key theoretical underpinning concepts in ‘A’ level Mathematics, Physics and Chemistry, but acknowledged that many learners having the triple sciences, going onto engineering degree courses, lacked the ability to apply that theory to engineering problems. In response, the Group helped develop a topic in the principal learning on analytical methods for engineering (Advanced Diploma, Level 3) which would give learners the opportunity to integrate and apply mathematical, physics and chemistry concepts to a number of engineering areas such as manufacturing, energy generation/processing, engineering systems, and mechanical engineering.

27. Many in the engineering community believed that additional mathematics material (beyond the principal learning) should also be available for those students studying the Advanced Diploma in Engineering to help prepare them for progression onto engineering degree courses. It was also recognised that teachers in schools and colleges needed more real engineering examples to underpin the essential mathematics and to excite interest in engineering. In response, the engineering and maths communities formed a Maths Task Group in May 2007 comprising:

- Engineering Professors Council (EPC).
- The Higher Education Academy: Engineering Subject Centre.
- The Royal Academy of Engineering.
- Institute of Mathematics and its Application (IMA).
- Engineering Diploma Development Partnership (EDDP).
- Engineering Council UK (ECuk).
- Mathematics in Education and Industry (MEI).
- University of Cambridge.
- National Centre for Excellence in the Teaching Mathematics (NCETM).

28. The task group developed a specialist mathematics qualification, (Level 3 Certificate in Mathematics for Engineering (H860) accredited by OCR) available for any Level 3 learner wishing to develop his or her mathematical skills and knowledge beyond those already incorporated in the principal learning, through problems set in real life engineering contexts. The qualification is 180 GLH in size, and attracts 90 UCAS Tariff points (50% more than any other 180GLH unit) at grade A. This learning needs to be considered in conjunction with the 60 GLH Mathematics unit within the Advanced Diploma, giving 240GLH of intensive, engineering-specific mathematics study.

29. The Engineering Diploma was specifically developed to provide students with an exciting and broad learning experience about engineering disciplines and the impact they have on their lives. Students following the programme are more able to appreciate its social and technological construct and make informed choices about their future careers. Enabling the entry of under represented groups and particularly women into professions which are traditionally and predominantly male is economically vital. It is estimated the value to the UK economy could be £15–23 billion or 1.3%–2.0% of Gross Domestic Product (Kiwana *et al.* 2011). The UK is failing to keep pace with the world demand for engineers and recognition that the “traditional” view of engineering and the source of engineers needs to be countered. (Inspiring Women Engineers http://www.raeng.org.uk/news/publications/list/reports/Inspiring_Women_Engineers.pdf).

30. Devaluing the engineering diploma removes at a stroke the opportunities it could have delivered in terms of providing an inclusive and innovative curricula that would serve the needs of students and engineering industry across the UK.

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

31. We refer the committee to the arguments presented above. We recommend that the government remove current barriers to progression onto apprenticeships and consider incentives valuing inclusive and innovative curricula which will appeal to male and female learners from a diverse range of backgrounds

RECOMMENDATION

32. Semta recommends that government:

- considers incentives to schools and colleges to offer STEM subjects and to students to study them (re-visit the league tables scoring system);
- removes current barriers to progression onto apprenticeships; and provides an exemption for the PEO qualification so that it can be included in the 2014 Key Stage 4 performance tables;
- provides incentives to schools which value inclusive and innovative curricula which will appeal to male and female learners from a diverse range of backgrounds backgrounds.

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June 2012

Written evidence submitted by EEF

1. EEF, the manufacturers' organisation, is the voice of manufacturing in the UK, representing all aspects of the manufacturing sector including engineering, aviation, defence, oil and gas, food and chemicals. With 6,000 members employing almost 1 million workers, EEF members operate in the UK, Europe and throughout the world in a dynamic and highly competitive environment.

2. Investment in engineering skills provides real economic returns. Depending on the sector, manufacturing employees produce between £49,000 and £76,000 Gross Value Added compared to the UK national average of £35,500.⁵⁵ Those entering the engineering industry must be equipped with economically valuable skills and qualifications that employers within the industry require in order to remain globally competitive. We also need to be producing young people with a vast array of skills as more and more companies are achieving flexibility in their workplace by employing multi-skilled staff who are able to switch between tasks quickly. Yet businesses continue to raise their concerns about the availability of high quality engineering skills and the negative impacts this has on their business. In addition, employers are becoming increasingly concerned about the provision of careers advice and the status of technical subjects.

Q1. *Does the current engineering skills base meet the needs of employers? Do employers in the engineering sector prefer an academic or vocational profile?*

Engineering skills base

3. It is vitally important that when new employees join a business they do so with the necessary skills to support the business and excel in their role. However, more and more young people are entering the labour market without the knowledge of a working environment or the relevant skills they need to occupy a job in the manufacturing industry. Although one may expect the long-term unemployed not to have all the necessary skills required by engineering employers to enter the workplace and hit the ground running, employers do expect STEM graduates to have an adequate grounding of the workplace and the necessary skills required for the role.

⁵⁵ Institute of Mechanical Engineers (IMechE) (2011) Meeting the challenge: demand and supply of engineers in the UK.

4. Anecdotal evidence suggests that many school leavers, FE leavers and even graduates do not have the necessary skills to undertake a role in the engineering profession. Companies expect that some additional training may be required to ensure that new entrants to the workplace are able to carry out the necessary tasks required in their job role. Employers are also increasingly aware of the benefits of investing in their staff through training and as such will offer various forms in order to capitalise on this. However, there are an increasing number of employers who are finding themselves offering educative training in core subjects. Young people should be leaving the education system with sufficient numeracy, literacy and IT skills to succeed in the workplace, yet this is not the case. SMEs in particular, do not have the time and resources to offer further training to school leavers, FE leavers or graduates who should have achieved a level of attainment in core subjects that enables them to undertake an entry-level role in the engineering industry.

5. A raft of previous EEF research highlights the concerns that UK manufacturers have about the availability of skills and the negative impact this has on their competitiveness. Companies strived to hold onto skills during the recession, and as demand has picked up again, more and more businesses are reporting difficulties in recruiting skilled workers they need to occupy jobs. Furthermore, manufacturers expect the problem to escalate with two-thirds of manufacturers predicting difficulties recruiting production staff in the next five years. This concern is shared by all companies, regardless of size or sector. There are also specific concerns about recruitment within two other manufacturing-specific categories of skills: technical for R&D, and design.⁵⁶

6. A 2009 report from the previously named Department of Innovation, Universities and Skills revealed that employers were concerned about the quality of candidates in some STEM subject areas, referring both to technical skills and relevant work experience. A recent CBI Skills Survey also supported this with employers saying that candidates lacked employability skills, and 37% lacked workplace experience. Furthermore, STEM applicants often held qualifications not relevant to the needs of the business, with one third of employers (33%) citing this as a barrier to recruitment.

7. Other reports have revealed real skills gaps, with employers struggling to find the right workers for the job. The CIPD Labour Market Outlook (Summer 2011) showed that the proportion of UK employers that have vacancies that are hard to fill increased from 43% in 2010 to 46% in 2011. Moreover, manufacturing and production employers were those most likely to say they had hard to fill vacancies, with over half (55%) reporting that this was the case.⁵⁷ This is also supported by findings from the CBI, which revealed that STEM skills shortages are widespread, with 43% of employers having difficult recruiting staff, rising to 52% of those expecting difficulty in the next three years.

8. Other research has shown that around a quarter of manufacturers have skills gaps, the most likely occupations being trades/crafts and management occupations. SEMTA estimates that 170,000 people working in manufacturing have skills gaps. Furthermore, the sector will need 136,000 people with intermediate and higher level qualifications—NVQ Level 3 and above—over the period 2010 to 2016. The sector will also need 44,500 people at Level 2; 34,200 at Level 1 and 17,000 without any qualifications.⁵⁸

9. That is not to say that the number of people with STEM qualifications is decreasing. In fact, in 2009–10 there were 233,731 STEM higher education qualifiers at all degree levels. This compares to 172,018 in 2002–03 representing an increase of 36%. Moreover, there are over 2.4 million STEM degree holders in employment in the UK, an increase of 42% since 2002–04 when the figure stood at 1.7million.⁵⁹

10. Nonetheless this figure is somewhat distorted as it includes non-EEA students. Previously non-EEA students were able to apply for a Tier 1 post-work study visa, which allowed students two years to seek employment after their course ended. However this route was closed in April 2012, leaving non-EEA students with no option but to return to their residing country, or try and switch from Tier 4 to Tier 2 (General). In the majority of cases only graduates who have a highly skilled job offer from a sponsoring employer under Tier 2 will be able to stay and work in the UK. Moreover, the new rules mean that the graduate will have to have a job offer of at least £20,000, or more in specific occupations, and the sponsoring employer would have to be already accredited by the UKBA. Finally, the employer will have to carry out a Resident Labour Market Test (RLMT) prior to recruiting the non-EEA graduate.⁶⁰ Both the format and complexity of the system is likely to result in the UK losing some of its best international talent to competing countries.

11. We are also concerned about the direction of Government policy on immigration more generally. Caps to migration and continuous changes to the UK's migration system are likely to deter international students from coming to the UK to study. We believe that students should not be included in net migration figures and a full review of international student's contribution to the economy should be conducted to support this.

12. An additional problem is that STEM graduates do not always occupy jobs in STEM occupations. Research undertaken for the UKCES found that only three-quarters of the graduate intake for STEM occupations studied a STEM subject at HE level. In England, 40% of STEM graduates went into non-STEM graduate occupations in 2008–09. Moreover, three and a half years after graduation, 28% of STEM graduates

⁵⁶ EEF (2011), Flexibility in the Modern Manufacturing Workplaces.

⁵⁷ CIPD (2011) Labour Market Outlook: Summer 2011.

⁵⁸ SEMTA (2010) Skills and the future of UK Science, Engineering and Manufacturing Technologies.

⁵⁹ UKCES (2011), Supply and demand for high-level skills.

⁶⁰ It is also worth noting that the student must have successfully completed a course which lasted at least one academic year during their most recent period of leave as a Tier 4, whilst meeting the points requirements of Tier 2.

were in non-STEM graduate occupations. This is slightly offset by the fact that a quarter of recent graduates working in STEM occupations do not hold STEM degrees.⁶¹

13. Nonetheless, this does not sufficiently address the problem that many STEM graduates are deciding against a career in their chosen discipline. There are positive programmes that support skills retention once engineering professionals enter the industry, such as the *Talent Retention Solution*, which provides recruitment services to companies who have current vacancies or are keen to attract new talent; however there is a distinct lack of well-known, successful programmes that encourage graduates and FE leavers into the industry in the first instance. What we would like to see is a programme that encourages STEM graduates to go into STEM roles. There is an increasing appetite amongst employers to engage with HEIs to ensure that businesses can access skilled engineering graduates. Initiatives such as STEMNET and its ambassador scheme have been developed but one may still question its awareness amongst businesses, especially SMEs. We believe there is scope to review the STEMNET programme to ensure that more is being done to engage with undergraduates studying STEM disciplines and encourage them to occupy a STEM role upon graduating.

Employers welcome vocational and academic profiles

14. There are various routes into a career in engineering; university-based education, FE college-based vocational education and work-related training (eg apprenticeships). EEF members welcome new recruits from both academic and vocational backgrounds, and do not tend to prioritise one over the other, instead seeing them as complimentary.

15. A survey of employers by City & Guilds revealed that many employers would prefer to take on an apprentice than hire a graduate. This is likely to be due to seeing a faster return on investment with an apprentice. The poll also showed that over half (52%) of companies which already recruited apprentices believe they offer greater value than hiring graduates. Despite this, the report also found that one in five companies thought it was too risky to take on an apprentice in the current economic climate.⁶²

16. The number of new starts apprenticeships in all subjects has increased from 65,000 in 1996–97 to 279,000 in 2009–10, an increase of 330%. In this same time period, the number of engineering apprenticeship starts rose from 11,500 to 15,000, an increase of 35%. There was also a slight increase in Level 3 Apprenticeships, which rose from 48.6% to 52.2%.⁶³ Although a “slight” increase is welcomed, the Government must do more to promote high end apprenticeships and ensure that the maximum number of people undertake these. A survey of EEF members revealed that nearly half of respondents planned to recruit apprentices between the ages of 16 and 18 in the next year, and almost a third plan to hire apprentices aged 19 to 23, demonstrating the continuing desire amongst manufacturing companies, including those within the engineering sector, to take on apprentices.⁶⁴

17. The introduction of Higher Apprenticeships demonstrates employers’ enthusiasm for a mix of academic and vocational skills. Higher Apprenticeships not only meet employers’ need for high level skills, but also provide a way of developing a company’s workforce, therefore increasing productivity and maximising efficiency. There are currently 11 Higher Apprenticeships Frameworks, one of which is Engineering Level 4, again showing engineering employers’ desire for high end skills. Within this framework, more and more apprentices work towards a knowledge-based qualification such as a Foundation Degree.

18. Furthermore, Engineering Apprenticeships are highly rigorous. As well as undertaking an array of practical skills tests, apprentices are subject to intense examinations. Therefore Higher Apprentices are becoming a hybrid of both vocational and academic qualifications, and as such provide a viable solution to engineering employers’ increasing desire for practical and academic skills.

Q2. What impact will recent changes relating to engineering qualifications in England have on the uptake of technical subjects and the skills based needed by the engineering sector?

19. The Secretary of State for Education’s announcement that the Engineering Diploma is to be downgraded from five GCSEs to one initially caused concern amongst EEF members. The Diploma is widely recognised by the industry as a route to providing young people, the next generation of engineers, with the skills they need for the future. The downgrading of Diplomas has not sent out the right signal to both employers and young people that Government is serious about the status and value of vocational education. Moreover, identifying the Engineering Diploma as an example of what will be downgraded relayed the message that Government was not committed to rebalancing the economy towards manufacturing.

20. The impact of these changes will undoubtedly be a reduction in the number of schools offering the Diploma as the additional support needed to offer such a course would not be reflected in league tables. Consequently, we will see a fall in the number of students enrolling on it.

21. We are also aware of the National Curriculum Review and the impact this may have on the number of young people studying subjects that encourage young people to pursue a career in engineering. An example of

⁶¹ UKCES (2011), Supply and demand for high-level skills.

⁶² City & Guilds (2011) Business through apprenticeships: a research report.

⁶³ Institute of Mechanical Engineers (IMechE) (2011) Meeting the challenge: demand and supply of engineers in the UK.

⁶⁴ EEF (2011), Flexibility in the Modern Manufacturing Workplaces.

this is the removal of Design and Technology (D&T) as a compulsory subject. Introducing elements of engineering through subjects such as D&T can often ignite a spark in a young person to explore the option of engineering as a career choice.

22. We must stress however that the main priorities for EEF members are qualifications in STEM subjects, and this should be Government's primary focus. We welcome efforts to ensure that young people study these core subjects through all Key Stage levels. Attached to this is impartial careers advice, which will be discussed later on in this submission.

23. We would like to see the Government explore the role of University Technical Colleges (UTCs) further. UTCs are one of the most radical changes we have seen to our education system in some time providing tailored and specialised engineering and technical schools to 14 to 19 year olds. Importantly, employers play an active role in shaping what is being taught so that students obtain the skills and qualifications that are beneficial to them and the workplace. Local and national employers engage with the students by offering work experience so they have real life experience of the working environment.

24. As of May this year the number of UTCs stood at 34, and it is hoped this figure will increase to 100 in the next five years, growth that EEF supports. If UTCs are to be seen as a key source of skills to the engineering industry, then this number must continue to rise at a relatively fast pace. The concern is that UTCs require a substantial amount of investment at a time when government spending is being reduced

25. We are aware of the possible impact of the rise of tuition fees from autumn 2012. Although its real impacts remain slightly uncertain, we may see a fall in the number of students going to university to study STEM subjects including engineering. Recent estimates show fall in applications by 10%, although when looking at engineering disciplines alone, this figure is far lower.

Q3. How do the approaches taken by Devolved Administrations to produce technically skilled workforce differ to the current approach in England? What are the strengths/weaknesses of the different approaches?

Learning lessons from Scotland

26. One of the major challenges in England is the lack of coordination when it comes to delivering skills. In Scotland, information is more readily available in a single portal, notably *Skills Development Scotland*. Its employer services range from funding for employee training and training plan development to redundancy support. *Skills Development Scotland* has decided on three goals (enable people to fulfil their potential, make skills work for employers and be a catalyst for positive change), each with key strategies which articulate its contribution to the Scottish Government's Economic Strategy (GES). The *Scottish Advisory Committee on Lifelong Learning* has also been a contact point for the Scottish Government on all items skills-related. Comprising of employers, training providers, colleges, HEIs and Unite, the Committee acts as a sounding board to the Scottish Government and has been extremely effective in doing so.

27. There are clear benefits of such a Committee in Scotland, as it ensures that Government skills policies are formulated, even in the early stages, against a backdrop of views from relevant stakeholders. Although we would not wish the Government to introduce an additional Committee or Advisory Board, we do believe we can ascribe some of the benefits to existing organisations, such as UKCES.

28. EEF's sister organisation *Scottish Engineering* works closely with *PrimaryEngineer*, and the message is clear that when it comes to instilling interest in manufacturing, you cannot start early enough to promote and encourage a future career within engineering. There is also a strong focus on integrating engineering into the curriculum. What was previously termed Technological Studies has been renamed Engineering Science. The aims are to apply knowledge and understanding of key engineering facts and ideas, apply skills in analysis, design, construction, communicate engineering concepts and develop an understanding of the role and impact of engineering, to name a few. It is easy to see the benefits of introducing subjects that focus on engineering at an early age, as well as the core subjects of English, Maths and Science. We would be keen for the National Curriculum Review to explore the possibility of introducing a subject similar to Engineering Science.

Profile-raising in Wales

29. A positive example of a STEM awareness raising programme in Wales is the *Engineering Education Scheme Wales (EESW)*, which is designed to encourage sixth form students to study engineering in FE or HE. Local firms set R&D briefs related to real industrial problems for teams of Year 12 students. Over a period of six months, the students develop solutions to the problems, working with engineers from the local businesses. The benefits of EESW are enhanced knowledge and capabilities in STEM, interview, teamwork and project management experience and exposure to engineering projects, demonstrating that engineering is an exciting and intellectually challenging career. Through the Extended Projects (120 Guided Learning Hours) students can obtain up to 70 UCAS points, giving them a head-start in applications to HEIs.⁶⁵

⁶⁵ Engineering Education Scheme Wales, <http://www.stemcymru.org.uk/en/getinvolved/eesw/default.php> Accessed at 15/06/2012.

Q4. *Could the Government and others do more to raise the status of technical subjects?*

Profile-raising initiatives

30. EEF welcomes the launch of *See Inside Manufacturing* initiative as a way of raising awareness of the industry. We also strongly back the *Make it in Great Britain Campaign* as a way to champion the industry. Such campaigns and initiatives give engineering a much needed promotional boost. We hope to see a firm commitment from the Government to continue these projects and increase awareness of their work.

31. EEF supports organisations such as *EDT*, *PrimaryEngineer* and *EngineeringUK* in promoting careers in manufacturing and many EEF members already engage directly with schools and FE colleges. However, this work is uncoordinated and some employers are unaware of the avenues that enable employers to connect with schools. Business understands it has a role to play, with 31% of employers offering STEM related work experience and 28% engaging with schools in order to promote STEM subjects.⁶⁶ If we want to see these percentages increase, then barriers that prevent employers from offering work experience and engaging with schools in other forms need to be addressed.

Impartial careers advice is key

32. The key factor to increase participation and raise status of technical subjects is solid, impartial careers advice for young people, their parents and teachers. It is imperative that the recently launched All Age Careers Service promotes engineering apprenticeships, and the rewards of pursuing a career in engineering are relayed to encourage take up.

33. A survey conducted on behalf of City & Guilds in September 2011 found that a quarter of teenagers had never received any careers advice. Of those studying A Levels and university courses, 22% had not received careers advice, increasing to 28% for those undertaking apprenticeships, BTecs and GNVQs. This is extremely worryingly given that the new National Careers Service will not provide face-to face guidance for those under 19.

34. From September 2012, the responsibility of delivering careers advice will fall to schools themselves although this will not be in any prescribed form. It is crucial that those issuing the advice are aware of the various pathways available to young people and identify those careers the young person can excel in. Many companies still struggle to attract new talent straight from compulsory education into industry.

35. Our biggest concern in this regard is the lack of direction as to how schools will offer guidance and the lack of any requirement to engage with business. In our submission to Government ahead of the Budget earlier this year we recommended improving STEM careers advice, by making it part of CPD for science teachers and the subject curricular. It is also important to build real-world relevance into teaching so that young people understand how engineering is integrated into their everyday lives and the opportunities that result from an engineering career.

36. A study by the previously named Department for Trade and Industry (2006) revealed that “employment levels in SET occupation groups are expected to grow faster between 2004 and 2014 than the growth rate across all occupations.” There is therefore a wealth of opportunity for young people to pursue a career in such subjects and these are the messages we should be relaying to our young people.

37. One way of achieving this is by publishing average earnings of STEM occupations in a place accessible to young people, as well as teachers, careers advisors and parents. *Milkround* is a successful programme that provides graduates with key information on what they can do with their degrees, applying for jobs and much more. *Notgoingtouni.co.uk* mirrors the work of *Milkround*, offering young people advice on apprenticeships, jobs and possible gap years. What is still missing however is an accessible portal for young people to view the potential opportunities and benefits, including earnings of pursuing a career in STEM occupations. With the new All Age Careers Advice Service now launched and schools taking on responsibility for careers advice from September this year, this is something we would like to see implemented as soon as possible.

38. Our Budget Submission also called on the Government to implement a minimum standard of careers advice on the whole range of employment and learning options available. To this end, local authorities must have a role in ensuring vocational education and progression routes are given equal in careers guidance.

Q5. *What more could be done to attract and retain a more diverse technically skilled workforce.*

39. EEF’s report *Flexibility in the modern manufacturing workplace* revealed that on average respondents said that almost 80% of their workforce was male. This split between male and female employees was roughly in line with the findings of EEF’s 2009 survey as well as official statistics which put female employment in manufacturing at 24%.⁶⁷

40. Moreover, there is a huge disparity in the percentage of female engineering professions in the UK compared to other European countries. The percentage of women working as engineering professionals in Italy, Spain and Sweden as well as the vast majority of other European countries, was twice that in the UK. UKRC

⁶⁶ CBI (2011), Building for growth: business priorities for education and skills.

⁶⁷ EEF (2011) Flexibility in the modern manufacturing workplace.

research, commissioned by Engineering UK showed that only nine% of engineering professionals are women compared to 18% in Spain, 20% in Italy and 26% in Sweden.⁶⁸

41. Furthermore, nearly two-thirds of men who graduated in engineering and technology disciplines entered employment within engineering and technology, whilst for women this figure was under half (45.8%). There is therefore an immediate need to address the lack of female participation in STEM professions, which will subsequently expand the engineering talent pool.⁶⁹

42. Organisations such as the *UKRC* and *Campaign for Science and Engineering (CaSE)* are a step in the right direction. UKRC provides expert advice and guidance to build gender equality and diversity into science, engineering and technology (SET), working with a range of stakeholders to promote general equality and diversity in SET and assisting thousands of women in STEM careers. Similarly *CaSE* raises the political profile of science and engineering, with a strong focus on overcoming challenges in getting women into STEM. We would like to see a firm commitment from the Government to address this issue and build on the successes of organisations such as *CaSE* to both promote technical subjects and ensure that they are accessible to all.

EEF'S FUTURE WORK ON SKILLS GAP IN THE MANUFACTURING INDUSTRY

43. We are currently conducting a skills survey to provide a baseline of manufacturing skills, illustrating the current investment in skills and training by manufacturers and to identify where skills gaps lie within the industry.

The main objectives of our survey are:

- to determine what the current (and future) needs of manufacturers and in terms of the skills need to support and grow their business;
- to identify how manufacturers currently meet their skills and training related needs;
- to seek employers' views on qualifications available and their value;
- to evaluate the quality of training providers;
- to look at the importance of apprenticeships to business; and
- to explore the need for impartial careers advice.

We look forward to sharing our findings of this report with the Science and Technology Committee in Autumn 2012.

June 2012

Supplementary written evidence submitted by the Department for Education

INTRODUCTION

1. This memorandum provides further written information from the Department for Education (DfE). It responds to the Science and Technology Select Committee's request for:

- (a) Data on the take up of triple science and the number of pupils in schools and colleges taking Maths and Science subjects at GCSE and A-level,
- (b) The list of 140 high quality non-GCSE/iGCSE qualifications,
- (c) The barriers to take-up of science, and
- (d) The impact of Higher Education reforms (ie tuition fees) on the take up of STEM subjects.

MATHEMATICS AND SCIENCE TAKE UP AT GCSE AND A-LEVEL

2. The number of young people taking GCSE triple science has increased year on year since 2007 (table 1) and in 2012, 23% of pupils in state funded schools took triple science (table 2). This is despite a decline in the number of pupils who took GCSEs at the end of KS4 with 561,177 in state funded schools taking GCSEs in 2012.

⁶⁸ Engineering UK, UK has lowest number of female engineers in the whole of Europe http://www.engineeringuk.com/viewitem.cfm?cit_id=383326 Accessed on 31/5/2012.

⁶⁹ Engineering UK (2012), *The state of engineering*, p209–211.

Table 1

NUMBER OF PUPILS TAKING GCSE TRIPLE SCIENCE COMPARED TO NUMBER OF PUPILS TAKING GCSE AT END OF KS4

	2007	2008	2009	2010	2011	2012
State funded schools						
Pupils taking triple science	36,056	51,214	66,421	94,885	113,688	130,319
Overall numbers	600,664	598,102	578,841	578,060	566,927	561,177
All Schools						
Pupils taking triple science	48,585	64,314	80,002	110,489	134,988	152,685
Overall numbers	655,146	653,083	634,496	639,263	627,093	623,440

Table 2

PERCENTAGE TAKE-UP OF GCSE TRIPLE SCIENCE

	2007	2008	2009	2010	2011	2012
State funded schools	6%	9%	11%	16%	20%	23%
All Schools	7%	10%	13%	17%	22%	24%

3. More schools than ever before are now offering triple science with 84% of state funded schools entering pupils for triple science at GCSE in 2012 (table 3). To encourage more schools to offer triple science, the Triple Science Support programme provides practical support and guidance for schools that have either very few pupils or none at all taking triple science and schools in challenging circumstances.

Table 3

PERCENTAGE OF STATE FUNDED SCHOOLS* WITH PUPILS ENTERING TRIPLE SCIENCE.
(* DOES NOT INCLUDE SPECIAL SCHOOLS)

2005	2006	2007	2008	2009	2010	2011	2012
27%	31%	32%	40%	50%	72%	82%	84%

4. The number of young people taking A-levels has increased and the numbers taking STEM subjects has increased in line with this (table 4).

Table 4

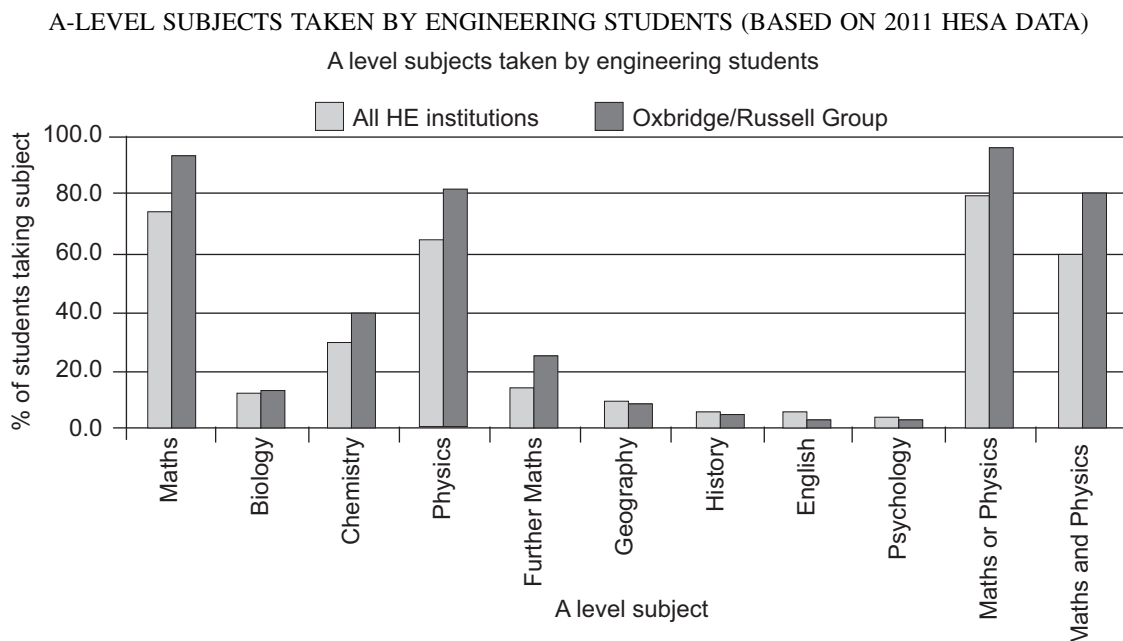
NUMBER OF PUPILS ENTERING A- LEVELS IN STEM SUBJECTS COMPARED TO OVERALL NUMBER OF PUPILS TAKING A-LEVELS (2012 FIGURES ARE PROVISIONAL)

	2007	2008	2009	2010	2011	2012
Biology	46,797	48,397	47,978	52,728	54,739	55,793
Chemistry	35,077	36,328	37,141	40,379	43,250	44,715
Physics	23,887	24,703	25,620	27,786	29,206	30,747
Mathematics	53,331	57,618	64,519	69,803	75,547	78,069
Further mathematics	7,241	8,447	9,443	10,813	11,408	12,387
Number of pupils taking A levels	249,547	256,610	261,218	267,350	258,892	266,211
Number of A levels entered	718,756	741,356	757,696	783,347	782,771	779,500

5. Male students are more likely to progress from GCSE to A-level in maths and physics, while both male and female students are equally likely to progress to A-level chemistry and female students more likely to progress to A-level biology.

6. The percentage of Higher Education engineering students that take maths and physics at A-level continues to remain high (chart 1). The Triple Science Support Programme, Stimulating Physics Network and Further Maths Support Programme (all funded by the Department for Education) are encouraging more students to study qualifications which enhance their prospects of studying and doing well in engineering related subjects at university.

Chart 1



HIGH QUALITY VOCATIONAL QUALIFICATIONS

7. The Wolf Review of vocational education concluded that the system of equivalences currently used in performance tables provided incentives for pupils to take large number of vocational qualifications over core academic study. Too often, these vocational qualifications were not of high quality and did not enhance pupils' opportunities for progression into further education or employment.

8. High quality vocational education is crucial to improving England's educational performance. It is important that vocational education is not seen as the second rate route, where less able young people are directed, before they take up low skilled, low value jobs.

9. We are strengthening the credibility of vocational qualifications by ensuring that school performance tables only recognise high quality qualifications which will count as equivalent to one GCSE in the 2014 Key Stage 4 performance tables. These will serve to remove false equivalences between these qualifications and academic subjects and help to make sure that young people have the relevant qualifications to help them find employment. Employers will also be able to identify qualifications which can meet their needs.

10. To achieve this, we have reduced the number of non-GCSE/iGCSE qualifications in school performance tables from 3,175 to 140 rigorous qualifications. These still include eleven engineering qualifications namely the two "Principal Learning in Engineering" qualifications at levels 1 and 2, which represent the core of the current Engineering Diploma and the:

- (a) Edexcel BTEC Level 1 Certificate in Engineering (QCF),
- (b) Edexcel BTEC Level 1 Diploma in Engineering (QCF),
- (c) Edexcel BTEC Level 2 Extended Certificate in Engineering (QCF),
- (d) Edexcel BTEC Level 2 Diploma in Engineering (QCF),
- (e) City & Guilds Level 1 Certificate in Engineering (QCF),
- (f) City & Guilds Level 2 Certificate in Engineering (QCF),
- (g) EAL Level 1 Certificate in Engineering and Technology,
- (h) EAL Level 2 Certificate in Engineering and Technology (QCF),
- (i) and EAL Level 2 Diploma in Engineering Technology (QCF).

11. To be recognised as a rigorous qualification, qualifications have to offer pupils proven progression into a broad range of further qualifications or careers post-16; be the size of a GCSE or bigger; have a substantial proportion of external assessment and require pupils to use knowledge across their subject; have grades such as A*–G (those with simple pass or fail results will be excluded); and have good levels of take-up among 14 to 16 year olds, if taught for at least two years.

12. This list of qualifications which will count in the Key Stage 4 Performance Tables from 2014 is attached with this memorandum.

BARRIERS TO TAKE-UP OF SCIENCE AND DRIVERS OF PUPIL CHOICE

13. Young people's subject and career choices are driven by many factors including subject engagement and prior attainment, family influences and background, careers information and teacher influence.

14. We believe that primary and secondary phases of schooling are both important in engaging young pupil's interest in science. Pupil's interest in science can initially be engaged at primary school and this interest developed further at secondary school through the influence of good quality teachers and teaching, a well-balanced curriculum and appropriate information about progression routes. All these are fundamental to improving engagement in science.

15. Pupil performance at the end of Key Stage 2 has been fairly consistent over the last few years. It remains important however that primary school pupils' are taught in a way that engages and inspires them to do well in science as they progress through their education.

16. The Ofsted report⁷⁰ on science education cites a lack of specialist expertise among primary teachers, which is needed to challenge more able pupils. More generally across all levels of education, Ofsted identified more practical lessons and the development of scientific enquiry skills as key factors in promoting student engagement, learning and progress.

17. Improving ability in mathematics at primary school underpins good performance and progression in "the sciences". Secondary schools also require good mathematics results as well as science results. Many universities are now encouraging, and in some cases requiring, students to take further mathematics qualifications to improve their preparation for degree courses in mathematics dependent subjects such as engineering and "the sciences".

18. The most important barriers to science enquiry across primary and secondary schools are identified as lack of time in current curriculum arrangements, lack of teacher confidence and lack of appropriate equipment and space.⁷¹ The importance of these factors differs, with secondary schools viewing the lack of time in the curriculum as the main barrier and primary schools prioritising the lack of appropriate equipment and space. We are taking forward a programme of reform to improve the quality of teachers and teaching and this is set out in our initial response to the inquiry in June 2012.

19. The main factors pupils seem to consider when choosing a subject is that they find it enjoyable and that they believe they need the subject for a future job, career or training.⁷² Analysis carried out internally by the DfE indicates that pupils' choices about what subjects they study is motivated by their inherent interest in or enjoyment of the subject and/or a sense that it would be useful in the future. This is in turn affected by individual attributes (perceived subject ability and an understanding of the relevance of the subject to future careers) and external influences (from parents, teachers and curriculum content).

20. DfE analysis also suggests that the impact of these factors vary between individuals and over time, however the key considerations in increasing motivation for studying particular subjects and the quality of pupil's decision making process appear to be:

- (a) an engaging and challenging curriculum and pedagogy;
- (b) well-timed, personalised careers education and guidance;
- (c) high quality, comprehensive and impartial information about subjects and routes; and
- (d) well informed support and advice from parents and carers.

21. Our reform of the National Curriculum is designed to ensure that the primary and secondary programmes of study focus on the core essential knowledge needed to stimulate and challenge children's minds so that they develop a sense of excitement and curiosity about the world around them. Practical science or "working scientifically" will be embedded into the content to ensure sound understanding. We are also funding the network of Science Learning Centres to ensure primary school teachers have access to the development needed to improve the quality of science education in their school and support the introduction of the new curriculum.

22. It is important that pupils have the right information when choosing subjects, courses and places of study. The Department for Education recently held a full, public consultation on extending the age range of the new duty to secure access to independent careers guidance which currently applies to years 9–11. The consultation is looking at extending the duty down to year 8 and to young people aged 16–18 studying in schools and further education from September 2013. Subject to the outcome of the consultation, the age range will be extended by regulations from September 2013.

⁷⁰ *Successful Science*, January 2011

⁷¹ 2008 NFER Teacher Voice survey (Nesta 2008)

⁷² McCrone *et al.* 2005

23. Improving access to information for prospective Higher Education students is a priority in the Higher Education White Paper (June 2011). The Key Information Set⁷³ provides comparable course level information on over 30,000 undergraduate courses at UK universities and colleges. This information will help students make decisions, so they make the best choice of course and university.

24. There is also a need for high quality advice and guidance. The “UCAS” consultation on the HEI application process identified the importance of high quality guidance on the ability of an applicant to make effective choices. Informal sources of information, advice and guidance are also particularly important to young people.⁷⁴ Family and friends are considered by pupils to be their most important source of career information and advice and pupils may generally prefer receiving subject information from people over information in written sources.

IMPACT OF HIGHER EDUCATION REFORMS

25. The percentage of acceptances on STEM courses at University has increased. In 2012, 41.0% were on STEM courses (170,418 out of 415,444 people who were accepted to full time undergraduate courses in the UK). In 2011, 40.2% were on STEM courses (178,707 out of 444,784 people accepted to full time undergraduate courses in the UK).

26. There is no evidence that increased tuition fees have led to fewer young people taking up STEM subjects or taking up professional degrees. The increase in the number of students taking STEM related GCSEs and A levels, is encouraging. And, whilst there has been a drop in the numbers of overall applications to Higher Education in 2012–13, applications to STEM subjects have held up well. Our HE reforms enable prospective students to be able to access improved information about their Higher Education choices.

November 2012

Further supplementary written evidence submitted by the Department for Education

INTRODUCTION

This memorandum provides further written information from the Department for Education (DfE). It responds to the Science and Technology Select Committee’s questions at the oral hearings on 21 November 2012 with Carole Willis (DfE Chief Scientific Adviser) and Ministers Hancock and Truss.

1. Q 163—Ms Willis mentioned a leaflet on RCTs and sending us some information on RCTs. We would like that leaflet (electronically if possible) and any internal/external guidance that the DfE uses in deciding whether to conduct a RCT on a policy area.
2. Q 170/171—Ms Willis was asked about the DfE research budget over this spending review period. She told us it was £9.5 million this year; could we have the figures for the whole SR period (2011–12 to 2014–15)?
3. Q 217—Mr Hancock offered to provide figures on apprenticeships. Could we have figures for (i) total apprenticeship starts and (ii) engineering apprenticeship starts since 2009? Also if possible, could we have similar data for apprenticeship completions?
4. Ms Willis also agreed to send data on the English Baccalaureate to confirm the information provided at the hearing.

1. Randomised controlled trials

The leaflet on RCTs is “*Test, Learn, Adapt: Developing Public Policy with Randomised Controlled Trials*” published by the Behavioural Insights Team at the Cabinet Office in collaboration with Ben Goldacre, author of *Bad Science*, and David Torgerson, Director of the University of York Trials Unit.⁷⁵

This document argues that RCTs, now widely used in medicine, international development and internet-based businesses, should be used more extensively in public policy. It sets out nine separate steps that are required to set up an effective RCT.

In deciding whether to conduct an RCT in any policy area, the Department is able to draw on academic expertise from organisations such as the Institute of Education and the Institute for Fiscal Studies. They provide research advice and capacity to the Department through our three research centres. Leading members of these organisations already oversee RCTs in the education sector, notably through projects commissioned by the Education Endowment Foundation.

⁷³ The Key Information Set (KIS) pulls together key facts students need to choose a higher education course including information on graduate salaries and employment, tuition fees and financial support.

⁷⁴ Longitudinal Survey of Young People in England (LSYPE) (DCSF 2009)

⁷⁵ <http://www.cabinetoffice.gov.uk/resource-library/test-learn-adapt-developing-public-policy-randomised-controlled-trials>

As a matter of principle, the Department seeks the best methodology for each research or evaluation study that it conducts. The option of an RCT is considered as an approach for assessing clearly-specified initiatives. Our decisions are informed by a range of cross-Government guidance and academic expertise. We use HM Treasury guidance on policy evaluation methods published in the “*Magenta Book*”; and the companion HM Treasury guidance on economic appraisal (the “*Green Book*”).

2. DfE Research Budget

The DfE’s research budget was £9.5 million in 2011–12; it was £9.5 million at the start of 2012–13. The budget was reduced during this year as, after careful review, it seemed highly likely that it would be underspent this year and the funds were needed for other priorities. We expect to spend around £6.2 million on research this year. In addition to the research budget, evaluation activity is funded from a range of different programme budgets across the department, depending on the need to evaluate new policy initiatives. There is no fixed budget for this evaluation activity. The Department’s detailed budgets—including the research budget—have not been decided for the remainder of the spending review period. They are subject to a business planning process which is currently underway and will conclude in the New Year.

3. Engineering Apprenticeships

The Department for Business, Innovation and Skills has provided the following data:

(i) Total and Engineering Apprenticeship starts

<i>Sector Subject Area</i>	<i>2008–09</i>	<i>2009–10</i>	<i>2010–11</i>	<i>2011–12</i>
	<i>Full Year</i>	<i>Full Year</i>	<i>Full Year</i>	<i>Full Year</i> <i>(provisional)</i>
Engineering and Manufacturing Technologies	36,990	37,860	48,970	57,000
Grand Total	239,900	279,700	457,200	502,500

(ii) Total and Engineering Apprenticeship achievements

<i>Sector Subject Area</i>	<i>2008–09</i>	<i>2009–10</i>	<i>2010–11</i>	<i>2011–12</i>
	<i>Full Year</i>	<i>Full Year</i>	<i>Full Year</i>	<i>Full Year</i> <i>(provisional)</i>
Engineering and Manufacturing Technologies	22,890	26,090	27,040	28,300
Grand Total	143,400	171,500	200,300	233,700

4. *The English Baccalaureate*¹

The following table outlines the evidence provided to the Committee by Carole Willis on the English Baccalaureate. The provisional data for 2012 shows that 25% of pupils at the end of Key Stage 4 took all of the components that make up the English Baccalaureate.

	<i>Pupils entering the English Baccalaureate</i>		<i>Pupils achieving the English Baccalaureate</i>	
	<i>Number</i>	<i>Percentage of KS4 cohort</i>	<i>Number</i>	<i>Percentage of KS4 cohort</i>
All Schools ²				
2009–10	140,551	22.0	99,652	15.6
2010–11	148,986	23.8	110,374	17.6
2011–12 ⁴	155,839	25.0	113,101	18.1
State-funded Schools ³				
2009–10	126,172	21.8	87,518	15.1
2010–11	122,524	21.6	87,090	15.4
2011–12 ⁴	129,248	23.0	89,923	16.0

Coverage: England

Source: Statistical First Release—GCSE and Equivalent Results in England 2011–12 (Provisional)⁷⁶

Table Notes:

1. The definition of the English Baccalaureate is outlined in the “Definitions” section of the SFR.
2. All schools include state-funded schools, independent schools, independent special schools, non-maintained special schools, hospital schools, Pupil Referral Units and Alternative Provision.
3. State-funded schools include Academies, Free Schools, City Technology Colleges and state-funded special schools but exclude independent schools, independent special schools, non-maintained special schools, hospital schools, Pupil Referral Units and Alternative Provision.

Figures for 2011–12 are provisional, all other figures are final.

December 2012

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⁷⁶ www.education.gov.uk/researchandstatistics/statistics/recentreleases/a00214981/gcse-national-curriculum-teacher-assessment-ks3-england