

GENDER IN ENGINEERING

Institution of
**MECHANICAL
ENGINEERS**

It is Government policy to encourage working populations to reflect the prevailing diversity of the UK population; legislation exists for each of the equality strands of race, gender, disability, sexual orientation, religion/belief and age. Despite this minority groups and women are relatively poorly represented in the engineering profession.

The contribution of women to engineering is not a new subject; the Women's Society for Engineering was established in 1919. Although there are many different perspectives on the subject the most commonly cited reasons for more equal representation between men and women in engineering are: human rights and natural justice; to help engineering better reflect the needs and interests of both sexes; and to provide a greater talent pool. This statement identifies barriers to the participation of women in engineering, be they in the way the sciences are taught at school, college or university or dominant practice in the engineering profession itself. As such, IMechE offers the following recommendations:

DCSF should:

- 1** Review science curricula (particularly physics) at GCSE and at A Level to ensure they better reflect the interests of both boys and girls
- 2** Promote the potential of the 14–19 Engineering Diploma to appeal as much to girls as to boys
- 3** Support new inclusive approaches to teaching; engineering employers involved in the Engineering Diploma should ensure they provide opportunities that appeal to both boys and girls

Schools should:

- 1** Ensure that teaching of science and engineering subjects includes positive references to the subjects in a human context as well as in the technological context

Engineering employers should:

- 1** Prioritise the release of female engineers to support engineering engagement and enrichment schemes so that both boys and girls see female engineers as positive role models
- 2** Actively pursue greater flexibility in employment practice, particularly in the provision of career breaks and associated systems to facilitate re-entry to work through, for example, re-entry training
- 3** Be seen to be (as well as actually being) attractive to and genuinely welcoming of all who have the aptitude and aspiration to achieve – this may demand further changes in attitude and working practice within engineering premises.

GENDER IN ENGINEERING EDUCATION, TRAINING AND EMPLOYMENT

THE LEAKY PIPELINE

As young people move through the UK education and training system they make choices about the subjects that they wish to study, each affecting their future subjects of study and, eventually, career options. Many factors influence young people during their education and training journey; among these are the availability of courses, parental influence, careers advice, personal aptitude, teachers and peers. While choice has increased and both girls and boys are more willing and able to make non-stereotypical career choices, it is still true that girls choosing to become engineers are seen to be, to an extent, breaking the mould. As their journey towards engineering continues the route becomes increasingly male-orientated; in the way in which engineering is applied ("planes, trains and automobiles"), the working practices of engineering companies and the simple fact that the vast majority of engineers and those on route to be engineers are men.

SCHOOL

At present all pupils study mathematics and science up to the age of 16, although the level and amount of science varies depending on ability and school provision. The number of young people studying science, technology, engineering and mathematics (STEM) post-16 reduces dramatically, a minority of these being girls. Within each of the available subjects, however, there is significant variation in the gender balance: in 2007 59% of A level Biology entrants were female, 50% of Chemistry entrants, 40% of Mathematics and 29% of Computing/ICT; the lowest female STEM A level participation rate was 22% in Physics¹.

One major reason for this is that boys and girls have markedly different interests within the broad subject labelled "science", which are not adequately catered for in the science curricula². Boys tend to see science in the context of technological applications while girls tend to see it in the context of its ethics and interaction with people. In an ETB/RAEng report on perceptions of engineering and engineers³ girls reported certain subjects as being dull due to their association with subjects of interest mainly to boys; as one female participant in the study put it, referring to bio-fuels, "I suppose for, like, boys it's more interesting because it's talking about Formula One cars. I don't find it that interesting."

However it is possible to make changes that will address this issue; the Parliamentary Science and Technology Committee, for example, recommended that "evidence from A level courses that focus on presenting science in contemporary and relevant contexts suggests that it is possible to attract girls to study physics and for them to enjoy the experience. This has lessons for the study of physics at 14 to 16. QCA should explore how the curriculum and assessment at key stage 4 could be adapted to reflect the positive features seen in the new physics A level courses"⁴.

The recently introduced 14-19 Engineering Diploma provides an opportunity to incorporate areas of reference that will appeal as much to girls as to boys, although this will require new approaches from teachers and the engineering employers involved.

Relative ability is often cited as a reason for subject choice. However, during the compulsory phases of science education (i.e. up to age 16), girls and boys achieve similarly. Research shows that at primary school there is no significant difference in the innate science ability of boys and girls⁵ while 51% of grade A*-C awards in Mathematics and Double-award Science are obtained by girls (2007)⁶.

FURTHER EDUCATION & APPRENTICESHIPS

Vocational courses are an increasingly important route to employment and higher education. Although, in 2002, 62% of girls achieved GCSE grades A*-C in Design & Technology subjects, they made up only 11% of students in Engineering, Manufacture and Technology (EMT) in Further Education (FE) – although this increased slightly to 14% in 2004/05. Overall female participation in all other areas of vocational post-16 education is 61% and research shows that when females do participate in these areas they outperform males⁷.

EMT courses in FE are heavily male dominated. In 2004/05 the proportion of males in EMT (86%) was more than twice the average across all other areas of learning combined (39%). Although national success rates by gender are not published other research has shown that in general males are less successful than females. This is likely to have contributed to the below average success rates of EMT⁸.

During 2006/07, 54.2% of people starting Apprenticeships were men. Opening up Apprenticeships from traditional craft-based programmes to a wider range of occupations has provided more opportunities for women to 'earn and learn' and have their skills and achievements developed and recognised through an Apprenticeship. However, the proportion of women in the top 10 apprenticeship frameworks in 2006/7, Table 1, shows a clear and unsurprising gender orientation.

HIGHER EDUCATION

Between 1980 and 2008 the proportion of women at university rose from 40% to 54%. However, the gender balance in more traditional subjects remains largely untouched¹⁰.

As with A levels there are markedly different levels of participation within STEM in Higher Education; in the Biological Sciences 64% of students are female whereas in the Physical and Mathematical Sciences it is 41% and 38% respectively and within Engineering & Technology it remains at just above 15%¹¹. The careers followed by graduates on leaving education are also highly gender-orientated¹².

EMPLOYMENT

Entry to employment is not the end of the leaky pipeline. Fewer women choose to pursue STEM careers once they have the qualifications to do so.

However women now form 51.3% of the UK labour market¹³. Of the 500,000 plus Science, Engineering and Technology (SET) qualified women in the UK only 150,000 are working in SET occupations¹⁴. Within the SET sector only among research professionals are there more women than men while engineering has the greatest imbalance between male and female in the UK with 93.1% males¹⁵. Labour Force Survey data shows that between 2001 and 2006 little overall change in the proportion of women in SET occurred¹⁶, illustrating initiatives to create a more equitable balance between men and women in SET have yet to have the desired effect. An engineering-specific indicator of this is by the end of 2007 only 3% of all professionally registered engineers¹⁷ were female; progress is, however, being made as in 2007 13% of new Chartered Engineer registrants were women¹⁸.

Research by the Equal Opportunities Commission¹⁹ found agreement that there are a number of major barriers confronting organisations seeking to challenge gender segregation, both in general and specifically in Modern Apprenticeships; these were:

- Traditional attitudes regarding proper jobs for women and men
- Social stereotypes
- The poor image of some sectors
- The attitudes of employers

Other evidence suggests²⁰ that a significant barrier to the flow of women into SET is the simple fact that men are dominant numerically. Women who are interested in engineering stand out increasingly as they progress through the education and training process and are seen to believe they do not belong in this 'male space'. There is evidence to suggest that Engineering employers with a predominantly male workforce have embedded corporate cultural norms and values, which are often alien to female employees²¹. This factor alone dissuades many women from entering or, vitally, remaining in engineering occupations as opposed to remaining in the sector but in non-engineering occupations.

In addition, the relatively low reward offered to women, to some extent a factor of limited progression, can add to the creation of a 'man's' world. Salary data indicates a significant variation between male and female engineers and technicians as well as other SET professionals (see Table 2).

Predictions about when the male to female balance would be achieved if growth continues at the same rate as it has been in the last five years indicate that²³:

- Female and male A level students in STEM subjects will be equally represented in 2058
- Female HE students in SET disciplines will reach 50% representation in 2069
- Proportion of women in SET employment will not reach 50% in the 21st century

Apprenticeship Framework (levels 2 & 3)	2002/03 (%)	2006/07 (%)	Change (%)
Construction	1.3	1.3	0
Hairdressing	92.6	91.7	-0.9
Business Administration	78.6	79	0.4
Customer Service	68.2	67	-1.2
Hospitality and Catering	50.6	50.6	0
Children's Care Learning and Development	97.3	97.1	-0.2
Engineering	4.6	2.6	-2
Health and Social Care	88.9	89.7	0.8
Retail	65.8	66.4	0.6
Vehicle Maintenance and Repair	2.9	1.4	-1.5

Table 1: Percentage of women in the top 10 apprenticeship frameworks⁹

Mean Gross Annual Pay (£)	Female	Male	Female as % of Male
Draughtspersons and Building Inspectors	24,237	26,921	90.0
Information and Communication Technology Professionals	34,653	41,504	83.5
Engineering Professionals	30,290	37,559	80.6
IT Service Delivery Occupations	25,054	31,645	79.2
Science Professionals	30,205	41,113	73.5
Architects, Town Planners, Surveyors	32,376	45,067	71.8
Science and Engineering Technicians	19,160	27,785	69.0

Table 2: Mean Gross Annual Pay (£) of selected SET occupations in the UK, 2008²²

SUMMARY

It is generally agreed that the UK will need more engineers and technicians in the future. On the other hand, demographic trends militate against any increase in the number of young people available to pursue engineering careers. Current levels of female representation in engineering do not reflect the potential number available; women represent a pool of talent that could play a significant part in meeting the predicted future demand for engineers and technicians.

Although much has been done in the past 20 years to create a more gender-neutral workplace the male-inertia within the engineering sector has yet to be overcome. Mirroring society's gender balance is unlikely in the medium term, mainly due to deep-seated differences in career choice between men and women.

Education, training and employment must properly cater for and foster women's interest in engineering. The setting of specific targets for the proportion of females to males, however, is not supported at any stage of education, training or employment journey; neither is compulsion. We support positive action rather than positive discrimination.

It is in all our interests to ensure that women have every opportunity to develop an interest in STEM subjects and to follow engineering careers. Stakeholders must be aware, however, that pursuing science and engineering is a choice; engineering may want women, but women must want engineering.

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