

LIFTING BARRIERS TO WOMEN IN SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS: A STRATEGY FOR SCOTLAND

SCET109g

Additional call for evidence from learned societies/professional organisations

The Royal Society of Edinburgh, with the involvement of the Chief Scientific Adviser for Scotland, is addressing the challenge of developing a cohesive and comprehensive strategy for Scotland to tackle the under-representation of women in science, technology, engineering and mathematics (STEM). The principal aims are to identify factors that appear to limit the proportion of women in the STEM workforce, and to seek to introduce measures that may increase the number who rise to senior positions in universities, institutes, public and professional bodies, business and industry.

As part of its evidence-gathering activities the Working Group, led by Professor Dame Jocelyn Bell Burnell, is seeking information from learned and professional bodies about how they develop gender-balanced memberships.

We welcome submissions as soon as possible.

Submissions

We prefer to receive submissions by email to cwallace@royalsoced.org.uk. If you would like to make a postal submission, please send to: Dr Caroline Wallace, The Royal Society of Edinburgh, 22-26 George Street, Edinburgh EH2 2PQ.

Key questions

Inclusion of women:

- a) Does your organisation feel that it would benefit from increased inclusion of women in its Fellowship? If so, in what ways would the organisations benefit?

As an employer and scheme promoter the Academy is committed to diversity. We value the diversity that men and women with differing backgrounds, skills and abilities bring not only to the Academy itself but also to the Science, Engineering and Technology (SET) Professions as a whole.

Increasing the proportion of women in our Fellowship, and also increasing their active involvement in the Academy activities and Standing Committees, provides a valuable means of promoting strong female role models from academia and industry. Their presence and perspective also ensures that the Academy takes a diverse and inclusive view in all aspects of its work, both internally and externally, which is vital if long-standing stereotypes within the profession are to be challenged.

- b) What mechanisms, procedures or actions, if any, are in place to move towards achieving an appropriately gender-balanced membership? Examples may include positive action, gender-balanced panels, attention to the pipeline.

Following a full membership review carried out by Sir Peter Gershon in 2006, the Academy determined to establish a proactive membership committee (PMC), a nominating committee tasked to encourage and support new nominations for Fellowship from under-represented

groups and sectors. The PMC always includes a female membership and has as one of several explicit aims, to increase the number of female Fellows overall.

- c) Are there any further mechanisms or actions that the organisation could initiate by which the gender balance could be improved?

The Academy has operated an internal Diversity Campaign for the last 3 years. It is designed to raise the diversity of the people involved in all activities undertaken by the Academy, is prioritised by the Academy's Council and chaired by Professor Dame Wendy Hall FRS FREng. In addition to the internal Diversity Campaign, the Academy's Pro-active Membership Committee has demonstrated how a concerted and pro-active approach to seeking nominations to the Fellowship has raised the diversity of each subsequent cohort of new Fellows year on year – without compromising on quality. The work initiated under the internal Diversity Campaign will continue.

One key mechanism that is being used to consolidate our diversity focus is the development and deployment of an integrated IT system that will enable us to collect, monitor and track participation in our programmes and awards. This will be used, together with a 'comply or explain' approach, to embed accountability into our internal management.

As part of the new Diversity Programme launched this year, we also plan to undergo assessment against the UKRC SET Fair standard. Any findings from this exercise will be addressed, to strengthen the gender support within our organisation.

Election of fellows:

- d) What criteria are used in selecting new Fellows?

The principal criterion is: "personal achievements in engineering displaying individual engineering excellence". This is judged in a variety of ways depending on the background, role and profession of the nominated candidate.

- e) Has your organisation done a gender impact analysis on the selection criteria to assess if they are equally appropriate for both genders?

Not known, but the Gershon review did explicitly look at the issues surrounding the nomination of more female candidates among other diversity matters.

- f) How transparent is the selection process? Are the criteria published and do those outside the Council and Selection Committees understand how the selection is done?

The criteria of excellence in engineering are stated clearly on every nomination paper. There are copious guidance notes for proposing Fellows explaining the nomination and evaluation process.

- g) How are interdisciplinary nominations handled?

There are five discipline-based membership panels: mechanical, civil, electrical, chemical and computing. Multi and interdisciplinary nominations are sent to two panels for simultaneous review.

Statistics:

- h) Is the % of females in the candidate pool the same as/lower than/higher than the % of females in the pool candidates are drawn from? (We suggest taking professors as the best approximation to the pool candidates are drawn from).

It is difficult to accurately estimate the percentage in the pool as the RAEng, unlike most other learned societies, does not draw candidates only from academia but also, in approximately equal numbers, from industry.

i) Are there trends in these percentages? Does the trend match that of the pool?

In 2005 the percentage of female (ordinary) Fellows was 1.75% (22F from 1259), which under-represented the proportion women in senior positions (CEOs, directors and professors) in engineering. Since 2007, with the activity of the proactive membership committee and the efforts of nominating Fellows, there has been a year on year increase in the number of women elected to the Fellowship. In 2011, there are 3.5% female Fellows. The proportion successfully elected, broadly matches the proportion nominated.

j) Once in the candidate pool, do women get elected more often/quickly than men?

All candidates undergo the same assessment and evaluation process, but special efforts are made to identify and support the nomination of female candidates (and also those from other underrepresented groups). The additional effort to support these candidates results in a higher than otherwise expected number of successfully elected female Fellows.

k) Is the number of women in the candidate pool growing, static, decreasing? (Are they being elected faster than they are being nominated?)

The number of women in the pool under consideration is steadily increasing as is the number of female candidates successfully elected as Fellows. The rate of increase has been marked over the past 5 years and has now likely reached a plateau (e.g. 8F from 50 Fellows elected in 2011 is 16%).

If there are several categories of Fellowship (e.g. Honorary Fellows and Ordinary Fellows) it would be useful to have figures for each category.

There are Honorary Fellows (2F from 42); International Fellows (2F from 104) and Fellows (47F from 1359 or 3.5%).

Related areas:

Similar questions may be raised about the gender balance in the award of prizes and grants, in the membership of its most powerful committees and in the slates of speakers and chairs of meetings it promotes. We welcome any information you can provide us in this regard.

About the project

Scope

The strategy will address the vertical segregation of women in the science, technology, engineering and mathematics (STEM) workforce from postgraduate level to senior positions in universities, institutes, public and professional bodies, business and industry. It will also consider the support for women in entrepreneurship.

Inquiry process

Attracting and retaining more women in the STEM workforce to boost economic growth is a public policy challenge which demands public, private and third sector solutions.

The Working Group will take evidence from experts in the field, STEM practitioners and employers, and engage with stakeholders during the process through specific discussion fora. A formal written consultation will take place during the summer with a final consultation event in October, arranged with the Foundation for Science & Technology. This will review the evidence and recommendations in the RSE report and will involve experts familiar with relevant evidence; representatives of the STEM base and those with executive responsibility in business, institutes, universities and colleges that employ STEM graduates. The Working Group will publish its final report in November which will provide reasoned recommendations to those who have a key interest in STEM such that the full potential of women in science can be harnessed more effectively.

The project is being led by Professor Dame Jocelyn Bell Burnell FRS FRSE (Visiting Professor of Astrophysics at the University of Oxford) and draws on the expertise of a high-level Working Group comprised of:

- Professor Alice Brown FRSE (Deputy Chair), Former Vice-Principal, University of Edinburgh
- Professor Geoffrey Boulton FRS FRSE, Regius Professor of Geology Emeritus, University of Edinburgh
- Professor Anne Glover FRSE, Chief Scientific Adviser for Scotland, Scottish Government
- Professor Rebecca Lunn, Professor of Civil Engineering, University of Strathclyde
- Mr Jim McColl FRSE, Chairman and Chief Executive, Clyde Blowers Ltd
- Professor Teresa Rees AcSS (Special Adviser), Professor of Social Sciences, University of Cardiff
- Dr Susan Rice FRSE, Managing Director, Lloyds Banking Group Scotland
- Professor Wilson Sibbett FRS FRSE, Professor of Physics, University of St Andrews
- Ms Linda Somerville, Director, Scottish Resource Centre for Women in SET
- Professor Bonnie Webber FRSE, Professor of Intelligent Systems, University of Edinburgh

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Royal Society of Edinburgh consultation
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Your details

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About your response

Are you responding independently or on behalf of an organisation? **An organisation**

May we include your name/your organisation's name in the list of respondents that will be published in the final report? **YES**

If you have answered yes, please give your name or your organisation's name as it should appear in print: **The Royal Academy of Engineering**

May we quote your response in the report and make it available on the RSE website when the report is published? **YES**

**Royal Society of Edinburgh consultation
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The Royal Academy of Engineering submission
August 3rd 2011

As the UK's national academy for engineering, The Royal Academy of Engineering brings together the most successful and talented engineers from across the engineering sectors for a shared purpose: to advance and promote excellence in engineering. We lead the engineering profession, harnessing the collective expertise, energy and capacity of the profession to enhance the UK's economic and social development. We provide analysis and policy support to promote the UK's role as a great place from which to do business. We take a lead on engineering education and we invest in the UK's world class research base to underpin innovation. We work to improve public awareness and understanding of engineering. We are independent of Government and are a registered charity.

1. What do you see as the opportunities and challenges facing the STEM workforce in Scotland today?

(i) Engineering skills are a priority for the Westminster government but the UK lags behind international competitors

The Westminster government's growth strategy places skills at the centre of the economic recovery and emphasises the need for a rebalanced economy¹.

"We need a more competitive, rebalanced economy, which is environmentally sound and resource efficient, and we need to reduce the deficit. There should be no illusions about the scale of the challenge we face. Our working age population is less skilled than that of France, Germany and the US and this contributes to the UK being at least 15% less productive than those countries²"

A rebalanced economy which is environmentally sound requires excellent engineering (and STEM more widely) skills. This is reflected in the National Strategic Skills Audit which emphasises the importance of engineering occupations and skills to the economy³.

(ii) The business community values STEM skills but they are hard to secure

The recent CBI Education & Skills survey⁴ identifies STEM higher education as a priority for business: *84% of employers surveyed (STEM and non-STEM) have concerns over the availability and quality of STEM graduates; 66% of respondents were not confident that they could access high level skills in the future.*

¹ BIS (2010) Skills for Sustainable Growth

² ONS: International Comparisons of Productivity, October 2010

³ Skills for jobs: Today and tomorrow. The national strategic skills audit for England. UK Commission for Employment and Skills. March 2010

⁴ *Building for Growth*, CBI / EDI education and skills survey 2011

(ii) The engineering profession is ageing but the replacement demand thus created means there will continue to be good jobs to be had in engineering

The importance of replacement demand in engineering needs to be emphasised as it is a substantial part of all future job openings. This means that even occupations facing net job losses will still remain viable sources of employment resulting from the need to replace workers leaving for various reasons (mainly due to retirement)⁵. Replacement demand is particularly significant in engineering where the median age of the chartered engineer in the UK is now 57 years⁶ and the median age of the registered engineering technician is not much younger.

(iii) STEM is good for social mobility but there are problems with under-representation of certain groups in society

Engineering is a profession, and as such confers social mobility on those who access it. However, currently the profession is having limited social mobility effect on a range of under-represented groups (women, those from certain minority ethnic groups, those with disabilities).

Only 9% of those working in the engineering profession are women⁷. This is far behind every other country in Europe and significantly behind the USA. Nearly half the UK population are classified in the bottom four (out of seven) socio-economic categories whereas only a third of those applying for engineering degrees are from those bottom four categories. Whilst on average, the proportion of those in engineering who are from non-white ethnic groups is larger than the prevailing proportion in UK society, those from particular groups, Caribbean, Pakistani, Bangladeshi in particular, are under-represented.

(iv) Sustained long term investment is required in a time of austerity

Public investments in renewable energy, lower carbon housing, water, energy supply and distribution, transportation will require steady supply of engineering graduates and engineering-related apprentices over long periods of time if the nation is to obtain long term value from initial investment. Long term commitments from those operating and maintaining the national infrastructure are required, despite the prevailing climate of financial austerity in the UK.

(v) Immigration policies have an effect

It is not easy to maintain levels of engineering skills through the open skills market alone. The Skill Shortage Occupations list⁸ produced by the Migration Advisory Committee regularly identifies skill shortages in engineering occupations – in particular amongst geological, electrical, chemical, design, planning and production and process

⁵ Cedefop (2010) *Skills supply and demand in Europe: Medium-term forecast up to 2020*

⁶ Engineering UK 2010 – the state of engineering, Engineering UK, 2010

⁷ UKRC has produced a significant baseline gender statistics picture in its 2010 publication: *Women and Men in Science, Engineering and Technology: the UK Statistics Guide 2010*. In parallel, Engineering UK include diversity statistics (amongst a wealth of other statistics) for engineering in their annual *Engineering UK* digest of statistics.

⁸ UK Border Agency shortage occupation list. Migration Advisory Committee. www.ukba.homeoffice.gov.uk

engineers - highlighting the lack of UK engineering graduates in key areas for the economy and sectors that are particularly important to Scotland.

In addition, the funding base to engineering higher education is particularly vulnerable to loss of income from overseas students if visas become more restricted as a relatively high proportion of engineering undergraduates are from non-EU countries⁹ (reflecting the quality and reputation of engineering higher education in the UK attracting students from around the world – a real success story). This situation is significantly more marked for the case of postgraduate and research degrees where the UK domiciled Masters and PhD students are now in the minority compared with EU and non-EU domiciled students in key engineering disciplines such as mechanical and civil engineering¹⁰. The requirement for non-EU postgraduates to return to their home countries after graduation puts the UK engineering research base at threat as well as restricting the supply of higher education teaching staff in engineering.

2. What do you see as the current barriers to the recruitment, retention and progression of women in the STEM workforce?

There is antipathy amongst young people towards engineering as a career choice. Only 37% of 12-16 year olds and 31% of 17-19 year olds in the UK see engineering as a desirable career¹¹. This varies with gender as another survey found¹² that in the UK 18% of young women and 50% of young men are willing to become engineers. The UK is well behind all other European countries in gender inclusion¹³.

3. What steps are being taken within your organisation and/or sector to enhance the career options and progression routes for female staff members?

The Royal Academy of Engineering is very experienced in the field of diversity. Its London Engineering Project¹⁴ has won several awards for its focus on diversity and the Academy's internal Diversity Campaign (designed to raise the diversity of the people involved in all activities undertaken by the Academy), prioritised by the Academy's Council and chaired by Professor Dame Wendy Hall FRS FREng is showing the right signs of success after only 3 years of operation¹⁵. In addition to the internal Diversity Campaign, the Academy's Pro-active Membership Committee has demonstrated how a

⁹ Strategically Important and Vulnerable Subjects. The HEFCE advisory group's 2009 report. www.hefce.ac.uk (accessed April 2010)

¹⁰ A Higher Degree of Concern, The Royal Society, January 2008

¹¹ Engineering UK, (2010), *The 2010 Engineers and Engineering Brand Monitor:*

Understanding perceptions of engineering, engineers, manufacturing, science and technicians. London: Fresh Minds Research. Available at

http://www.engineeringuk.com/db/documents/2010_Engineering_UK_Brand_Monitor_FINAL_20100909120039.pdf.

¹² Becker, Frank Stefan (2010), 'Why don't young people want to become engineers? Rational reasons for disappointing decisions', *European Journal of Engineering Education*, Vol. 35, No. 4, 349–366

¹³ Reported in Engineering UK 2010, Engineering UK, December 2010

¹⁴ An engineering outreach project with 50 schools in London - www.thelep.org.uk

¹⁵ In FY 2009-2010 the Academy made over 2,500 grants and awards to organisations and individuals totaling £11.7 million. The Academy allocated 39.5% of its awards to female applicants and 60.5% to male applicants. 77% of applicants were male, 23% female. Recipients of funds were – 62% White, 24% Chinese, 5% Indian-Asian or Asian British. The remaining 9% were distributed amongst other ethnic groups. In the Academy's education programme, 72% male, 28% female. Participation amongst minority ethnic groups varied up to 75% for the London Engineering Project. In 2010 53 Academy Fellows were elected - 6 of them women (11%). In 2011, 59 Fellows were elected – 9 of them women.

concerted and pro-active approach to seeking nominations to the Fellowship has raised the diversity of each subsequent cohort of new Fellows year on year – without compromising on quality.

We know there are no magic bullets. Learning from our own internal efforts, raising the diversity of the engineering profession will require an absolute commitment to quality and a pro-active approach to finding the best people. The keys are effective data monitoring, constant vigilance to spot emerging trends in the data and the willingness to make management and business decisions on the basis of that data. We have adopted a culture of 'comply or explain' internally so that no part of our work is left untouched by our Diversity Campaign.

4. What further steps could/should be taken within your organisation and/or sector, including any specific policies and practices?

The Royal Academy of Engineering has recently launched an Engineering Diversity Programme. This is about raising the diversity of the engineering profession by actively seeking out talented people from under-represented groups: women, those from lower-socio economic groups, minority ethnic groups and those with disabilities.

By *the engineering profession* we mean those who are suitably qualified and experienced to gain professional status as Registered Technicians, Incorporated Engineers or Chartered Engineers.

By *raising diversity* we mean measured increases in those from under-represented groups who go through *engineering formation*; completing relevant programmes of study and opting to work in the engineering profession.

The Engineering Diversity Programme is about the engineering profession expressing the demand for more diversity in a coherent way. It is not about stimulating an interest in engineering amongst young people from under-represented groups. That work is important, and the Academy is deeply committed to it, but it takes place outside of the Diversity Programme. For example, the Academy has been a supporter of the WISE Campaign for many years and looks to WISE to provide strategic leadership on gender inclusion to those who deliver SET outreach activities. One such example is the *Tomorrow's Engineers* initiative which is co-led by the Academy.

5. More generally, how could the potential of women in the STEM workforce be more effectively and efficiently realised? Who would be responsible for implementation and what support would be required?

For the case of engineering, the profession needs to:

- Develop Diversity Campaigns at all professional engineering institutions with ongoing support from the Royal Academy of Engineering, the UKRC and others.
- Assemble data on a full range of diversity indicators in engineering (not limited to gender diversity data which is collected and analysed by others such as UKRC, Engineering UK, Science Council etc.) which is more comprehensive, up to date, better validated, easier to obtain and better analysed than before. This is

required to monitor progress on diversity in the engineering profession more accurately.

- Agree a national data set for diversity, allowing organisations working to develop the STEM pipeline to collect and contribute data more effectively. Data collection will be encouraged and international comparisons will become easier. This data then needs to be used as a management tool to drive improvements in the diversity of participants in all the profession does to inspire the next generation of engineers.
- Provide an authoritative case for increasing diversity in engineering and in the wider STEM workforce.
- Provide authoritative advice on best practice for increasing diversity in engineering by identifying as engineering diversity champions in the profession.

6. Do you think there needs to be any changes to existing employment law? If so, in what areas?

We do not see a requirement for changes to existing employment law.

7. Are you aware of any existing resource that is effective in addressing the under-representation of women in STEM?

We can recommend two:

- The Athena Swan Charter for female academic staff in STEM university departments
- The UKRC *SETFair* standard which recognizes effective practice in the recruitment and retention of female workers in SET occupations.