skills Commission

SPOTLIGHT ON...

Women accessing careers in engineering

“Attitudes and perceptions take time to change, making it all the more important that the government take action now - both to use the upcoming skills system reforms and to bring in additional measures to support more women into engineering.”

Lucy Allan and Preet Kaur Gill MP, Parliamentary Inquiry Co-Chairs

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FOREWORD

Improving STEM skills in England, and in particular of the wide variety of skills and employment opportunities known in shorthand as 'engineering', is a key prerequisite to delivering economic growth and capitalising on the Government's initiatives in its Industrial Strategy published in November 2017.

There is a serious shortage of such skills in the workforce and it is important to increase our home grown talents. Achieving this ambition relies critically on increasing the number of women in the engineering workforce. Currently women only account for around 1 in 10 of engineers, which is particularly low by OECD standards.

We are conscious that there have been many attempts to grapple with the representation of women in engineering, through specific initiatives and 'mainstreaming'. But these have only scratched the surface of what is a deep-seated problem with its roots in our cultural norms and gender bias. As the problem is not just a workforce diversity issue, but starts in the education and skills system, this inquiry examined why women are under-represented within engineering courses at levels 2-6. It looked at the structural and cultural barriers to participation, what has been done already to try to improve the situation and whether it has worked, including looking at overseas examples and at what should be done now.

These are urgent issues and ones that will not be solved overnight. Attitudes and perceptions take time to change, making it all the more important that the government take action now - both to use the upcoming skills system reforms and to bring in additional measures to support more women into engineering. The recommendations we set out below look at what is needed from early school years to later-in-life re-entry and retraining.

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RECOMMENDATIONS

Improving educational pathways into Engineering

Recommendation

Unconscious bias training should be provided to all teachers, within a framework of whole school measures, on a routine basis as part of Qualified Teacher Status.

Recommendation

Ofsted criteria should include reporting criteria around challenging gender stereotypes.

Recommendations for the public sector: showing leadership

Recommendation

The government should apply the learning on Equality, Diversity and Inclusion (EDI) and procurement from the transport sector across all public sector procurement.

Recommendations for industry: showing leadership

Recommendation

In the private sector, large employers should show leadership by including EDI requirements in their procurement from their immediate supply chain.

Getting maximum impact from sector initiatives

Recommendation

BEIS, DfE and the Government Equalities Office should provide joint funding to a central organisation empowering them to provide clear oversight of 'women in engineering' initiatives, acting as a central hub for shared learning and point of contact for education practitioners. It would be good practice for government funded initiatives to be independently evaluated.

Recommendation

The Career Learning Pilot should be used to investigate the most successful ways to re-train and engage adult women in engineering.

Monitoring progress

Recommendation

Government Equalities Office should collect longitudinal data on employment outcomes of women engineering apprentices and graduates, by employer size, region and role type to better understand retention, highlight good practice and areas of concern. This data should be reported periodically in Parliament.

1 INTRODUCTION

The Government has proclaimed 2018 as the 'Year of Engineering', as part of a campaign aimed at promoting and celebrating engineering. Engineering contributes 26% to the UK's GDP[1] and developing skills in this area is a key element of the Industrial Strategy. Given that between 12% of the engineering workforce is made up of women making engineering more open and accessible to women will help significantly in addressing skills shortages within the sector. In addition, as is well evidenced, gender diversity will not just fill skills gaps but will enhance economic productivity.[2]

There is a significant body of academic and policy research regarding women's participation in STEM sectors, as well as active campaigning from organisations such as WISE, Women in STEM, and the Women's Engineering Society (WES), who partner with many engineering organisations taking action. The Commission heard that the very fact women are still so underrepresented in engineering, despite all of this great work, indicates how deeply culturally rooted this issue is and the need for a step-change in how we tackle it. In recent years there has been a very modest growth in the proportion of women in the engineering sector, but there is still a long way to go.

"Much noise and investment has been made by subsequent Governments, employers and sector bodies seemingly to little avail. Efforts so far seem to have chipped away at the edges of the problem without bringing about the step-change that is required to make engineering a diverse and representative sector"

- Young Women's Trust, written evidence

If the UK is to achieve higher levels of home-grown skills in the sector, a post-Brexit aspiration, it will be the more important for policymakers, education providers and employers to work together in a focussed way to tackle the key causes of the skills gap. This is the case in terms of both overall numbers but also, crucially, diversity in the industry: the economic 'business case' for improving gender balance across the industry is now much better understood.[3]

Occupational segregation - that is the tendency of men and women to be disproportionately employed in different occupations - is a major contributor to determining the wages of men and women.[4] Occupations can be distinguished by gender for many different reasons, from social norms to personal preferences (which can also be grounded in social norms), to

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1 Engineering UK (2017), 'The state of engineering.' Available at: http://www.engineeringuk.com/media/1355/enguk-report-2017.pdf

2 McKinsey&Company (2018), 'Delivering Through Diversity'. Available at: https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Organization/Our%20Insights/Delivering%20through%20diversity/Delivering-through-diversity_full-report.ashx

3 Westminster Business School (2014), 'Diversity in STEMM: Establishing a business case.' Available at: https://royalsociety.org/~/media/policy/projects/leading-the-way/exec-summary-diversity-business-case-june-2014.pdf?la=en-GB

4 Arcila, Andres & Ferrer, Ana. (2018). Occupational segregation, skills, and the gender wage gap. 10.13140/RG.2.2.22850.27848

discrimination by employers. In the UK, women tend to cluster in the '5 Cs' – cleaning, catering, caring, cashiering and clerical work – men tend occupy a wider range of occupations.[5] Economists have attributed recent narrowing of the pay gap to significant gains in academic attainment and work experience, however much of the remaining pay gap is due to the types of occupations men and women typically hold.[6] Other economists have determined that where gender pay gaps exist within occupations, it is often due to differences in working hours.[7] Thus one of the most important mechanisms for driving up women's wages relative to men is to tackle occupational segregation so that men and women both feel comfortable in working in all occupations.

The legislative requirement from 6 April 2017 for all companies with over 250 employees to report on their gender pay gap is a welcome step in encouraging employers to tackle diversity issues by shining a light on the problem. But it is not enough to reverse self-selection by women into particular occupations based on deep-rooted cultural prejudices and gendered stereotyping within society - proactive measures are needed to tackle such prejudices at the very earliest stages in the education/work cycle. In June 2018 the Public Accounts Committee reported that departments were making insufficient progress in addressing gender imbalance in STEM, calling for the implementation of targets on STEM learning programmes such as apprenticeships.[8] As this inquiry shows, monitoring is a key element to making progress and we endorse the PAC's recommendation.

Our inquiry draws on oral and written evidence as well as a literary review to look at how this issue can be tackled (See Methodology, page 32). As many contributors to our inquiry highlighted, encouraging more women to take up careers in engineering will require a multi-faceted approach: [9]

"[The] contextual realities of women's lives and experiences mean more nuanced approaches and solutions are required to address the engineering gender imbalance; one size will not fit all."

- E4E, written evidence

1.1 Defining engineering

Defining engineering is itself a contentious issue, as it covers a very broad range of professions and roles in England, and is changing rapidly with advances in technology - a number of contributors highlighted the exciting array of careers available in engineering. But the sector still suffers from an out-of-date image as a 'dirty, manual job for men' or as

[5] http://www.equalpayportal.co.uk/gender-pay-gap/

[6] http://www.nber.org/papers/w21913

[7] https://scholar.harvard.edu/files/goldin/files/goldin_aeapress_2014_1.pdf

[8] House of Commons, Committee of Public Accounts (2018), 'Delivering STEM skills for the economy'. Available at: https://publications.parliament.uk/pa/cm201719/cmselect/cmpubacc/691/691.pdf

[9] Education 4 Engineering (E4E) written submission to the Skills Commission

something specialised and irrelevant to the issues young people care deeply about. To shake off this image the Royal Academy of Engineering and Tomorrow's Engineers 'This is engineering' campaign has sought to set out what careers in engineering look like in the 21st Century and the pervasiveness of engineering in our everyday lives, from design to fashion and sport.[10]

"Engineering is a vastly diverse discipline with a wide range of academic and vocational entry points across all levels and encompassing many different activities from being at the forefront of artificial intelligence developments, designing cities of the future, to helping ensure clean water supplies to developing countries. Despite the pervasiveness of engineering in our lives, it is too often poorly understood and unrecognised, which means that large sections of the population are unaware of its economic value to the UK and the sheer breadth of opportunities that lead to fulfilling careers"

- E4E submission

Contributors repeatedly told the Commission that these perceptions are still deeply entrenched in our society, and will take time to change. The sheer breadth of the term engineering makes it particularly difficult to distinguish the different types of roles available and match with young women's interests.

"There are other countries where engineer is a title, like professor"

- Evidence session 1

"I don't know what it is [engineering], but I know [I] couldn't do it with my grades"

- ASPIRES project participant

This immediately presents a challenge when getting young people and wider society to think about the breadth of careers available in the sector. At one evidence session engineering was described as 'almost a redundant term' because of its breadth. We will explore later some of the ways the education sector and professional engineering sector are tackling these perceptions.

Grouping 'engineering' under 'STEM' can also make it hard to disaggregate the effects of some of the many initiatives and campaigns aimed at increasing female participation and means we need to be cautious when looking at data, as greater uptake of subjects like Biology and Psychology can skew overall results.

Disparities in definitions also mean that comparing 'like with like' with other countries is a challenge. Engineering UK, the Royal Academy of Engineering, and the Engineering Council agreed a 'sectoral footprint' in 2017 to aid comparability of data, which sets out the Standard Occupational Classifications that fit into engineering. This is a positive step

10 https://thisisengineering.org.uk

forward, but this footprint is still not used universally, and is important to consider when making global comparisons.

1.2 Government investment

Successive governments have attempted to address the shortage of women in engineering, for example through national campaigns such as 'Your Life' and 'Year of Engineering'. Commitments to tackling the underrepresentation of women have formed part of a number of government strategies and reports in recent years, including the John Perkins Review of Engineering Skills and more recently, in the Post-16 Skills Plan and Careers Strategy.

However, according to a report by the Science and Technology Select Committee, since 2008 government investment in diversity in STEM has gradually reduced in real terms (Table 1). This is largely a consequence of the decision to end government funding of the UK Resource Centre (UKRC). The UKRC was set up following the publication of the SET Fair report in 2002 led by Baroness Professor Susan Greenfield to examine the challenges of women in science, before joining efforts with WISE to become UKRC-WISE. In 2011 funding was cut and the government announced it would pursue gender equality through a strategy of 'mainstreaming' equality and diversity issues within policymaking and 'embedding' equality and diversity in existing Government funded projects.

Table 1: Government investment in Women in STEM initiatives, 2008/9-2014/15 (in £'000s)

Financial Year							
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Royal Academy of Engineering	0	0	0	275	276	277	278
Royal Society	2,992	3,430	4,045	3,941	3,414	2,754	2,291
UK Resource Centre for Women in STEM	2,538	2,443	2,468	500	0	0	0
Daphne Jackson Trust	0	0	0	0	0	40	
Total in cash terms	5,530	5,873	6,513	4,716	3,690	3,071	2,569
Total in real terms	6,070	6,274	6,780	4,800	3,690	2,972	2,467

Source: Data provided by BIS to the Science and Technology Select Committee (2014). Total in 'real terms' calculated by the House of Commons Library, benchmarked in 2014/15.[11]

[11] Science and Technology Committee (2014), 'Sixth Report, Women in Scientific Careers'. Available at: https://publications.parliament.uk/pa/cm201314/cmselect/cmsctech/701/70105.htm. Data provided by BIS to the Science and Technology Select Committee (2014). Total in real terms calculated by the House of Commons Library

Nonetheless there have been a few targeted initiatives in the last few years. In 2014 the then Skills and Enterprise Minister, Matt Hancock, announced a £30 million engineering skills fund, £10 million of which would be set aside specifically for women in engineering.[12] However, this fund came under some criticism after just three successful bids were made in the first year, with some anecdotal evidence suggesting the requirements were too restrictive. In 2015 the then Skills Minister, Nick Boles, announced funding for two further projects worth £208,000, specifically focused on retraining and upskilling women already in the sector. One was to WS Atkins to support the training of 100 women to support their return to work after a career break and the second to Hyder Consultancy to upskill 80 women engineers up to level 4.[13] In addition BEIS have been a long-term funder and supporter of the STEM Ambassador programme.[14]

More recently in Government policy, the Post-16 Skills Plan highlighted the key issues at play. The plan set out:

"We want to make sure that girls are able to choose from a broad range of careers and are not hindered by stereotypes. In particular, we want to encourage more women to go into science, technology, engineering and maths (STEM) occupations, which carry a significant wage premium. The lack of women within STEM occupations is a significant factor contributing to the gender pay gap, which we want to eliminate within a generation. While around half of all apprenticeships are taken up by women, not enough women are accessing apprenticeships in STEM occupations. As set out in paragraph 2.11, we are taking action to address this."

Paragraph 2.11 the Post-16 Skills Plan sets out some of the general steps that will be taken to reach the target of three million apprenticeship starts by 2020, such as the creation of apprenticeship standards, establishment of the Institute for Apprenticeships (IfA) and putting employers in control. The Skills Plan (2016) references engineering and gender balance and singles out the transport sector as an area where government has set 'ambitions' for progress:

"Further work to attract and support more women to start apprenticeships of all types, including those traditionally dominated by men, with an ambition for 20% of new entrants to engineering and technical apprenticeships in the transport sector to be women by 2020, and gender parity in the working population by 2030 at the latest"

We set out later what the government can do to target investment so as to address the shortage of women in engineering.

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[12] Department for Business, Innovation and Skills (2014), '£30 million fund to secure supply of engineers and boost number of women in sector'. Available at: https://www.gov.uk/government/news/30-million-fund-to-secure-supply-of-engineers-and-boost-number-of-women-in-sector

[13] Department for Business, Innovation and Skills (2015), 'Government joins forces with industry to get more women into engineering'. Available at: https://www.gov.uk/government/news/government-joins-forces-with-industry-to-get-more-women-into-engineering

[14] STEM Learning, 'Continuing Support for STEM Ambassadors confirmed'. Available at: https://www.stem.org.uk/news-and-views/news/continuing-support-stem-ambassadors-confirmed

1.3 Women in engineering: the skills pipeline

According to Engineering UK, women account for 47% of the UK workforce but just 12% of engineers, and 20.5% of the engineering sector more broadly.[15] Just 6.8% of EMT apprentices in 2014/15 were women.[16]

Recent research from the Centre for Vocational Education Research (CVER) shows that Engineering and Manufacturing Technology (EMT) is one of the highest paying sectors for those who complete an advanced apprenticeship. It is the most popular sector in which men complete advanced apprenticeships, with average earnings at 28 found to be £29,265.[17] In stark comparison, the most popular sector in which women complete advanced apprenticeships is Child Development and Wellbeing, where average earnings at 28 are just £12,038.

Based on IER 'Working Futures' data, Engineering UK estimates that based on the need to fill engineering roles, at Level 4+ there is a 44,826 annual shortfall in core engineering skills supply. At Level 3+ this increases to 59,281.[18] While 'engineering' is a generic term, for the purposes of estimating skills supply and demand in the sector Engineering UK break the broad sector of "engineering" down into different tiers of graduate level study, and 'core' apprenticeships in engineering and technology. (See Annex A for a breakdown of Tier 1, 2 and 3).

The Government's Industrial Strategy, drawing on data from the UK Commission for Employment and Skills (UKCES) and the CBI, drew attention to the need to address the unmet demand from employers for STEM graduates. This has triggered debate about the level at which skills shortages are most acute in the Engineering sector. The Lords Economic Affairs Committee's report published in 2018 into demand for engineering skills found a particular shortage of sub-degree, technician level skills, at levels 3-5. The Committee reported evidence that a general shortage in vocational skills over the last 20 years meant the sector was often reliant on an ageing workforce to fill these types of roles. They received evidence from Siemens that recent graduates with academic qualifications were often 'not equipped' to fill technical roles.[19] This suggests there are two key issues – one about whether the qualification routes into the workforce are providing the right types of skills, and the other about numbers coming into the workforce. In relation to both issues a fundamental part of the Government's strategy should be to attract more women into engineering and then to retain them.

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[15] Engineering UK (2018), 'The state of engineering.' Available at: https://www.engineeringuk.com/report-2018

[16] FE Data Library

[17] C. Cavaglia, S. McNally, G. Ventura (2017), 'Apprenticeships for Young People in England: Is there a payoff?' Research Discussion Paper 010. Available at: http://cver.lse.ac.uk/textonly/cver/pubs/cverdp010.pdf

[18] This is based on Demand of 87,061 Level 4+ core engineering occupations and 123,790 level 3+ Core Engineering roles and supply of 35,654 Level 3 and 4+ apprentices and 58,670 graduates across tiers 1-3. See Annex A for a definition of tiers 1-3. Source: IER Working Futures data, cited in Engineering UK (2018), 'The state of engineering.' Available at: https://www.engineeringuk.com/report-2018

[19] House of Lords Economic Affairs Committee (2018), *'Treating Students Fairly: The Economics of Post-School Education'* https://publications.parliament.uk/pa/ld201719/ldselect/ldeconaf/139/139.pdf

The next section will look in greater depth at issues around the qualification routes into the workforce - the current 'supply' of skills through technical and higher education.

1.4 Women in engineering education and training

Qualifications at level 3 and above are widely cited to be the most useful entry routes for a career as a professional engineer or technician[20] through either FE or HE, and more recently jointly between the two sectors through Degree Apprenticeships.

Technical education

Excluding apprenticeships, estimates from the Royal Academy of Engineering and the Gatsby Charitable Foundation suggest there are around 75,000 full-time students taking level 3 engineering qualifications, 10,000 part-time students taking level 3 engineering qualifications and 27,000+ students taking level 4+ engineering qualifications, though accurate data is hard to get.[21]

Just looking at the Engineering, Manufacturing and Technology Sector Subject Area (which does not include all related engineering disciplines), Table 2 shows the proportion of female participation in NVQs, SVQs and VRQs in 2013/14.[22]

Table 2: Vocational qualifications by gender, Engineering, Manufacturing and Technology sector (NVQ, SVQ and VRQ data for 2014/15

	Male achievements	Female achievements	%Female achievements
NVQs/SVQs	2,000	0	0%
VRQ	4,300	1,300	30%
QCF Qualifications	236,300	33,100	14%

Source: FE Data Library

[20] Royal Academy of Engineering (2016), 'The UK STEM Education Landscape', Available at: https://www.raeng.org.uk/publications/reports/uk-stem-education-landscape

[21] ibid

[22] National Vocational Qualifications (NVQs), Scottish Vocational Qualifications (SVQs) and Vocationally Recognised Qualifications (VRQs). In 2017 the Regulated Qualifications Framework (RQF) replaced NVQs

Apprenticeships

In 2016/17, provisional data indicates that 8% of Engineering, Manufacturing and Technology (EMT) apprentices were women, but this varies by framework/standard, with figures for some as low as around 3%.[23]

Throughout our inquiry, concerns were highlighted over some of the negative societal perceptions of apprenticeships, given that apprenticeships are such a key route into engineering. Recent research from Learning and Work Institute in partnership with the Gatsby Foundation found that although fewer women than men apply for EMT apprenticeships, there is more interest than perhaps otherwise thought. While success rates for male and female applicants are similar, men are more likely just to apply for EMT subjects whereas women are more likely to apply at the same time to other, often completely unrelated sectors. Men are also more likely to try again if they at first do not succeed: 43% of men reapply if first unsuccessful for an EMT apprenticeship but only 25% of women do. Together this suggests that encouraging more focus on the sector and persistence in application could be one way to raise the number of women EMT apprenticeships.[24]

In general, the age profile of engineering apprentices is slightly lower than for apprenticeships as a whole. In 2015/16, 36% of EMT apprentices were under 19 and 32% were 25 and over, compared with 26% and 44% respectively for all apprenticeships. This slightly younger age profile is potentially significant when thinking about targeting interventions early to encourage young girls to consider a career in engineering.

Higher education

In Higher Education courses, the gender balance in engineering has slightly improved, but is still low. According to Engineering UK (2018), in 2015-16 16% of first degree engineering and technology students were women whereas 56.1% of overall first degree entrants were women.[25]

HESA data shows that the proportion of women engineering students has remained relatively stagnant since 2005/6, with a very slight increase in the absolute number of women engineering students. Over the coming years as degree apprenticeships develop, it will also be important to look at the gender balance within this type of provision.

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[23] FE Data Library

[24] Learning and Work Institute (2018), 'Understanding the under-representation of women in engineering apprenticeships'. Available at: http://www.learningandwork.org.uk/wp-content/uploads/2018/03/Understanding-the-under-representation-of-women-in-engineering-apprenticeships-1.pdf

[25] Engineering UK (2018), 'The state of engineering.'

2 PATHWAYS INTO ENGINEERING

Given the evident skills shortages within the sector our education system should provide young women with a number of pathways into engineering.

It is important that the curriculum and such pathways keep the door open for as long as possible for women.

Throughout this inquiry, the steering group heard evidence on the system of early specialisation at secondary school level, which may be failing to leave opportunities for women to change their mind or be inspired to pursue a career in engineering at a slightly later stage.

2.1 International learning

To understand how we could improve our pathways for young women into engineering, the Commission looked to international best practice in countries where the proportion of women in engineering is higher. Widely cited Eurostat data, analysed by UKRC, shows that the UK has the lowest percentage of women engineering professionals in Europe, at less than 10%, while Latvia, Bulgaria and Cyprus lead with nearly 30%.[26] When looking at this dataset, it was highlighted that within Europe, while many countries perform slightly better than the UK, few do particularly well.

Some emerging markets have experienced particularly high rates of growth of female participation in engineering. For example, Mexico, Hungary and Turkey have increased the absolute number of women graduates in engineering from 2008-12 by over 150%, compared with 31% for the UK in the same time period.[27] Evidence suggests that significant growth in their manufacturing bases is partly driving this, simply by providing job opportunities. In Mexico for example, former President Felipe Calderon had a vision for Mexico to be a 'country of engineers'.[28] Rationally, women might also be more inclined to pursue more lucrative STEM careers in emerging economies, in what has been described as the 'gender-equality paradox'.[29] In advanced industrial societies, the breadth of careers on offer is vast and as affluence increases, research suggests career choices can become more closely associated with personal identity and choice, rather than either the simple need for any job, or about going into the best-paid sectors. This association with personal identity is

[26] The Women's Engineering Society, 'Useful Statistics'. Available at: http://www.wes.org.uk/content/wesstatistics [Accessed 4th June 2018]

[27] CEBR for Royal Academy of Engineering (2016), 'Engineering and economic growth: a global view'. Available at: https://www.raeng.org.uk/publications/reports/engineering-and-economic-growth-a-global-view

[28] ibid

[29] Gijsbert Stoet and David C. Geary (2018), 'The Gender-Equality Paradox in Science, Technology, Engineering, and Mathematics Education'. Psychological Science, Vol 29, Issue 4, pp. 581 – 593. Available at: https://doi.org/10.1177%2F0956797617741719

where gendered prejudices and perceptions enter into decision making.[30] This was supported by one witness who highlighted the difference in Pakistan, India, China and Mexico:

"Research indicates and my personal opinion suggests that in [developing economies], having a job is so important… it doesn't matter whether the discipline is perceived to be male dominated, you just need a job… It's a virtuous circle, you go [into engineering] because you need a job, it's well paid, it's recognised as a professional discipline, whether you are a chartered engineer or not … you get more women in to the profession, you have more role models."

- Elena Rodriguez-Falcon, Evidence Session 2

What this suggests is that a very important issue to be tackled in the UK, as an advanced industrial country, is of making engineering more relevant to the issues that young people care about in their lives.

2.2 Integrating the curriculum

A further key area of difference that arose from our international comparisons is the curriculum and pathways on offer:

"Some of the European work being done on this suggests that initiatives that start young and look at the curriculum and how that can be diversified … [if]we can look at the curriculum and think about how that might speak more directly to a more diverse population that might be helpful."

- Professor Alison Fuller, Evidence Session 1

Unlike many other countries, our system encourages early subject specialisation, and contributors repeatedly told the Commission this is narrowing the pipeline of talent.

[30] http://www.asanet.org/sites/default/files/attach/journals/mar6socuisfeature.pdf Venus, Mars, and Math: Gender, Societal Affluence, and Eighth Graders', Aspirations for STEM, Maria Charles. https://doi.org/10.1177/23780231176971

At secondary school level, the pressure placed on schools by league tables, the EBacc and Progress 8, leads to a narrowing of the curriculum:

"Unfortunately in that traditional secondary stage, I think schools are judged on how well students do in academic subjects… The curriculum isn't broad enough because schools want a good Ofsted inspection; this is what parents are going to be looking at."

- Jacqui Henderson, Skills Commission Co-Chair, Evidence Session 1

This is combined with the fact that students can effectively 'opt-out' of some science, technology or education at a relatively young age, particularly triple science at GCSE level. There is some research to suggest that the influence of peers and 'gender beliefs', might be reduced if subject choices are made at a later age.[31] The decision to introduce Engineering at GCSE level was felt to have been counterproductive, as women who hadn't chosen to complete a GCSE in Engineering might feel even more excluded from moving on to an engineering pathway later on.

As well as avoiding labelling engineering as a 'distinct' (and currently off-putting) subject, it is important that Physics and Maths GCSEs are not always seen as prerequisites for advanced study for engineering.

Subjects such as Design & Technology can act as an entry point for students into engineering and act as a way to capture and sustain interest. The Edge Foundation, chaired by Lord Kenneth Baker, proposed that a design and technology GCSE or approved technical award should form part of 'A new Baccalaureate'.[32] In 2017 the Institute of Civil Engineers and the Creative Industry Federation further highlighted the importance of arts and creative subjects for engineers of the future.[33]

Both in UK and abroad there are some innovative examples of engineering being introduced into the curriculum to boost engagement. For example, in 2013 the Hungarian Government reviewed school textbooks to remove stereotypes and develop an awareness of gender equality. The new content developed included sections celebrating successful women in STEM, including physics.[34] For women and girls, this type of practice could provide much needed exposure to engineering. Many of these initiatives are about increasing participation of all students in engineering, not just specifically women, but some have specifically targeted underrepresented groups. Professor Louise Archer commented that the 'version and nature of what is introduced is also critical'. If implemented badly, such initiatives could simply reinforce existing gender stereotypes. Evaluation of some existing STEM programmes, such as a number of 'Computer Clubs for Girls' initiatives, shows that

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31 Buchmann and Dalton 2002; Gerber and Schaefer 2004 in Charles, M. (2017), 'Venus, Mars, and Math: Gender, Societal Affluence, and Eighth Graders', Aspirations for STEM'. Available at: http://www.asanet.org/sites/default/files/attach/journals/mar6socuisfeature.pdf

32 Edge Foundation (2016),'14-19 Education: A new Baccalaureate'. Available at: http://www.edge.co.uk/sites/default/files/documents/14-19_education_-_a_new_baccalaureate.pdf

33 https://www.creativeindustriesfederation.com/sites/default/files/2017-05/CIF_EduAgenda_spreads.pdf

34 OECD (2017), Chapter 7, The under-representation of women in STEM fields. In 'The Pursuit of Gender Equality: An Uphill Battle'. Available at: http://dx.doi.org/10.1787/9789264281318-10-en pg. 6

interventions that fail to tackle wider cultural and social barriers to female participation can only have limited results.[35] Learning from effective initiatives should be made available across the sector, for example provided to teachers to raise awareness of how to tackle unconscious bias (we come back to the question of training later).

Post-16, the Commission also sought to explore whether the new T levels could be a further way to address some of the barriers that girls face in studying engineering. Aside from concerns around work placements and time-scales for T level delivery, a T level in engineering has some potential to help girls gain exposure to a non-traditional occupation in a 'safe' environment. However, this would only be the case if the qualification was of high value and transferable, should they change their mind, for example attached to UCAS points to make this a low risk choice. The fact that the ability to study another A level such as core maths alongside a T level is being considered is also welcome news, for reducing 'risk' for girls who want to try engineering.[36] The Commission was pleased to find that the current T level route panels are considering equality, diversity and inclusion as these new qualifications are designed. However, it remains the case that students must know what engineering is, and have developed an interest pre-16, in order to choose a T level route in engineering.

The Commission concluded, based on the findings above, that integrating engineering within existing subjects was the best solution. Mainstreaming engineering in the curriculum in the UK is challenging, and there are risks – academies are widespread and can opt out of the curriculum. One solution for the government would be to introduce into Ofsted criteria targets around challenging gender stereotypes. STELLAR, a group of leading women professionals seeking to encourage more women to consider careers in science, engineering, mathematics and IT, recommend the following as one of four key calls to action to achieve a step-change:

"Requirement[s] that no school can be awarded Ofsted Outstanding (Outstanding to be confirmed) without achieving Excellence in the benchmark on its provision of Independent Careers Advice, demonstrating it does not stereotype individuals, and showing it produces more scientists and engineers. Ofsted to consider the participation of girls in physics, maths and computer science as part of their inspection regime."

- STELLAR

35 Alison Fuller , Jill Turbin & Brenda Johnston (2013), 'Computer Club for Girls: The problem with seeing girls as the problem', Gender and Education, DOI:10.1080/09540253.2013.772712

36 Department for Education (2018), 'Implementation of T Level programmes: Government consultation response. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/711472/Implementation_of_T_Level_programmes-Government_consultation_response.pdf

Challenging gender stereotyping forms a key part of the Careers Strategy under Gatsby Benchmark 3 – 'addressing the needs of each pupil'. The Skills Commission supports the view this needs to be taken further, and makes a recommendation in the same spirit:

Recommendation 1

Ofsted criteria should include reporting criteria around challenging gender stereotypes.

2.3 Entry criteria: physics

Physics at A level is widely considered as a necessary entry requirement for degree level engineering courses. However, this is not necessarily the case in Level 3 and 4 apprenticeships, where GCSE physics or GCSE in a STEM subject may be the maximum required. While there is now parity in participation by gender of GCSE physics, at transition to A level there is a steep drop off in the number of women completing physics, to 22%.[37] The ASPIRES project, a longitudinal study tracking young people's career choices from 10-19, found that physics was felt by young people to be a 'masculine' and 'hard subject'.[38] Indeed, this identity challenge was discussed extensively in the inquiry's evidence sessions. The Commission heard that when faced with these persistent stereotypes about the engineering profession, girls have to be 'extremely resilient' and determined in order to avoid being put off.

The association of physics with being 'hard' is particularly problematic for initiatives to engage women as 'cleverness' is very gendered and also associated with race and class.[39] While girls outperform boys in many subjects, girls on the whole are more likely to 'undersell' themselves. Professor Louise Archer gave the Commission one example of a student interviewed as part of the ASPIRES project:

> **"We have, just as an example, a girl who did A level Physics, she had 10 A*s at GCSE, she got all As in her A levels, including A level Physics, and she told me in an interview 'oh but I'm not clever enough to do an engineering degree'. And I thought, if you're not who is?"**

The alignment of physics with engineering may be helping reinforce the view that engineering is high status but appears to have a negative impact on gender diversity. The Institute of Physics, amongst others, have been leading efforts to try and increase female uptake of A level Physics. Some contributors who have been working for many years on increasing female participation in engineering felt that a very high level of effort and investment was required to get a small number of girls to take up physics.

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[37] WISE (2017) 'Analysis of A level core STEM and entrants and results by girls'. Available at: https://www.wisecampaign.org.uk/statistics/analysis-of-a-level-core-stem-entrants-and-results-by-girls/

[38] Francis, B., Archer, L., Moote, J. et al. (2017), 'Sex Roles', 76: 156. https://doi.org/10.1007/s11199-016-0669-z

[39] Katelyn M. Cooper, Anna Krieg, and Sara E. Brownell (2018). 'Who perceives they are smarter? Exploring the influence of student characteristics on student academic self-concept in physiology', Adv Physiol Educ 42: 200–208. Available at: https://www.physiology.org/doi/10.1152/advan.00085.2017

Some participants to this inquiry were of the view that the requirement for A level Physics could and should be removed for many types of engineering. In fact, some universities have already started to do this, particularly for civil engineering, such as Bath and UCL.[40] A bold and more controversial new approach currently being developed is the New Model in Technology and Engineering (NmiTE). This will be a new University in Herefordshire that is aiming to achieve a 50/50 gender balance by removing the requirement for both A-level Physics and A level Maths.

While still in early stages of its establishment, NmiTE represents an exciting change to the norm. Speaking to the Commission, provost Elena Rodriguez-Falcon spoke of the opposition she had faced, with some concerns raised about whether employers would value degrees taught in this way and arguments that this is 'dumbing down' engineering.[41] The OfS, as part of its duties to promote equality of opportunity in HE, should monitor the success of NmiTE's new approach, to help the sector learn from this innovation.

The debate around entry requirements and A level Physics does not fully explain the lack of female entrants through FE routes at levels 2-5, where the requirements are usually much less restrictive and generally require, as a maximum, a GCSE in maths and a science subject. Furthermore, the IfA's 'recommended' prerequisites for many of the new Degree Apprenticeship standards often do not include a requirement for A level Physics, though most suggest 'a STEM based subject such as Physics, ICT, Computing or Electronics'.[42] To identify to what extent it is the entry requirements that are the problem, it will be important to monitor over time the take up by gender of these courses, as well as what employers actually demand, and what students actually offer by way of qualifications on entry.

As indicated above, changing entry criteria won't be a silver bullet and will not address the 'can do, don't want to do' cultural attitude described by Inquiry witnesses.[43]

2.4 Unconscious bias in careers advice, information and guidance

Evidence received by the Commission indicated that the perception of 'risk' associated with engineering for women and girls can be reduced by gradual exposure to employers throughout a young person's time at school.[44] A good experience with companies, while still

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40 New Civil Engineer (2015), 'Do Modern Engineers Need A level Physics?' Available at: https://www.newcivilengineer.com/latest/your-view-and-editors-comment/letters-do-modern-engineers-need-a-level-physics/10000184.article

Institute of Mechanical Engineers (2017), 'Drop physics requirement to encourage female engineers, says IMechE President'. Available at: https://www.imeche.org/news/news-article/universities-'should-drop-physics-a-level-requirement-to-encourage-female-engineers'

41 The Times (2018), 'University hopes women with arts A levels will flock to engineering'. Available at: https://www.thetimes.co.uk/article/university-new-model-in-technology-and-engineering-nmite-hopes-women-with-arts-a-levels-will-flock-to-engineering-bg5dzrznx

42 Based on suggested criteria from current approved EMT sector degree apprenticeship standards

43 Professor Alison Fuller, Evidence Session 1

44 Beck , V. , Fuller , A. , & Unwin , L. (2006a). 'Safety in stereotypes? The impact of gender and "race" on young people's perceptions of their post-compulsory education and labour market opportunities'. British Educational Research Journal, 32 (5), 667 –686

safe at school, can help young women to experience for themselves the breadth of engineering careers on offer and realise it could be a pathway for them.

The point at which careers interventions are most likely to have an impact was discussed by the Commission. Evidence we received demonstrated differing views on the 'moment of choice' for girls and young women. Research from UCL's ASPIRES centre suggests there is no single moment of choice, and that perceptions and choices around engineering can arise at an early age.

The Commission welcomes the fact that the Careers Strategy now makes provision for all secondary level students to have one intervention a year with an employer. As negative perceptions around engineering and gender stereotyping can gain a hold at an early age, GTA England suggested to the Commission that engagement with employers should start earlier, at primary level. The Commission welcomes the £2 million set aside in the Careers Strategy to test which career activities work best in primary schools.[45] How company visits and work placements are managed by schools can also be key – too often there may be gender stereotyping in how work placements or encounters are allocated to male and female pupils. Some best practice employers have taken the lead on this:

"MBDA for example, mandate 50/50 boys and girls going on site visits…they say if you're going to bring 10 boys you have to bring 10 girls, it just forces [teachers] to think a little bit differently and think, oh actually there is a girl in my class who might quite like to do this. By doing this they now have actually achieved a 50/50 gender balanced intake for their apprenticeship programmes because they've managed to get that pipeline early"

- Semta, ES1

The Careers Strategy also highlights women in STEM and commits to exploring with the Government Equalities Office solutions to gender stereotyping in the classroom. The Strategy states that 'Careers services must play a key role in encouraging people of all ages and backgrounds to consider the value of STEM'.[46] Recent research from the Careers and Enterprise Company, in partnership with World Skills UK, further highlighted the need for schools to challenge gender stereotypes when providing careers advice and when talking to young people about their future careers. Their report recommended:[47]

Beck , V. , & Unwin , L. (2006b). Increasing risk in the "scary" world of work? Male and female resistance to crossing gender lines in apprenticeships in England and Wales. Journal of Education and Work , 19 (3), 271 –289

45 Department for Education (2017), 'Careers strategy: making the most of everyone's skills and talents'. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/664319/Careers_strategy.pdf

46 Department for Education (2017), 'Careers strategy: making the most of everyone's skills and talents'. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/664319/Careers_strategy.pdf

47 [EMBARGOED]The Careers & Enterprise Company and WorldSkills UK. (2018). 'Are Jobs Still Pink and Blue? Exploring Gender Bias in the Career Outlooks of Young People and Their Parents.' London: The Careers & Enterprise Company and WorldSkills UK

"To schools and other stakeholders working with students' careers, we recommend that they recognise that young people's aspirations are likely to be gendered and encourage young people to think outside of the box in terms of career choices. This is important so that girls do not miss out of higher paying careers for reasons they may regret later in life."

Initiatives to train teachers about gender stereotyping and unconscious bias have been tried in the past. 'Let's TWIST' was an EQUAL funded project, aimed at widening participation of women studying, training and working in engineering, construction and technology, led by Bradford College and Sheffield Hallam University.[48] An evaluation of the staff development programme, which formed one aspect of this project and gave training to teachers, found that some participants faced negative responses from colleagues when trying to share and embed their learning within their institution. As a result, some felt that to be effective this type of training needed to be extended to all staff:

"EVERY member of staff should be made aware of the problems/difficulties faced by women in a predominantly male learning environment"

To really embed this, other participants in this study suggested:[49]

"This subject should form part of all teacher training and be a policy to support equal Opportunities in further and higher education"

"This programme must be extended to all teacher training courses to degree level"

One way to embed, at relatively low cost, the recommendations of the Careers and Enterprise Company and Careers Strategy would be to include unconscious bias training in PGCE programmes for teachers. WISE currently offer this type of training to employers and many HE institutions are already beginning to offer this type of training to their staff internally, and therefore have the expertise to teach it as a routine part of teacher training. On its own, this training is not a silver bullet and must be embedded in a 'community of practice' to achieve long-lasting results.[50] While we cannot expect teachers to have knowledge of the full and complicated spectrum of careers on offer, we can support teachers to challenge gender stereotyping in the classroom and help students to 'think outside the box'. This would have benefits not just for gender or women in engineering, but for all subjects where there are gender disparities and wider inclusion and diversity.

Recommendation 2

Unconscious bias training should be provided to all teachers, within a framework of whole school measures, on a routine basis as part of Qualified Teacher Status.

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48 Annette Williams, Pat Turrell, Ros Wall (2002), 'Let's TWIST: Creating a Conducive Learning Environment for Women', Int. J. Engng Ed. Vol. 18, No. 4, pp. 447±4 51. Available at: https://www.ijee.ie/articles/Vol18-4/IJEE1287.pdf

49 Ibid

50 Wideman & Owston (2003), 'Communities of practice in professional development: Supporting teachers in innovating with technology', Institute for Research on Learning Technologies York University

3 RETAINING AND RETRAINING WOMEN ENGINEERS

The 'gender filter' or 'leaky pipelines' are metaphors that commentators have used to describe women's pathways into STEM careers. Women leave the pathway at various points, including at the point at which they are working members of the engineering profession. This chapter will examine the issues around retention and retraining women engineers.

3.1 Retain

57% of women give up their professional registration in the engineering sector by age 45, compared with 16% of men.[51] This means we should be cautious about initiatives that solely focus on inspiring or enthusing women to become engineers, rather than also considering the wider cultural and structural barriers that may prevent women's career-long participation in the sector. While our education system, campaigns and good marketing can be altered to help to attract women to the sector, the reality of the workplace must meet the image sold through these initiatives. If women and girls lived experience in the workplace does not match up with the rhetoric, whether through work experience, training or in a full-time role this will have a negative effect on retention.

"Problems about retention rather than attraction are about micro-inequalities that build up over time in the workplace; the culture, the lack of inclusion and understanding, the unconscious bias."

- Dawn Bonfield MBE, Towards Vision

In broad terms, cultural problems highlighted to the Commission include really practical issues such as the availability of ladies toilets, places to change, appropriately fitting Personal Protective Equipment (PPE). There is some evidence of change in this area, for example, Transport for London has created a range of PPE, which now means this is more widely available in the market for others within the sector and amongst SMEs.[52] One recent civil engineering graduate told the Commission that it was not necessarily a 'bad' working environment, but simply that being in a minority over time can lead to a decision to leave the sector.

[51] E4E Written evidence submission

[52] SHP Online (2016), 'TfL Launches Women's Safety Clothing Range'. Available at: https://www.shponline.co.uk/tfl-launches-womens-safety-clothing-range/

Through our inquiry, perhaps understandably, we found very few organisations that were willing to share more specific examples or information, even on an anonymous basis, about cultural barriers in the workplace to female participation. Robust anonymous data on retention of women in the engineering sector would help us to better understand where more needs to be done. For example is there a problem with retention of women in engineering in organisations of different sizes, types of engineering, types of role or by geography? This would allow the sector to isolate good practice, and learn lessons from organisations that are successful at retaining women engineers.

Recommendation 3

Government Equalities Office should collect longitudinal data on employment outcomes of women engineering apprentices and graduates, by employer size, region and role type to better understand retention, highlight good practice and areas of concern. This data should be reported periodically in Parliament.

3.2 Women returners

A lack of retention in the engineering sector can in part be explained by women leaving for career breaks or caring responsibilities. In a survey conducted by WES, 60% of women surveyed experienced barriers to returning to work after maternity leave. Of this group 67% of those not currently in a STEM career would like to return to one.[53] While this issue is not unique to engineering, anecdotal evidence suggests there may be some aspects of engineering occupations that make it particularly hard for women to return to the workplace after a career break. Location was thought to be a significant factor, as well as a lack of opportunities to work flexibly in certain types of roles, though this is felt to be changing as the engineering sector modernises. Some organisations have developed their own initiatives to try to tackle this problem, for example Skills 4's 'Returners Programme' was offered through WISE to allow access for SMEs and for women returners to fund and attend. The Returner programme was developed by Skills 4 to address the issue raised by leading companies in the engineering and manufacturing sectors who were losing their women returners. The programme aimed to build confidence and achieve a good work life balance.

'Returnships' in the engineering sector, and in STEM more broadly, are thought to be popular for boosting confidence and providing training to help women transition back into a technical sector, where change and scientific advancements can happen rapidly. However, the Commission heard that 'returnships' for women looking to return to engineering after a career break can be very heavily oversubscribed, indicating a clear demand for these types of opportunities and their expansion.

[53] Royal Academy of Engineering (2017) 'Key facts for diversity and inclusion in engineering RAENG'. Available at: https://www.raeng.org.uk/publications/other/dilg-key-facts-for-di-in-engineering. Survey data from Women's Engineering Society (2014) 'Women in STEM: Are you IN or OUT?' WES surveyed over 500 women with STEM qualifications

It was suggested to the Commission that employers with oversubscribed programmes could work with their suppliers to help match candidates with employers across the supply chain. In addition, £5 million was set aside by Phillip Hammond in the 2017 Spring Budget specifically for 'returnship' programmes. In August 2017, Apprenticeship and Skills Minister Anne Milton announced that some of this budget was to be spent on career break returner programmes; however these currently focus on civil servants, social workers, allied health professionals and teachers; the Commission considered there is a clear case for these pilots to be expanded to engineering and STEM.

3.3 Retraining

The Skills Commission has frequently expressed the need for greater opportunities for lifelong learning and retraining for older workers[54] and welcomes the development of a National Retraining Scheme, initially announced by Chancellor Philip Hammond in the Spring Budget 2017 and since embedded in the Industrial Strategy. The Young Women's Trust's experience suggests that once women are slightly older, have experience of the labour market and are free from the peer pressure of school, some are more open to considering occupations outside traditional gender stereotypes. Greater opportunities for retraining, for women who decide to pursue careers in engineering at a slightly later stage in life, could also help to boost the proportion of women in the sector. This would also help to create more role models in the sector and assist with the 'virtuous circle' of women in engineering.

Engineering Employers Federation additionally reported a possible lack of awareness about the availability of second loans for some part-time second degrees in engineering. E4E further suggest a 'transition into engineering course', as a conversion course for those without the right academic qualifications, but who wish to transition into the sector. In a welcome development, in 2016 HEFCE announced a £1.7 million investment to develop conversion courses in engineering and computer science.[55] All of these ideas would aid recruitment into the sector generally and would therefore have wider benefits for skills shortages, but some may have the added benefit of disproportionately helping to support women into the sector and must be explored further.

As the Government develops its National Retraining Scheme as part of implementation of the Industrial Strategy, there are clear opportunities to develop programmes for adult women who wish to retrain in engineering.[56] The Government is currently investing £40 million in the Career Learning Pilot, piloting initiatives in adult learning and retraining to inform the National Retraining Scheme. In addition, £65 million has been made available

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[54] Skills Commission (2017), 'Spotlight on Lifelong Learning for an Ageing Workers'. Available at: https://www.policyconnect.org.uk/sc/research/spotlight-onlifelong-learning-ageing-workforce

[55] The Engineer (2016), 'STEM conversion courses receive £1.7m in funding', 16th November 2016. Available at: https://www.theengineer.co.uk/stem-conversion-courses-receive-1-7m-in-funding/

[56] HM Government Industrial Strategy: Building a Britain fit for the future, pg.117 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/664563/industrial-strategy-white-paper-web-ready-version.pdf

from 2018/19 – 2019/20 to specifically target construction and digital skills as part of the National Retraining Partnership (NRP).[57] The Commission believes this pilot is an excellent opportunity to trial new initiatives aimed at women.

Recommendation

The Career Learning Pilot should be used to investigate the most successful ways to re-train and engage adult women in engineering.

[57] Dr Susan Pember, NCFE, Campaign for Learning (2018) 'Shaping the new National Retraining Scheme'

4 LEADERSHIP FROM THE PUBLIC SECTOR AND LARGE EMPLOYERS

The previous section highlighted what the education sector and the industry could do together to retain and retrain women in engineering. While some SMEs within the engineering sector are trying hard to address gender disparity, the general perception from inquiry contributors was that many of these initiatives and best practices around recruitment were predominantly led by well-resourced large employers. For example, the Commission heard evidence of large employers going into primary and secondary schools to inform students about careers in engineering.

Others were looking at their recruitment practices, how they advertise and interview for roles and how they support women in the workplace. In particular, as previously highlighted, there are some early indications that gender pay gap reporting is helping some organisations to formalise these practices and think strategically by creating 'gender action plans', in order to improve their gender pay gap.

"You've got large companies who are doing great and wonderful things, targeting girls from early ages, when they're offering work experience to schools they're saying for every 1 boy you have to have a girl, that's pushing that pipeline of talent. But those tend to be the larger companies. On the small scale it's more ad hoc and less formal"

- Evidence session 2

Questions were raised about whether smaller companies would be motivated to take action on gender disparity, when skills shortages mean that simply filling vacancies are often the immediate priority. Over 80% of engineering companies are micro-SMEs and over 40% of those working in the sector work for a company larger than an SME.[58] While the business case for diversity is beginning to be understood, there is a sense that it is not being communicated as effectively to SMEs:

[58] Engineering UK (2017), 'Engineering UK 2017: The State of Engineering'. Available at: http://www.engineeringuk.com/media/1355/enguk-report-2017.pdf

"I'm not sure really why small employers would care, to be frank. It's not that they're trying to put barriers in the way, they just want a person [in the job]"

"You've got to incentivise people to do it. And I think almost actually financially incentivise, because if it's going to be impacting on your bottom line, then it's suddenly going to matter to your business, otherwise as you rightly say, well why?"

- Evidence Session 1

Many contributors felt that large employers had a moral duty to lead the way, embody best practice and pass this down their supply chain. A number of suggestions were offered to the Commission on how this could realistically be achieved, though it was noted that many large firms can struggle to know who's in their supply chain beyond tier 1. Suggestions included innovative practises around recruitment, where SMEs could be invited to join larger companies' recruitment assessment days, to match with women candidates.

Overwhelmingly, contributors suggested the greatest lever for government in this area is around public procurement and planning. Given the emphasis on the transport sector in the Post-16 Skills Plan, we spoke to HS2 about the activities they are undertaking to increase the diversity of their talent pool. We found some innovative practice, in terms of how they are engaging with their supply chain through procurement.

While the Government's direct influence can naturally only extend to the public sector, research on 'gender friendly' procurement suggests the government could in addition create greater transparency, in the way that it has on gender pay. For example by requiring reporting on the proportion attributed to EDI in procurement, supported through the provision of templates, guidance and metrics that employers can use for evaluation.[59]

[59] Chatham House (2017) , 'Gender-smart Procurement. Policies for Driving Change'. Available at: https://www.chathamhouse.org/publication/gender-smart-procurement-policies-driving-change

Case study: HS2

Equality, Diversity and Inclusion (EDI) is a key aspect of their procurement process:

1. EDI Screening in Pre-Qualification Questionnaire (a tool used to shortlist suppliers to invite to tender)
2. EDI is given up to a 6% weighting in invitations to tender. The difference between first and second place can be 3%, so demonstrating commitment to EDI can win or lose a contract
3. The level of action required is proportionate to the size of the company, what's essential is a commitment to progress
4. For Invitations to tender on contracts above £5 million, there are 2 EDI questions on workforce and the supply chain
5. An EDI strategy must be produced by bidders, which is monitored on a bi-annual basis

Recommendation

The government should apply the learning on Equality, Diversity and Inclusion (EDI) and procurement from the transport sector across all public sector procurement.

Recommendation

In the private sector, large employers should show leadership by including EDI requirements in their procurement from their immediate supply chain.

5 GETTING MAXIMUM IMPACT FROM SECTOR INITIATIVES

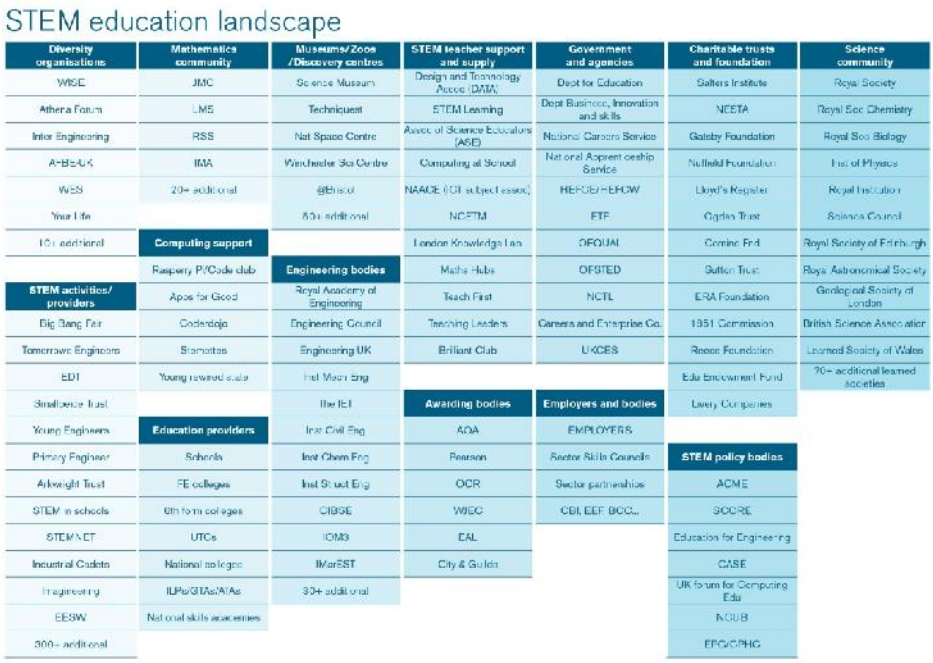
As well as actions by schools, employers and policymakers, there is much activity within the engineering sector itself aimed at tackling the gender balance. The Commission was pleased to find that the introduction of gender pay gap reporting requirements was ecouraging further action by employers. The Commission heard evidence from the EEF, the manufacturers' organisation, that this requirement was causing many more manufacturing and engineering firms to create action plans, with modest achievable targets to improve diversity.[60] Some of the action plans include looking at job descriptions and recruitment processes, which evidence shows can make a fundamental difference in the number of women applicants, such as use of language in job descriptions.[61]

More broadly, sector-led campaigns such as Tomorrows Engineers and 'This is Engineering' have sought to demonstrate the breadth of careers available, to attract young people to the sector based on their interests in design, sport, fashion, space, technology and more. The campaign involves a number of videos and social media-friendly content designed to reach a wide audience. However, while conducting this inquiry we found that knowledge of such campaigns was patchy, particularly amongst FE sector professionals, but was exactly the type of campaign many were calling for, that fitted engineering in to young women's existing interests. Given that the Government is currently running a national campaign 'The Year of Engineering' we recommend more effective join up or government-backing of existing campaigns, rather than adding to an ever-growing number of fragmented campaigns and initiatives (see Figure 3).

[60] POWERful Women (2018), 'Sparking action. POWERful Women, How the UK's gender pay gap legislation has given companies in the energy sector a fresh impetus for change.' Available at: https://dsqapj1lakrkc.cloudfront.net/media/sidebar_downloads/KF_Sparking_Action_Whitepaper_VISUAL_WEB.pdf

[61] BBC (2018), 'Why do some job adverts put women off applying?' Available at: https://www.bbc.co.uk/news/business-44399028

Figure 3: Royal Academy of Engineering, the UK STEM Education Landscape (2016)



An illustration of the complex STEM education landscape that highlights just a fraction of the organisations engaged in various types of activity.

The Royal Academy of Engineering estimates there are over 600 organisations with STEM promotion initiatives.[62] Innovation is of course a good thing, as there is not necessarily a one size fits all approach.

However, what is concerning is the cynicism we detected amongst some employers and stakeholders about the next new initiative or scheme. Of further concern are reports from Engineering UK that teachers find it hard to navigate the plethora of initiatives, particularly as evaluation of initiatives and evidence of effects can be patchy. College leaders and practitioners in some cases told us about one year schemes and initiatives carried out by external evaluations, and explained they did not know what had happened as a result, or received any evidence of impact.[63] A big challenge is that many projects receive short-term funding, or do not have the funding and resources required to carry out long-term evaluations, whereas the effects of interventions with teenagers may not be seen for many years.

[62] Royal Academy of Engineering (2016), 'The UK STEM Education Landscape', Available at: https://www.raeng.org.uk/publications/reports/uk-stem-education-landscape

[63] Skills & Education Group Conference 2018 workshop

"There are currently thousands of schemes and STEM movements in the UK in 2018. I am sure that all of these movements have great visions and aims but there is no coordinated approach or strategy from the government which incorporates educational establishments, industry and these movements to move this issue forward"

- Veolia, Written Submission

In particular, recent gap analysis of existing STEM interventions conducted by the Royal Academy of Engineering showed that while there were a great number of initiatives within schools, few sought to address wider public perceptions of engineering. We must be cautious that initiatives don't prioritise inspiring or 'changing the girl' rather than tackling broader cultural perceptions and systemic factors that prevent women from entering the sector, or indeed cause them to leave the sector.

This is particularly important as parents, peer networks and wider cultural trends can be key influencers of young people. WISE run a programme called 'People Like Me' which gets girls to self-select 15 out of 44 adjectives, which then links to personality types based on the Science Council's 10 types of personality in the workplace. Based on this analysis, WISE help the girls to meet inspirational women from the sector like them, providing role models.

Speaking about an initial evaluation of this programme, WISE told the Commission:

"Following the session there is an attitudinal change in girls. And actually more importantly, if we bring parents in to the room, particularly mothers, there's an attitudinal change in the mothers because they're able to see that it's not the dirty men's club environment that sits there unconsciously at the back of their mind"

While this gap analysis conducted by RAEng is a step in the right direction, a lack of central coordination means that disproportionate resources might be being invested in certain types of initiatives. More worryingly, RAEng's assessment also highlights a lack of 'robust' evaluation and evidence of the long-term beneficial impact of many of the current initiatives being tried. They highlight STEMNET as one of the few organisations that have conducted any kind of extensive external evaluation.

The question of leadership and coordination is not new territory for the sector. In 2002 the SET Fair report,[64] produced by Baroness Greenfield CBE for the Secretary of State for Trade and Industry, looked at the difficulties faced by women in Science, Engineering and Technology (SET). The report highlighted a 'fragmented' ecosystem of over 70 SET initiatives, leading to government funding of the UKRC. There are now nearly 600 organisations working on STEM initiatives. While this is to be welcomed, a lack of central oversight, evaluation and communication to relevant stakeholder means that despite the increase in activity, there has been relatively stagnant growth in the proportion of women in engineering over the same period.

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[64] The Baroness Greenfield CBE, (2002) 'SET Fair'. Available at: http://image.guardian.co.uk/sys-files/Education/documents/2002/11/28/4408-DTI-Greenfield.pdf

Commenting on the end of funding to the UKRC, which previously provided some central oversight, the Science and Technology Committee's inquiry into Women in Scientific careers questioned the end of funding to the UKRC, and whether it was too soon for gender parity to be 'mainstreamed' into existing policy activities. The Committee argues that the UKRC acted as a 'go to' organisation for women in science, engineering and technology careers.[65] While England has moved away from this idea, in Europe government education departments have adopted this approach. In Germany the Federal Ministry for Education and Research leads the National Pact for Women in MINT (STEM). 50 individual projects worth £22 million have been funded so far.[66] In Scotland, the Scottish Funding Council has taken responsibility for creating a 'gender action plan' that sets some modest targets and milestones for change, including in engineering.[67]

Following recommendations from the Perkins Review 'Tomorrow's Engineers', jointly run by the Royal Academy of Engineering and Engineering UK, is increasingly engaging with employers from across the sector to centralise some of this activity. Tomorrow's Engineers currently runs campaigns such as 'Tomorrow's Engineers Week' and 'Big Bang Near Me' events, a UK-wide programme of regional events to get students excited about STEM. This collaborative organisation is attempting to draw together some of the existing STEM engagement activity and develop a common evaluation framework.

There are already a long list of organisations working around STEM and engineering; the evidence heard by the Commission and the international examples suggest that what is now needed from the Government is a joining-up of initiatives such as the 'Tomorrow's Engineers' programme. This requires some central interventions and clear roles and responsibilities for the different organisations within the sector.

We propose a single body should be nominated to provide a clear oversight of 'women in engineering initiatives'. It should disseminate findings and help practitioners to understand the evidence base. This could for example be by reinstating the kind of 'go-to' role previously played by UKRC.

Recommendation

BEIS, DfE and the Government Equalities Office should provide joint funding to a central organisation empowering them to provide clear oversight of 'women in engineering' initiatives, acting as a central hub for shared learning and point of contact for education practitioners. It would be good practice for government funded initiatives to be independently evaluated.

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[65] Science and Technology Committee (2014), 'Sixth Report, Women in Scientific Careers'. Available at: https://publications.parliament.uk/pa/cm201314/cmselect/cmsctech/701/70105.htm

[66] OECD (2017), Chapter 7, The under-representation of women in STEM fields. In 'The Pursuit of Gender Equality: An Uphill Battle'. Available at: http://dx.doi.org/10.1787/9789264281318-10-en pg. 6

[67] Scottish Funding Council (2016), 'Gender Action Plan'

ANNEX A

Core engineering as defined by Engineering UK (2018):

Tier 1: “contains engineering and technology graduates at different levels of HE study, who are expected to have high rates of transition into engineering occupations.”

Tier 2: “contains graduates from key STEM subject groups known to have a high progression rate into engineering occupations. These are: architecture, building & planning; computer science; mathematical science; and physical sciences.”

Tier 3: “contains graduates from all other subject areas, ranging from creative arts and design to biological sciences. Although the rate transitioning into engineering occupations may be small, the total number of graduates to which it is applied is large, so the number entering engineering roles is significant.

METHODOLOGY & STEERING GROUP

Scoping for the *Spotlight* series began in late 2015, with work on this report, the fourth in the series, starting in February 2018.

The findings and policy recommendations herein are based on a review of pertinent literature, semi-structured interviews, responses to a written call for evidence, evidence given to the Commission by expert witnesses and responses from the FE sector elicited during two workshops at the Skills and Education Group’s Annual Conference, May 2018.

Three steering group evidence sessions were held between March 2018 and May 2018 to explore and scrutinise key issues and inform and guide the desk based research. The evidence sessions were led by the inquiry Co-Chairs, Professor Sandra McNally, Lucy Allan MP and Preet Gill MP.

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This report is not an official publication of the House of Commons or the House of Lords. It has not been approved by either House or its committees.

The Higher Education Commission, the Skills Commission, and the All-Party Parliamentary Group for Skills and Employment make up the Education and Skills team as part of the Policy Connect network.

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