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This briefing paper addresses key issues relating to the gender imbalance in Science, Engineering and Technology (SET) occupations.

The Engineering and Technology Board (ETB), is an independent organisation that promotes the vital role of engineering and technology in our society. The ETB partners business and industry, Government and the wider science and technology community; producing evidence on the state of engineering; sharing knowledge within engineering; and inspiring young people to choose a career in engineering, matching employers' demand for skills.



Introduction

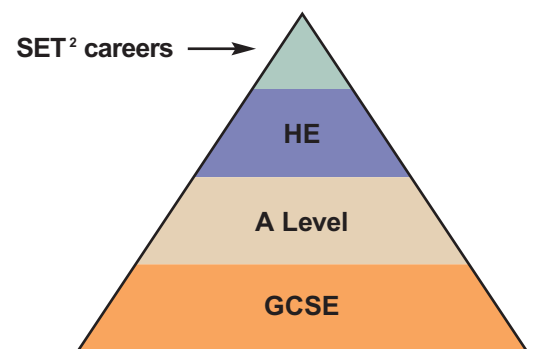
There is a growing demand for people with Science, Technology, Engineering and Mathematics (STEM) skills in today's economy. It is widely acknowledged that to remain globally competitive the UK needs a Science and Engineering skilled workforce. Moreover, this need must be set in the context of an overall decline in the proportion of students studying Engineering and Technology and a generally poor perception¹ of Engineering and Technology careers. There is also a challenge in that many STEM graduates move into unrelated occupations, where their analytical skills are sought after. This briefing paper looks at the potential pool of female employees as a key answer to the skills challenges that the UK faces. Women are one of the country's most under-utilised resources and this is particularly prevalent in the Physical Sciences and Engineering where only a minority choose a career in these sectors.

As judged by the numbers achieving GCSE awards in STEM subjects, girls reach 16 on a fairly even footing with boys. However, only a minority of girls continue their education in STEM, with even fewer choosing a career in Science, Engineering and Technology. Nevertheless, girls who do continue with STEM subjects after the age of 16 actually

achieve higher pass rates in nearly all STEM subjects compared to the boys. This includes vocational training in traditionally male dominated areas such as Engineering and Manufacturing.

Current Situation – Female participation at different levels

Post 16³, when STEM subjects cease to be compulsory, despite good attainment, female levels of involvement begin to fall. This decrease in participation continues throughout the academic path, and into the workforce, particularly in Engineering; at the end of 2007 only 3% of all registered Engineers were female.



School

GCSE

At GCSE level, 51% of grade A*-C awards in Mathematics and Double Award Science were obtained by girls, showing that when STEM is compulsory, girls and boys are on an equal footing.

A Level

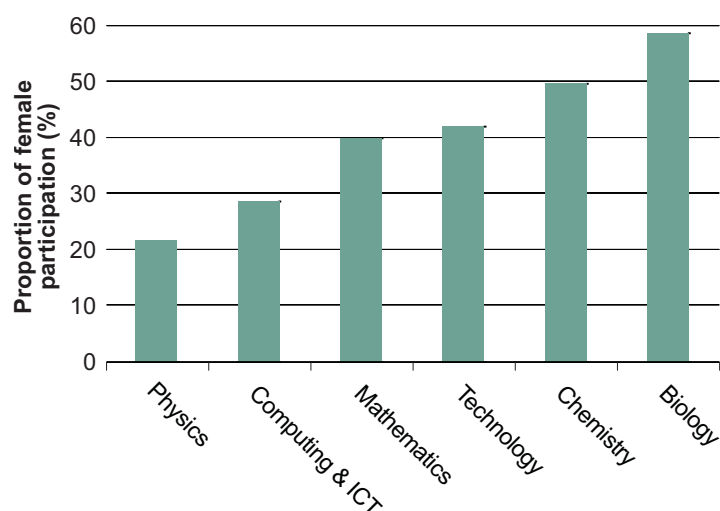
In 2007, female students represented 59% of those taking A Level Biology, 50% of those taking Chemistry, 40% of those taking A Level Mathematics and 29% of those taking Computing/ICT. The lowest female STEM A Level participation was in Physics at only 22%.

¹ Public Attitudes to and Perceptions of Engineering and Engineers 2007, September 2007 http://www.etechnology.co.uk/_db/_documents/Public_Attitudes_to_and_Perceptions_of_Engineering_and_Engineers_2007.pdf

² Science, Engineering and Technology. Before the drive for STEM, this area was referred to as SET. Where source data talks about SET, this has been reflected in the narrative. SET is still used when describing careers.

³ Post 14 in NI

Figure 1: Proportion of Female A Level Students by Subject



Source: Joint Council, AQA 2007/QCA

Figure 1 shows a good level of female participation in Biology and Chemistry, but of major concern is the gender gap in Physics with the proportion of female candidates remaining fairly static at a low 22%. This is significant because, historically, Engineering departments have sought Physics A Level as a prerequisite subject. However, in recent years many universities have begun to accept Design & Technology (D&T) A level as (at least) a third offering, with Mathematics. Since more female students are sitting D&T A Level than Physics, this may be a route to improving gender balance in Engineering courses at university, as females make up 42% of

Technology subject A Levels in 2007. However, it should be noted that the total number of students for Maths and Physics have been falling which further compounds the issue of numbers of females pursuing these subjects.

Diplomas

In England, from September 2008, the new 14-19 specialised Diplomas will begin to be introduced. Amongst the first five of these will be the Engineering Diploma. The concept behind the Diploma is to provide pupils with a range of knowledge and skills required by employers. The range of units being offered will provide an opportunity to encourage a high proportion of female pupils to participate in this Engineering Diploma and pursue Engineering through an alternative learning route.

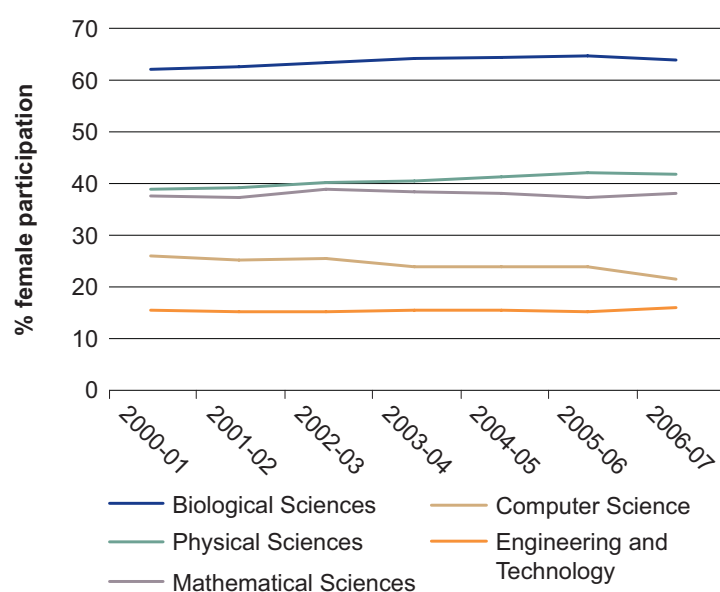
Higher Education

In some disciplines increasing the number of female students will provide a key means of allowing HE teaching departments to expand the number of students studying STEM courses. Clearly STEM subjects have markedly different levels of female participation, as shown in Figure 2. Biological Sciences has 64% involvement whereas Physical Sciences and Mathematical Sciences have mid-levels of participation at 41% and 38% respectively, and within Engineering and Technology female participation has remained at just above 15%. Hence focus on improving female participation in Engineering and Technology is an obvious target for HE departments.





Figure 2: Female proportion of undergraduates by subject group



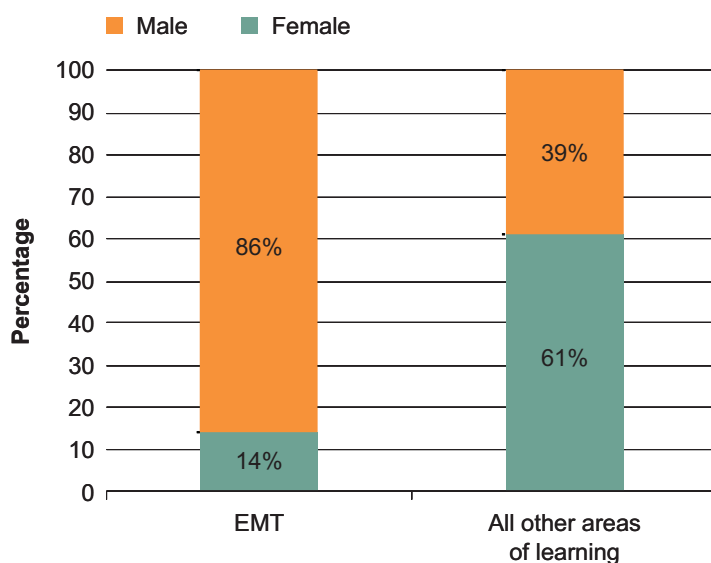
Source: HESA 2008

Post-16 Vocational Education

Another increasingly important pathway to HE and/or employment is via vocational courses. However, even though in 2002 62% of girls achieved GCSE grade A*-C in Design & Technology subjects, they only represented 11% of students in Engineering, Manufacture and Technology (EMT) in FE, as illustrated in Figure 3. In 2004/05 this increased slightly to 14% however the number still remains woefully low. Overall female participation in all other areas of learning in vocational post-16 education is 61% and Figure 4 shows that when females do participate in these areas they outperform the males.



Figure 3: Female Participation in FE



Source: ETB/York Consulting's 'Engineering, Manufacturing and Technology Provision within Further Education' 2007

These data for vocational education clearly show a huge potential for growth in female participation.

Figure 4: Completion Rate by Subject Sector Area

	2005/06 Success Rates (%)	
	Female	Male
Construction and the Built Environment	76	68
Engineering and Manufacturing Technologies	85	72
Information and Communication Technologies	69	67
Science and Mathematics	74	73
All Areas of Study	77	75

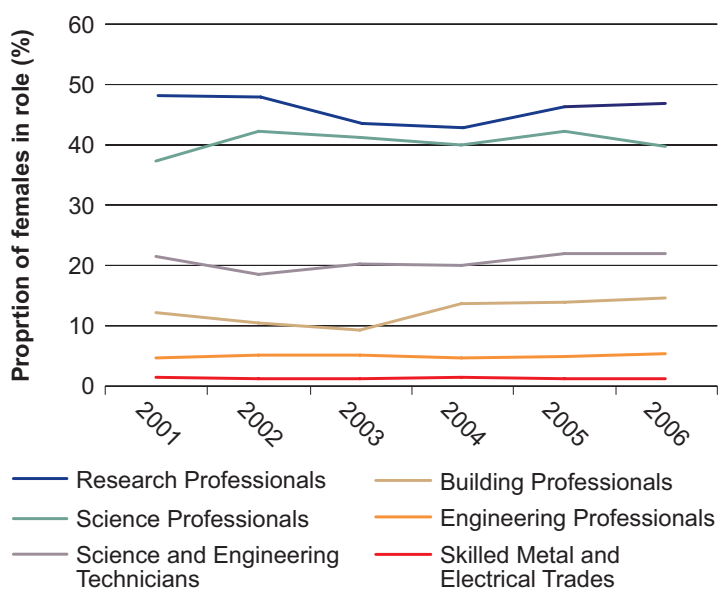
Source: 'Further Education and work-based learning for young people –learner outcomes in 2005/06' LSC Statistical first release 2007



Women in Science, Engineering and Technology (SET) Careers

Of the women who do graduate with a SET first degree, only 27% actually pursue a SET career compared with 54% men⁴. In 2007 only 13% of new Chartered Engineer registrants were women. However, the number of female registrations is gradually rising and given time this figure should be reflected in the total registration figures.

Figure 5: Female Participation in SET careers



Source: Labour Force Survey (annualised – four quarters)



For those women who do pursue SET careers the levels of female participation in different SET careers varies vastly, as shown in Figure 5. Science and Research roles enjoy the highest proportion of women workers (40%-47%) with only a minority of around 5% working as Engineering professionals. The lowest participation is within the skilled construction & building trades and skilled metal & electrical trades where women account for only 1%. Figure 5 also shows that there has not been much improvement in female representation since 2001, suggesting that a different approach to recruitment and retention is required.

There is evidence⁵ to suggest that Engineering employers with a predominantly male workforce exhibit corporate cultural norms and values, which are often alien to female employees. This factor alone dissuades many women from entering or remaining in Engineering occupations.

⁴ Secondary analysis by UK Women's Resource Centre of the HESA (2007) Destination of Leavers of Higher Education 2005/06 data

⁵ ASL Sector Skills Agreement employer research, Inverness, 2005/6



Conclusions:

If the UK is to compete in the knowledge and innovation based economy it must have a good supply of well trained, skilled people. This has to be addressed all the way through all of the key phases of education and training by means of concerted action of government, training providers and employers in order to ensure the UK's future skills demands are met.

This briefing paper clearly shows that in addressing the challenges of diversity and numbers of females pursuing Engineering and Technology, there remains much to be done; not only through government policy intervention but via the education and training sector and the ultimate end user, the employer.

It has been shown that female involvement in STEM varies widely between subjects, the lowest participation being in Engineering. Indeed after GCSEs few girls take this career path. There is a large gender imbalance in the take up of A Level Physics which is generally the pre-requisite for Engineering at HE. Within the FE vocational arena the figures are even more pronounced with a small fraction only studying towards STEM vocational qualifications particularly in Engineering and Technology.

More targeted and bespoke promotion needs to be done to ensure girls, particularly in the 11-14 year old age, are well informed about what a SET career could offer and are encouraged to continue their education in the STEM disciplines, through both the graduate route and vocational progression pathways such as apprenticeships. The new Engineering Diploma is attractive in that it provides an alternative learning route.

Employers need to ensure that the jobs they offer women provide viable options for those who also choose to have children, which means industry and academia both have to acknowledge that the full time working week is but one of a variety of options for employment in the future. We need to accept that whilst currently Engineering and Technology roles are traditionally male centric, future demand trends show that this state of affairs is clearly untenable for UK competitiveness; there are still difficult issues around masculine work place culture, discrimination and work-life balance to be addressed to make careers in Engineering and Technology appealing to women.

We acknowledge the innovative work of agencies such as the UK Resource Centre for Women in Science, Engineering and Technology and WISE (Women into Science, Engineering and Construction) in targeting gender related issues. Nevertheless, this paper highlights how the throughput and representation of women in Engineering and Technology careers remains low suggesting that Government support into this area needs to be significantly increased in tandem with a requirement for employers to take a lead in addressing the under representation of women and working together more closely to address their gender imbalance issues.

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If you have any comments related to this briefing you can send them direct to: feedback@etechb.co.uk

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