



# **An investigation into why the UK has the lowest proportion of female engineers in the EU.**

A summary of the key issues

## Summary

### Background and context

In 2010 the UK engineering sector made up nearly a fifth of the UK economy (19.6% of GDP) and employed over 4.5 million people. However, a substantial number (76%) of women qualified in science, engineering and technology (SET) in the UK do not go into SET occupations.<sup>1</sup> In 2008, there were 620,000 female SET graduates of working age in the UK, but 70.2% of these were working in non-SET occupations, inactive or unemployed.<sup>2</sup> Removing barriers to women working in occupations traditionally done by men and increasing women's participation in the UK's labour market could be worth £15-23 billion or 1.3% to 2.0% of GDP.<sup>3</sup>

An analysis of the European Labour Force Survey conducted by the UK Resource Centre for Women in Science, Engineering and Technology (UKRC) revealed that the UK has the lowest proportion of female engineering professionals across the EU states (Table 1).

This report seeks to examine and understand what lies behind this finding by comparing the education systems in the UK, Ireland, Italy and Sweden. In order to determine if there are any successful national characteristics or strategies which help promote the uptake and retention of women within SET, this report uses an analysis of literature and a detailed examination of available databases across several possible key influencing factors: Education; teachers' attitudes; careers information, advice and guidance (CIAG) and women working in SET, all of which contribute to varying extents towards increasing the supply of women from education into employment within the engineering sector.

Our research identified 3 major themes:

1. Girls are effectively ruling themselves out of a degree in engineering by the age of 14
2. Enjoyment of a subject is as significant as attainment in terms of a pupil's likelihood to pursue that subject further
3. Careers information, advice and guidance is still reinforcing gender stereotypes

Table 1: The proportion of female 'engineering professionals' in EU countries

Country	Percentage of female engineering professionals
Latvia	30.0%
Bulgaria	29.3%
Cyprus	28.6%
Sweden	25.9%
Turkey	21.0%
Italy	19.5%
Ireland	14.3%
Austria	10.0%
United Kingdom	8.7%

Source: UKRC's analysis of the European Labour Force Survey (2007)<sup>4</sup>

<sup>1</sup> Women's' Enterprise and SET report [www.setwomen.co.uk/images/data/WomeninSET](http://www.setwomen.co.uk/images/data/WomeninSET): 2002. The comparable figure for men is 51%.

<sup>2</sup> UKRC women and men in SET: The Statistics Guide 2010

<sup>3</sup> Women & Work Commission, 2006

<sup>4</sup> Figures are statistically less reliable hence need to be treated with caution

## Conclusions

Whilst it is not possible to apply a robust comparative weighting to the different factors that we studied, we have created a qualitative assessment (table 2) of the relative performance of the UK, Ireland, Italy and Sweden, in order to provide a pictorial representation of the combinations of successful national characteristics or strategies which appear to contribute positively towards promoting uptake by women into SET employment.

Our analysis of the breakdown of the number of students at each stage of the education system showed it was impossible to identify any discernable differences between the four countries which would explain why the UK is poor at encouraging women to pursue engineering careers. However, analysis of academic routes into engineering did show that a lower proportion of girls in England, Wales and Northern Ireland choose maths and physics post compulsory than in Scotland, Italy and Sweden.

Table 2 Qualitative assessment of the factors contributing to the positive promotion of female employment in SET

		Education					Teacher attitudes	Careers information advice & guidance	Women in SET	Position in EU - % professional engineers who are women
		Compulsory subjects at 14,16,18	Numbers of girls studying physics at age 18	No. of decision points	Girls enjoyment of science at age 15	Girls science performance at age 15				
UK	Eng, W & N.I	Red	Red	Red	Red	Green	Green	Yellow	Red	28 <sup>th</sup> 8.7%
	Scotland	Yellow	Yellow	Yellow	Red	Green	Green	Yellow	Red	
Ireland		Red	Red	Red	Red	Green	Red	Red	Red	23 <sup>rd</sup> 14.3%
Italy		Green	Yellow	Yellow	Green	Red	Red	Red	Yellow	13 <sup>th</sup> 19.5%
Sweden		Green	Green	Green	Yellow	Yellow	Yellow	Green	Green	4 <sup>th</sup> 25.9%

**Green** = Evidence of good practice across a number of different interventions within this area

**Amber** = Evidence of good practice in some interventions area but more progress can be made in this area

**Red** = Little or no evidence of good practice in the interventions or no interventions made

We identified three major themes particularly relevant to graduate progression routes and in turn several recommendations and actions which, if addressed in a strategic and co-ordinated manner by the UK engineering community, may positively contribute towards increasing the number of women engineers.

### Key findings:

#### Girls are effectively ruling themselves out of a degree in engineering by the age of 14

1. Broadening the number of compulsory subjects studied at ages 14–18 to include mathematics and physics (the two pre-requisite subjects needed to study engineering in Higher Education). This may contribute positively towards increasing the cohort of boys and girls at Key Stage 4 and significantly increasing the numbers of girls at Key Stage 5 and potential future female engineers.

### Enjoyment of a subject is as significant as attainment

2. A dip in pupils' motivation, performance and attainment has been identified in Year 8, with 'academic subjects' such as mathematics and science identified as being most affected, while subjects with a more overt practical orientation, such as art and technology, are less prone to 'dips'. Encouraging more practical application of science during this period, whether that be within the curriculum or via extra-curricular activity, may positively affect pupils' subject decision making at Key Stage 4.
3. It can be seen that enjoyment of a subject is as significant as attainment in terms of a pupil's likelihood to pursue it further. Consequently the provision of robust enhancement and enrichment activities targeted around pupils' key decision making points, (Year 9 and Year 11), should be encouraged and promulgated as they can make a positive difference to girls' perceptions of engineering.

### Careers advice, information and guidance is still reinforcing gender stereotypes

4. Teachers' influence on reinforcing or challenging gender stereotypes to young people cannot be underestimated. The sector should work towards producing *gender-based* careers education, information advice and guidance in order to help improve teachers' and young people's awareness and perceptions about the wide range of engineering careers available.
5. Encourage engineering businesses and the UK engineering third sector organisations to provide enthusiastic female role models into schools and colleges to promote and support schemes such as STEMNET ambassadors.

Finally, our analysis also indicated that the UK has one of the lowest conversion rates for women qualified in SET progressing into SET occupations. Whilst the roots of this need to be further researched by the engineering community, the more pressing and fundamental need is to implement activities and programmes which will significantly increase the supply of STEM qualified girls coming through the education system in the first instance.

### Recommendations:

1. Undertake attitudinal research of young people across the UK, Ireland, Italy and Sweden at relevant key decision points to identify differentiators between boys and girls across countries.
2. Encourage the Government to establish a broader curriculum across the 14-19 educational structure in England, Wales and Northern Ireland, aimed at keeping young people's subject options open for longer, enabling them to make better informed careers decisions.
3. Encourage the Government to develop a careers service that provides high quality careers education, information advice and guidance to young people across the UK prior to, at the time of, and beyond GCSE choices that promote the diversity of engineering careers available.

### Education

Our analysis of the breakdown of the number of students at each stage of the education system showed that it was impossible to identify any discernible differences between the four countries which would explain why the UK performs poorly at encouraging women to pursue careers in engineering. However, our analysis of academic routes into engineering showed that a lower proportion of girls in England, Wales and Northern Ireland choose maths and physics (at age 18) than in Scotland, Italy and Sweden. This strongly suggests that a key contribution to the low number of women studying engineering at Higher Education level and thereafter entering engineering employment is linked to the low number of females who study A level physics.

Across the different compulsory education systems, England, Wales and Northern Ireland have one of the highest number of school days (190 days) per year; the largest average class size (30 pupils per class); children start compulsory school the earliest and spend the longest amount of time in compulsory education.<sup>5</sup> Additionally,

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<sup>5</sup> EACEA: Key data on education in Europe 2009 [www.eacea.ec.europa.eu/education/eurydice/.../key\\_data\\_series/105EN.pdf](http://www.eacea.ec.europa.eu/education/eurydice/.../key_data_series/105EN.pdf)

pupils in England, Wales and Northern Ireland spend the largest amount of time studying science; have one of the highest proficiency levels in science and are the most able in explaining phenomena scientifically; yet, they report the lowest levels of enjoyment in science, with girls' enjoyment levels ranking significantly lower than boys.<sup>6</sup> Further research in *'Educating the next generation of scientists'* states that a major reason why children and young people give up science and maths is a lack of enjoyment and interest. In the UK, children's attitudes have become less positive in recent Years and in some aspects it is losing ground against other countries.<sup>7</sup>

When exploring dips in educational attainment, participation and motivation (a term used to describe a period where least progress is made by students), all countries examined identified a dip in their pupils aged 12-14.<sup>8</sup> Recurring themes contributing to dips in performance in the UK include: the effects of transfer from primary to secondary school; lack of definition and purpose in Year 8; curriculum change and the lack of urgency to focus in Years 7 and 8 because pupils feel that Year 11 examinations are far away. Academic subjects such as mathematics and science were identified as being most affected by dips in performance in UK, Italy and Sweden.

The difference in educational attainment in SET subjects between girls and boys is also linked to confidence. Results from across the countries showed that girls outperform boys in most subjects at school, including STEM. However, a central issue contributing to lower levels of enjoyment and performance in STEM amongst girls was 'self-perception'. Male pupils appeared to be significantly more self-assured in traditionally male gendered subjects such as mathematics, science and technology.

The analysis of information on vocational education is more difficult as the four countries do not collect vocational data in a comparable manner. However, looking at the number of achievements for UK female students in selected engineering specific sector framework codes indicates that the vocational route is not currently a significant one for training women to enter careers in the engineering sector, with only 200 girls in total studying a relevant engineering framework in 2008/09, compared to 9,500 boys. Nevertheless, all countries studied regard post compulsory education as important: the UK, Ireland and Italy provide a range of academic and vocational options, while Sweden offers full-time, school-based vocational education and training, which comprises of eight subjects which focus on general learning outcomes rather than specialisation. In 2011, Sweden will be introducing limited apprenticeship options in an effort to tackle the high unemployment rate among its 16-19 year olds.

### Teachers' attitudes

A comparison between the differences in gender based teaching initiatives<sup>9</sup> across the countries finds that the UK, Ireland and Sweden follow a clear and outlined gender based teaching policy, whereas Italy does not. Research from the European Commission further illustrates that teachers' perceptions and attitudes of male and female-ness are crucial for their relations with pupils and can be an important factor in generating gender equality in schools, and thus influence subject and career choices.<sup>10</sup>

### Careers Information Advice Guidance (CIAG)

Increasing the numbers of young people studying STEM subjects and subsequently seeking employment within the science, engineering and technology sector is essential for any knowledge based economy's growth strategy.

The provision of coherent and robust careers information (including gender sensitive CIAG within the education system) should be a fundamental consideration for all EU countries; and although some form of CIAG is available in all of the EU states, not all make the necessary provisions to meet the recommended standards related to *gender*

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<sup>6</sup> OECD 2007: PISA 2006 Science competencies for tomorrow's world Volume 1, Volume 2, Data and Analysis: Paris

<sup>7</sup> Educating the next generation of scientists: House of Commons Committee of Public Accounts

<sup>8</sup> INCA: Dips in performance and motivation: A purely English perception? [www.inca.org.uk/pdf/Final\\_Dip\\_Report.pdf](http://www.inca.org.uk/pdf/Final_Dip_Report.pdf)

<sup>9</sup> Refers to teaching activities which exist to combat the socially constructed roles, behaviours, activities and attributes that a given society considers appropriate for men and women. (Eurydice, 2009)

<sup>10</sup> EURYDICE: Gender differences in Educational Outcomes [www.eacea.ec.europa.eu/education/eurydice/documents/thematic.../120EN.pdf](http://www.eacea.ec.europa.eu/education/eurydice/documents/thematic.../120EN.pdf)

based CIAG. The UK, Ireland and Sweden provide 'sufficient' gender sensitive career options and programmes<sup>11</sup>. However, the feedback and experiences revealed by girls seeking CIAG showed it still remains significantly gender biased, indicating that, whilst countries may acknowledge the recommended standards for CIAG, without regulation these may go unobserved.

### Women working in SET

According to the *SET report*,<sup>12</sup> 76% of women in the UK who finish their education and are qualified in SET are not employed in the SET sector. In addition to this, two thirds of women do not return after maternity leave, therefore, at best, only 24% of SET qualified women make a long term career in the sector, and at worst only 8%.

In Sweden 53% of all women who are qualified in engineering and manufacturing work in engineering and manufacturing.<sup>13</sup> In Italy 30.7% of all women who qualify in engineering, manufacturing and construction work in these areas;<sup>14</sup> while for Ireland 11.2% of all women who studied engineering, manufacturing and construction are working within these fields.<sup>15</sup>

The results from the *She Figures 2009 Report*<sup>16</sup> illustrate a 'sticky floor' for female researchers working across all sectors showing that the majority remain concentrated at entry level positions. The proportion of women at entry level is roughly equal to that of men. However, the proportion of women at the top of the professional academic ladder rapidly drops to 17% in the UK, 10% in Ireland, 19% in Italy and 18% in Sweden.

Social barriers for women entering STEM occupations include a range of recurring themes, from the lack of female role models, to the banter used in male dominated workplaces, in addition to the limited understanding of work-life balance. Companies which have a woman CEO are more likely to provide leadership experience for women in the leadership pipeline,<sup>17</sup> therefore until the proportion of females in senior positions reaches the critical 30%, the culture and practices of the company are unlikely to fully support the advancement of women.

### Gender equality in legislative frameworks

Whilst the UK, Ireland, Italy and Sweden all include equality provisions in their law and signed international declarations, the extent of these gender provisions differs and can be defined in various ways. By 1975 the UK introduced its first Sex Discrimination and Equal Pay Act, whilst countries such as Sweden had been implementing gender initiatives as early as the 1930s. In the 2002 'SET Fair' Report,<sup>18</sup> specific targets set by the UK Government were established, and aimed at impacting and improving the representation of women working in SET by 2007. Additional plans outlined included having 25% of women as FTSE 100 Board members and 20% of female SET faculty professors. However, in 2010 only 12.5% of FTSE 100 Board Members were women along with only 1% of Physics professors.

### Economy in context

Analysis of the relative sizes of the industry sectors compared to employment in those sectors lead us to suggest that it is likely that a contributing factor for the higher levels of female participation within SET occupations in Ireland, Italy and Sweden compared to the UK is a larger presence of the industry sector in these countries, thus employing a larger proportion of its female workforce into the industry occupations.

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<sup>11</sup> EURYDICE: Gender differences in Educational Outcomes [www.eacea.ec.europa.eu/education/eurydice/documents/thematic.../120EN.pdf](http://www.eacea.ec.europa.eu/education/eurydice/documents/thematic.../120EN.pdf)

<sup>12</sup> The SET Report <http://www.setwomen.co.uk/images/data/WomeninSET.pdf>

<sup>13</sup> Swedish Statistical Database: [www.scb.se](http://www.scb.se)

<sup>14</sup> Italian National Institute of Statistics/ [www.istat.it](http://www.istat.it)

<sup>15</sup> Ireland Central Statistics Office: [www.cso.ie](http://www.cso.ie)

<sup>16</sup> European Commission, She Figures 2009 Report: [ec.europa.eu/research/science-society/.../she\\_figures\\_2009\\_en.pdf](http://ec.europa.eu/research/science-society/.../she_figures_2009_en.pdf)

<sup>17</sup> The WIRDEM report used data from She Figures 2006. More recent data from 'She Figures' 2009 show an improvement and indicate that in 2007, 19% of full professors were women.

<sup>18</sup> The 'SET Fair' Report in 2002 <http://www.vitae.ac.uk/cms/files/Greenfield-review-SET-Fair-November-2002.pdf>