

# **STAY OR GO?** **THE EXPERIENCE OF** **FEMALE ENGINEERS** **IN EARLY CAREER.**

Institution of  
**MECHANICAL**  
**ENGINEERS**



Improving the world through engineering

“““

Engineering can no longer afford to remain a sector in which women who join the profession are expected to change their personality in order to ‘fit in’.

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**Peter Finegold**

Head of Education and Skills,  
Policy & Research

This report has been produced in the context of the Institution's strategic themes of Energy, Environment, Education, Healthcare, Manufacturing and Transport and its vision of ‘Improving the world through engineering’.

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# FOREWORD

There are simply not enough female engineers in the UK. We don't recruit enough talented women onto engineering apprenticeships or degree courses, and of those we attract into the profession, we lose too many very early in their careers. As an employer of engineers, I have an interest in ensuring that we continue to produce a skilled and professional workforce, both now and in the future.

We need to attract more women into engineering, not simply to meet our skills demand, but because technology is central to all our lives and this should be reflected in the workforce. Engineering is often a fulfilling and creative career, and to retain as much talent as possible, we need to ensure that this is true for more engineers.

I was delighted that the Institution of Mechanical Engineers commissioned this research to help understand more about the attitudes of women in UK industry. This work is ground-breaking and challenging. It asks women who have chosen engineering, and those who have chosen other paths, to talk about a wide range of factors that influence their experience of work.

In my experience over the last 20 years in engineering, there has been an improved understanding of what is needed to develop and retain female engineers in the workforce – for example mentoring programmes and flexible work arrangements. Identifying what is required is key to ensuring the workforce stays diverse and delivers successful projects.

This issue is not just about boosting the number of women in the profession, but about having a more conducive working environment for all. Having a more representative workforce and ensuring that all people feel that they belong means more effective teams, more creative ideas, different perspectives, and ultimately better solutions; and that will lead to improved business performance.

This research is timely and informative, and I commend its recommendations to you.

**Sarah Haslam FIMechE**

Engineering Manager, Ford Motor Company

# EXECUTIVE SUMMARY

With women accounting for only 9% of the engineering workforce, the UK needs to recruit more female engineers. However, it also needs to hold on to those it already has. To achieve this, employers and universities must make the working environment and culture more conducive and comfortable for women, so that there is less of a need to support female engineers to adapt and cope with an unaccommodating environment.

Within a few years of gaining an engineering degree, just under half of UK female engineering graduates will have left the profession. By contrast, at the same stage, two-thirds of male engineers remain in the sector.

The Equality and Diversity Steering Group of the Institution of Mechanical Engineers commissioned this study, to better understand the reasons why a large proportion of women leave the engineering profession in early career, and to propose what needs to be done to address this unacceptable level of attrition.

To establish the specific character of engineering, this unique study compared the experience of female engineers with equivalent professionals in the medical sector where women comprise 43% of doctors<sup>[1]</sup>; and in the financial sector, where women make up 46% of financial professionals<sup>[2]</sup>. The research also sought comparisons with female engineers in Germany, where women form a similar proportion of degree entrants but are a significantly greater proportion of the engineering workforce (15%).

The research was undertaken by the market research agency, ICM Unlimited, in two phases during 2016: through an online moderated community, and by a detailed online survey in which 558 women participated.

The results showed personal experiences of discrimination were more prevalent in UK engineering than other sectors, with 63% of female engineers personally experiencing unacceptable behaviour or comments (2.5-3 times more that experienced by women in the financial or medical professions), while 20% stated they had witnessed similar actions directed at others.

Despite wishing to challenge 'workplace banter' in particular, female engineers describe being placed in an impossible position of either pretending they were not offended, or risking the accusation that they did not have a sense of humour.

More than two-thirds of UK female engineers reported feeling the need to adapt their personality or 'toughen up' to get by or get on.

To address these issues, the Royal Institution of Chartered Surveyors has introduced and promoted its Inclusive Employer Kite Mark scheme. The scheme benchmarks six key principles to help companies ensure that offer an inclusive, equal and fair environment for all employees.

Almost 40% of UK female engineers stated that they were simply not treated equally – including by their managers, the people they managed or by their peers. Over 60% believed it was easier for men to progress within the engineering sector – marginally higher than in finance, but significantly higher than in medicine.

Perceptions of the factors that led to career advancement suggested that while quality of work or technical ability was seen as personally important to them, two-thirds of female engineers felt that career progression was determined through networks and social connections, and that it was in these areas they felt at a disadvantage – one-quarter of UK female engineers did not feel comfortable socialising with their colleagues and some events were simply unwelcoming to women.

Earlier research shows that two-thirds of female engineers do not resume their engineering career after taking maternity leave. This figure is significantly higher than the average across all UK professions, and therefore warrants greater understanding. There was suggestion of stigma attached to the decision to take maternity leave – a statutory entitlement often enhanced by the company. Female engineers' experience of returning to work after having a baby varied significantly between companies, though UK engineering was identified as more progressive in offering flexibility than other UK sectors or engineering in Germany.

Engineering should be an attractive sector where talented women want to work. While financial reward is important when recognising achievement, female engineers tend to frame success in a different way from their male peers. Job satisfaction and the receipt of positive reinforcement from managers and colleagues both took precedence over remuneration, as measures of personal success. These factors need greater recognition and should be acted upon.

Many features of the working environment that typically encourage women to leave and move on, were common across sectors and nations. These included excessively high workload and a sense of feeling undervalued. But female engineers, uniquely placed high in their rankings 'unfair treatment' as a major reason for leaving the profession.



Human beings learn from one another and identify with those they admire, and perform better when they feel they belong. To understand the extent to which these are of particular importance to female engineers, the study sought to explore the nature of mentoring, role-modelling and the place of work-related social activity in setting the working culture.

It would appear that female engineers looked up to their role models because of their technical knowledge and ability. Approximately half of the role models chosen by these engineers were also women and this was seen as an important, though not the principal desired characteristic. However, irrespective of gender, a shared professional interest was identified as the most valuable trait and many respondents described examples of successful mentoring relationships with male colleagues. Female professionals do, however, often feel more comfortable having a female mentor.

For decades the first step along the standard path into a professional engineering career has been through an engineering degree. The study revealed how perceptions prior to embarking on a degree course and experience as an undergraduate, contributed to the wider (too often negative) narrative and experience of engineering for female engineers in early career.

Almost half of UK female engineers reported experiencing 'differential' treatment at some stage before graduation, either as a student or while on work experience. This figure was significantly higher than that reported by German engineers. By the end of their first year of work, three-quarters stated they were aware of being treated differently. The consensus is that even when the intentions were well-meaning, the outcomes were often detrimental, as they reinforced negative views in the minds of some about levels of competence and resentment surrounding perceived privileged support.

Positive action that unwittingly depicts female engineering students as exotic aberrations may not work in female engineering students' favour. Universities need to set out and adhere to a clear set of principles as rationale for positive action, and constantly reinforce these principles. Great care should be taken to consider whether, for example, dedicated prizes and awards challenge archetypes or reinforce negative views.

In 2005, the Athena SWAN charter was established by the Equality Challenge Unit to provide a framework, based around ten key principles, for good practice in advancing gender equality in the higher education sector.

The decision to remain as an engineer was also influenced by the nature and rationale in choosing engineering in the first place. Recruitment of female engineers in the UK seems to rely heavily on having 'an engineer in the family' and on a belief that academic success in mathematics and physics will automatically lead to a successful and serene career in professional engineering.

While the majority of female engineers were not the first person in their family to work in a science, technology, engineering or maths field, they were often the first woman to do so.

The findings suggest that engineering's low visibility in schools, coupled with variable and often poor careers education provision, not only prevents many talented women from entering the profession – it can also present an unrealistic set of expectations for others who choose to pursue engineering.

Most efforts to address the low participation rate of women in engineering have focused heavily on attracting women into the sector. Trends in applications to engineering degree courses show that this approach has had some small effect, with the number of women applying to these courses slowly creeping upwards. But the fragile hold over female engineers in early career threatens to undermine this good work.

The reasons why women choose to enter engineering employment and subsequently stay or leave, are as complex and diverse as the people who make up the profession. There is no single action that will bring about the desired change, but a unified view that making the working environment welcoming to all people of talent and commitment would no doubt improve wellbeing for all employees, increase productivity and address the skills shortages that seem to have plagued the engineering and manufacturing sectors for generations.

# RECOMMENDATIONS

## Recommendations

1. The engineering community should devise and promote the adoption of agreed quality benchmarks for retaining female engineers in early-to-mid career — building on existing best practice, such as the RICS Inclusive Employer Quality Mark. Employers must promote a message that no employee should feel a need to ‘toughen up’ to be successful in their career.

**[Women’s Engineering Society,  
professional engineering institutions,  
engineering companies]**

2. The engineering community needs to identify and emulate how the most-effective companies address career ‘flashpoints’, such as return to work after maternity leave, through implementing strategies that work both for female employees and the employer.

**[Semta, professional engineering institutions,  
engineering companies]**

3. Employers should consult all employees annually, and in confidence, on their views about the fairness of staff recognition, reward, professional support and work social activity – and, where necessary, implement changes to bring about improvement.

**[HR directors in engineering companies]**

4. The academic engineering community should carry out a UK-wide study to characterise the experience of being a university engineering undergraduate. All Higher Education institutions should be encouraged to participate in the Athena SWAN charter which addresses all aspects of equality and diversity.

**[Engineering Professors’ Council, Deans  
of university engineering departments,  
professional engineering institutions  
Women’s Engineering Society]**

5. Careers education should be properly resourced to reflect its vital role in contributing to a successful Industrial Strategy. A quality national careers programme in schools would both encourage more women to pursue engineering and contribute to the reduction of attrition in early career.

**[Government Education Departments,  
Careers and Enterprise Company]**





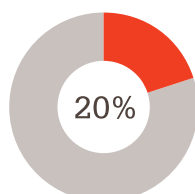
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I was bullied by another apprentice (male) during my first year as a trainee. Although the issue was raised at the company I work for, no action was taken.

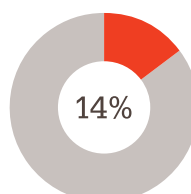




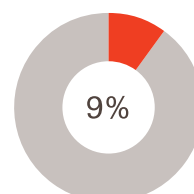
Women make up



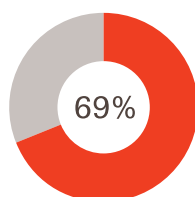
of applicants to engineering degree courses



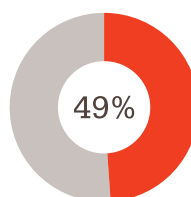
of first degree students in engineering



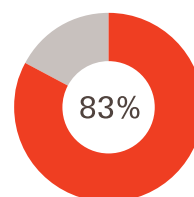
of professional engineers once in the workforce



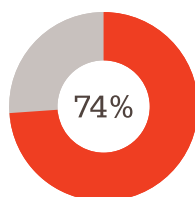
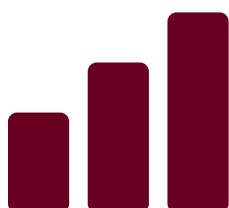
feel they have had to adapt their personality to get by



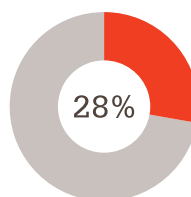
first observed differential treatment compared to male colleagues at university



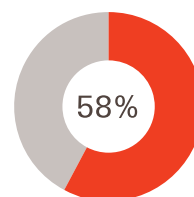
have personally experienced or witnessed discriminatory language or behaviour



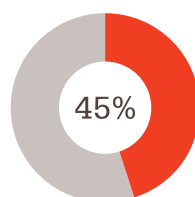
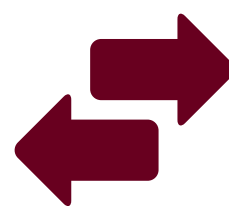
decided to pursue a career in engineering before 18 years old, compared with 53% for medical and 27% for finance



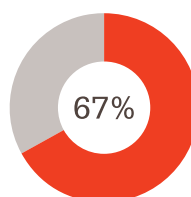
are the first person in their family to work in STEM



Female engineers are significantly more likely than finance (48%) or medical (49%) professionals to have had a role model



of female engineering graduates do not enter the profession



of female IMechE members leave by the age of 35 years old

# INTRODUCTION

Many women choose to leave the engineering profession early in their career, some before it has properly begun. According to data from the Higher Education Statistics Agency for 2013/14, some 45% of female engineering graduates in the UK did not enter the engineering profession compared to just 32% of their male counterparts<sup>[3]</sup>.

This study aims to understand the range of factors that contribute to these high levels of attrition. It seeks to understand why women choose to become engineers in the first place, their experience in higher education, and how welcome they feel during their studies, and in the workplace. It also investigates the extent to which negative views about the working environment are shared among all female engineers in early career. The report looks at perceptions of the culture and day-to-day working interactions that drive some to leave the profession.

With far fewer women than men choosing engineering, numerous campaigns and initiatives have been initiated to encourage women into the profession; primarily driven by a need to plug the skills gap. This focus on recruitment may have diverted the attention of engineering companies, policymakers and professional institutions from looking at factors affecting retention of the female engineering talent it already has. Consequently, though there are signs that the number of young women choosing to study engineering is slowly increasing to 20% of total applications<sup>[4]</sup>, this success is offset by attrition in early career, with the percentage working in industry stubbornly remaining in single figures.

A unique feature of the study is how it attempts to compare the experience of female engineers with those of women at an equivalent professional level in the medical sector, where women comprise 43% of doctors, and the finance sector, where women make up 46% of professionals. To offer further texture, comparisons were also made with female engineers in Germany, where women make up a similar proportion of engineering degree applicants but are more likely to remain in the profession, and are a significantly greater proportion of the engineering workforce at 15%<sup>[5]</sup>.

The research was commissioned by the Equality and Diversity Steering Group of the Institution of Mechanical Engineers, and carried out during 2016 by the market research agency ICM Unlimited. The methodology was designed to gather the views of 500 UK women in the first ten years of their career in engineering, medicine or finance, and the research samples comprised:

## **Qualitative**

- 12 engineers
- 6 finance professionals
- 8 medical professionals

## **Quantitative**

- 250 engineers in UK
- 104 engineers in Germany
- 102 finance professionals in UK
- 102 medical professionals in UK

The research aimed to establish the reasons why female professionals made their individual career choices and at what point these decisions were made. It then sought to understand their experience as they progressed through education into the workplace, and their first years as engineers. To allow comparisons with a culturally equivalent economy, but with a more balanced representation of female engineers, views were also sought from female engineers in Germany.

The research took place in two stages. Initially 26 female participants were selected, who had studied science, technology, engineering and mathematics (STEM) to degree level and who had been working in their chosen field for at least four years. This sample, comprising employees from engineering, finance and medicine, participated in an online community over the course of five days. The sample was recruited by ICM Unlimited and volunteer networks from the Institution of Mechanical Engineers and the Institution of Civil Engineers. The participants were presented with new topics for discussion each day and could post responses, ask questions or discuss the topics with other participants for the duration of the online community. The community was observed by a moderator who prompted further discussion through asking follow-up questions. The findings of the online community informed the development of a detailed online questionnaire at the second stage.

Some 2,000 eligible female members of the Institution of Mechanical Engineers were then invited to take part in an online survey, of which approximately 9% responded. The eligibility criteria comprised being a female Associate Member (awarded to early career professionals) or having been a member of the Institution for five years or less.

The survey was also promoted on social media and was open to female engineers working in any engineering field.

ICM Unlimited sourced participants in Germany, and medical and financial professionals in the UK, through their network of recruitment services using comparable eligibility criteria.

## **Research assumptions and limitations**

- The experiences from the sample of largely mechanical engineers and civil engineers are applicable to the sector more broadly.
- The research sample did not extend to those who had left the profession.
- The resources for the research study did not allow for a comparative study of male engineers in early career.



“““

I get treated differently in the manufacturing sector – it's kindly meant, but I'd rather be allowed to get on with my job as an engineer first and foremost.



# RESEARCH FINDINGS

## HOW THE WORKPLACE CULTURE AFFECTS FEMALE ENGINEERS

### Experience in the workplace

The vast majority of female engineers work in environments with more men than women, and with the senior roles being held by men. This can generate a particular ethos and have a negative effect on the culture of the organisation. Overtly discriminatory behaviour exists but is far less common than more insidious behaviours which are generally harder to police.

**“Whilst on graduate placement in a manufacturing environment, sexist comments and whistling at female colleagues appeared to be considered the norm. I have witnessed colleagues saying things such as ‘what would you know about this, you’re a woman’ and ‘I can’t criticise her work because she’ll just cry’.”**

**“I found out that a group of men in one of my company’s departments had a ranking and handicap system for scoring the sexual attractiveness of the women working there...”**

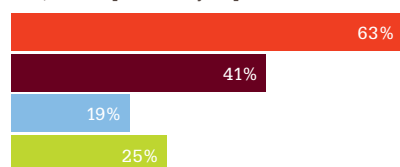
The study shows that personal experience of discrimination is much more prevalent in engineering than in other sectors. Some 63% of female engineers in the UK, report that they have personally experienced discriminatory behaviour or language, and a further 20% have witnessed it against others (**Figure 1**).

“““

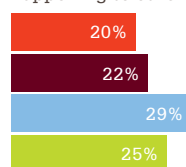
My profession is male-dominated and women are required to push themselves outside of their comfort [zone] to ‘fit in’.

### 1 I have witnessed or experienced discriminatory behaviour and/or language

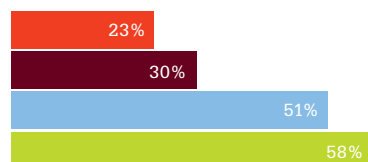
Yes, I have personally experienced this



Yes, I have witnessed this happening to other people



No







“““

Senior people are more likely to circumvent me and approach my team directly—this never happens to male managers at the same grade.



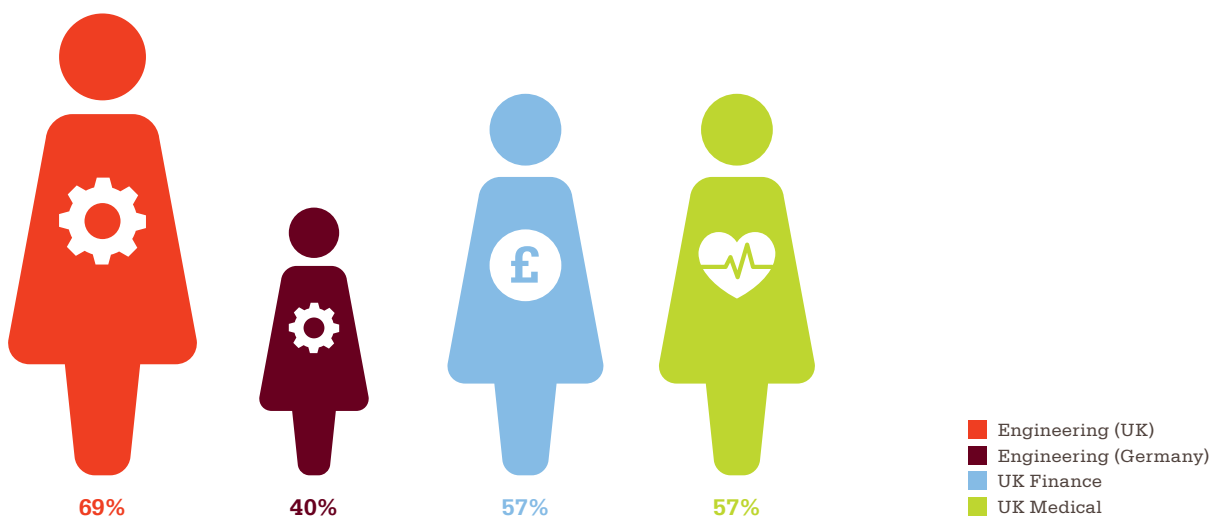
Psychologists argue that discriminatory behaviours escalate along a fairly predictable path, often based on pre-existing prejudice. This starts with derogatory or insensitive remarks and jokes, which then incrementally create conditions that make it easier for the out-group to become alienated. This, in turn, can more easily facilitate discrimination itself – that is, where the group is denied access to opportunities and services<sup>[6]</sup>.

**“I have been at several sites where there have been a large number of posters/pictures hanging around of mostly naked women, which is very uncomfortable when you are coming in as the only woman in a site full of men. I am normally quite emotionally strong, but the fact that nobody has put a stop to displaying such images did make me feel like an outsider for the first time since becoming an engineer.”**

Descriptions of experiencing this first stage were frequent among engineering respondents and identified as part of everyday workplace banter.

When they felt they needed to challenge ‘workplace banter’, women were placed in an impossible position, faced with the options of either being accused as ‘lacking a sense of humour’ or having to pretend they were not offended. This behaviour was not unique to engineering, but it was seen as being more prevalent in the sector than in other professions, with more than two thirds of female engineers in the UK reporting feeling the need to adapt their personality or ‘toughen up’ to get by (Figure 2).

## 2 I feel I have had to adapt my personality to get by in my industry



**"This is from men, who think of it as a joke, but in reality it can be frustrating, crude and unnecessary."**

**"Saying it's just a joke so that the woman looks like she takes herself too seriously if she doesn't laugh."**

The challenge therefore is how to remove the responsibility for challenging 'innocuous' comments from the intended targets without reinforcing negative stereotypes about humour or heightened sensitivity. It should be the employers who are responsible for clarifying what is not acceptable, and not female employees.

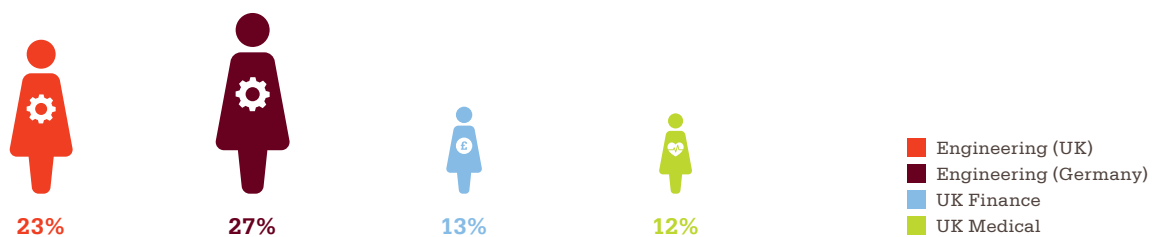
Rather than confront the negative language or behaviours that, by choice, they would not wish to experience, female engineers tend to change roles to avoid situations or adapt their personality to 'get by'. Though official reporting channels often exist, many engineers, in common with their counterparts in the other professions, had little confidence in the company systems to address their complaints (**Figures 3 & 4**).

Under such circumstances, how then would an employer know that there was an issue? The subjective interpretation of comments, coupled with a belief that being an engineer meant being resilient and able to cope, generated a level of ambiguity which may lead to the subsequent suppression of female engineers' own feelings.

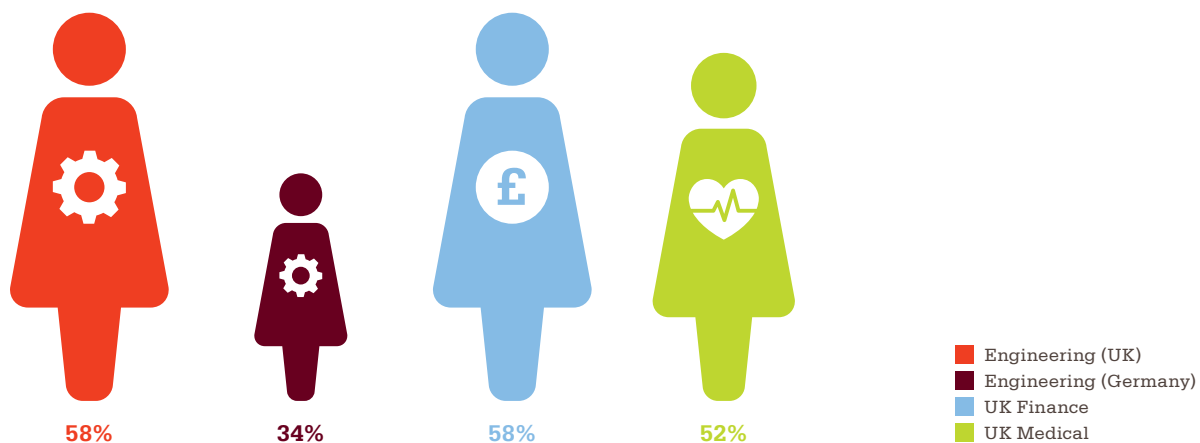
**"It's not worth the consequences of taking action. HR wouldn't do anything about it anyway."**

**"I have never reported this to HR or Senior Management. I have just learnt to toughen up."**

### 3 I have previously changed roles/taken steps to avoid a work situation I believed was sexist



### 4 I would feel comfortable reporting sexism through official channels





A large minority of female engineers referred to experiences that offered a hint of the unconscious biased views held by some male colleagues. When meeting for the first time there was often an assumption that a woman must be in an administrative or non-technical role.

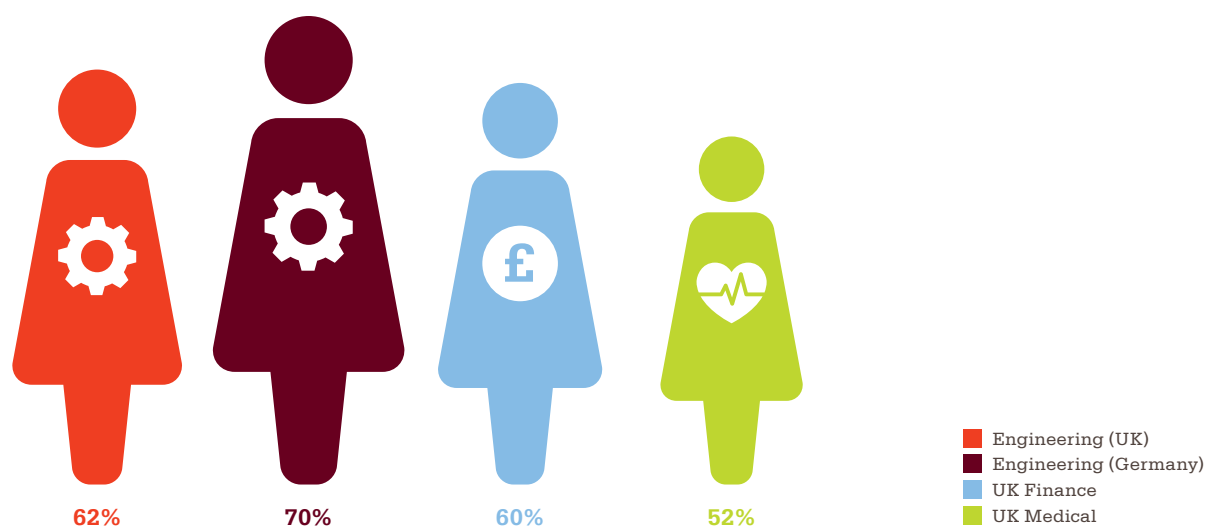
**“A man assumed a lady was the admin and transport organiser when actually she was the technical lead.”**

Only 35% of female engineers felt they were treated the same in relation to their male colleagues, by contrast to 54% and 42% in medicine and finance respectively. Yet when asked how they were treated by their colleagues, engineering fared well in comparison to the other sectors. This apparent anomaly may be explained by a view expressed by 46% of the engineers that in some areas of their professional life they were treated better than men and in others treated worse – far higher than the other professions. There was less ambiguity when it came to career progression, where engineering fared worse than finance and, especially medicine. (Figures 5 & 6).

Such comments pervade every aspect of working life. In 2016, the trade union, Prospect, in collaboration with the Women's Engineering Society (WES) and Women in Science and Engineering (WISE), carried out a survey of women's experiences of wearing personal protective equipment at an event hosted by the Institution of Mechanical Engineers as part of National Women in Engineering Day. Some 28% of women present reported receiving derogatory comments about their appearance while wearing the essential safety equipment. Respondents gave examples ranging from salacious comments through to unflattering comparisons to 'cartoon characters'<sup>[7]</sup>.

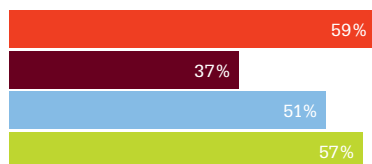
**“People shout, are rude and insulting and in a predominantly male workforce this is seen as acceptable, even though no one likes it and would prefer otherwise.”**

## 5 It is easier for men to progress in my sector

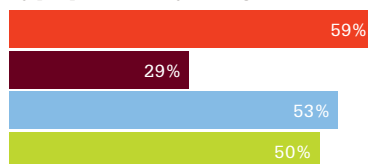


## 6 Perceptions of the extent to which women are treated equally (% agree)

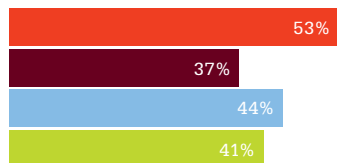
By peers



By people who they manage



By people who manage them



Maternity leave and return to work

Some female engineers may make the decision to take a career break or to change working patterns in early career as they start a family. Though having children will account for some women choosing to leave the sector, logically there should be no reason why the level of attrition for this reason differs so highly from comparable female professionals in other sectors.

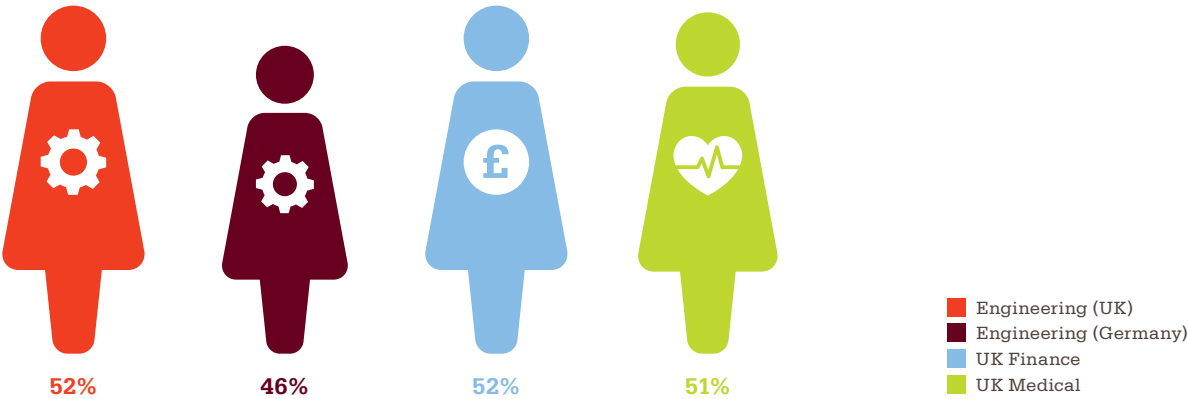
Despite the fact that the right to maternity leave is clearly set out both within the law and in company employment policies, taking up this entitlement continues to be identified as professionally contentious (Figure 7) and a rationale for female engineers leaving the profession.

“Removing the stigma attached to young women who are more likely to go on maternity leave will be a big step in retaining female professionals in companies...”

Figures from the Institute of Public Policy Research (IPPR) show that two-thirds of female engineers do not resume their engineering occupation after taking maternity leave<sup>[8]</sup>. In comparison, across the UK as a whole, 80% of first-time mothers expect to return to work, primarily on part-time or reduced hours<sup>[9]</sup>. This is clearly an issue for the engineering profession that warrants further investigation. Flexibility on behalf of the company, following a woman's return to work, is voluntary, and it would seem that it is at this stage that the ‘flashpoints’ can occur.

“Woe betide the female who puts children first for a significant period – better to invest in females without children or ones who are prepared to outsource the responsibility of child rearing whilst preaching work-life balance...”

7 Women are at a disadvantage to men when returning from maternity leave





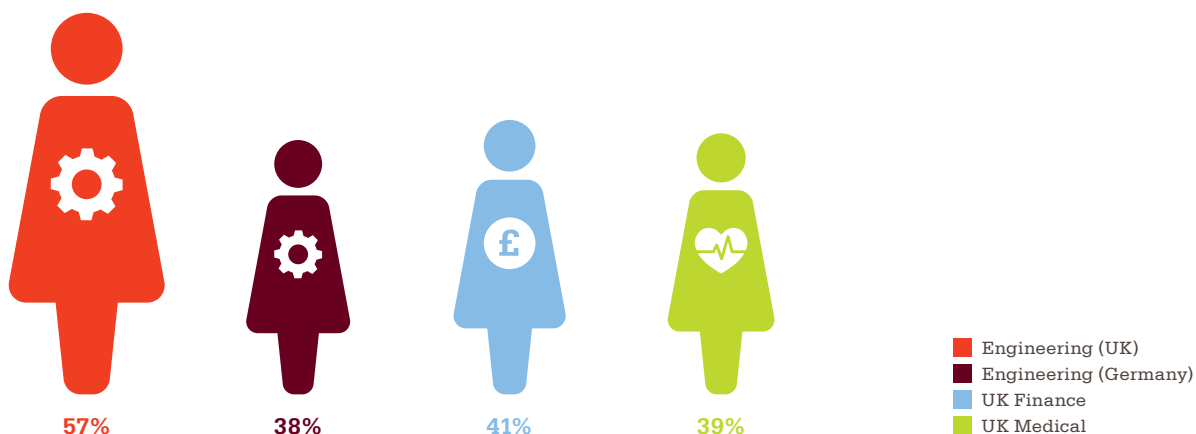
For those who do return, experiences vary significantly, with some women choosing to continue with their former working routine while others appreciate the option to work flexibly, where this is an option. Contrary to the expectations expressed by several of the engineering respondents, the data suggests that there was broader satisfaction with the provision of flexible working arrangements in engineering, than in both the medical and financial professions (**Figure 8**).

Professional bodies and institutions can play an important role in providing guidance and advice on best practice and policy which supplement the formal legislation set out by law. The Royal Institution of Chartered Surveyors (RICS) has created the Inclusive Employer Quality Mark, so that employers within their sector have a set of six key principles against which performance can be benchmarked<sup>[10]</sup>. The scheme recognises the differences between large and small companies, is voluntary and self-assessed, greatly reducing the cost of participation to smaller employers who find it necessary to devote significant resources to ensure compliance with complex legislation.

#### The six key principles identified by RICS:

1. Leadership and vision: Demonstrate commitment at the highest level to increasing the diversity of the workforce.
2. Recruitment: Engage and attract new people to the industry from under-represented groups.
3. Staff development: Training and promotion policies that offer equal access to career progression for all members of the workforce.
4. Staff retention: Flexible working arrangements and adaptive working practices that provide opportunities for all to perform at their highest levels.
5. Staff engagement: An inclusive culture where staff engage with developing, delivering, monitoring and assessing the diversity and inclusivity of the workplace.
6. Continuous improvement: Continually refreshing and renewing the firm's commitment to, and activities to support, being an inclusive employer; sharing and learning from best practice across the industry.

8 Parents feel they are given the flexibility to look after their children by their employers



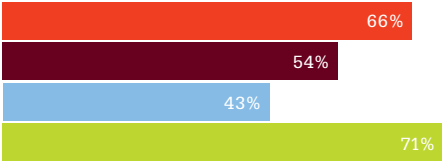
# MOTIVATING AND RETAINING FEMALE ENGINEERS

Engineering should be an attractive sector in which women want to work. To encourage more women to remain in the profession, they must feel valued and welcome to pursue their own goals and ambitions. It is important that engineering employers understand how to achieve this.

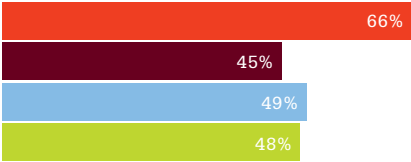
Female engineers tend to frame success at work differently from their male colleagues<sup>[11]</sup>. In common with female medical professionals, engineers reported the satisfaction of 'a job well done' as their principal sense of accomplishment. Of equal importance is receiving positive feedback from managers or colleagues; this is a strong indication of how much value is placed on the opinions of co-workers. While financial rewards are important, they also want informal recognition, promotion and additional seniority and responsibilities (**Figures 9 & 10**).

9 I measure success by:

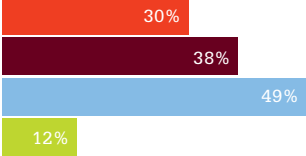
Job satisfaction



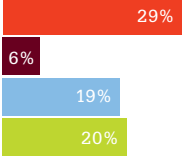
Positive feedback



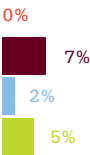
Salary/bonuses



Seniority/promotions

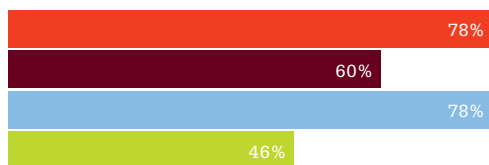


Awards/prizes

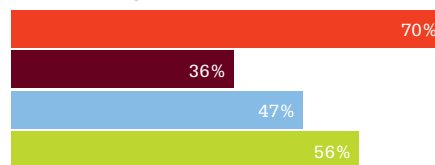


## 10 I would like my achievements to be recognised through:

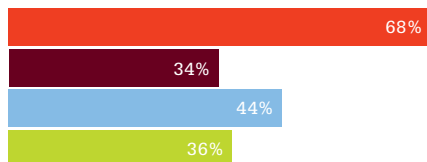
### Financial rewards



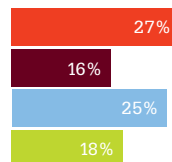
### Informal recognition



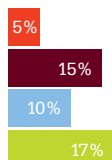
### Promotions/additional responsibility



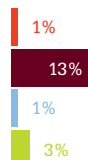
### Formal recognition



### Do not want recognition



### Don't know





“““

While quality of work or technical ability are vital for advancements in engineering, networks and social connections can also be seen as important factors.

As part of the survey, participants were asked to consider what factors would be most likely to 'push' them out of their chosen profession and rank them using a 'MaxDiff' model in which they expressed a preference by comparing each variable with each other in turn. Across both countries, and in comparison with the medical and financial sectors, there are common consistent complaints including high workload, feeling undervalued and the emergence of a job offer elsewhere. However, for female engineers, being treated unfairly was seen as a significantly more off-putting factor than their counterparts in medicine and finance (**Figure 11**).

**11** Ranked order of factors that female engineers identified as influencing likelihood they would leave the profession, highlighting responses from all three professions on being treated unfairly compared to male colleagues





ROLE MODELS AND PERSONAL SUPPORT STRUCTURES

Humans learn from one another and identify with those they admire. People perform better when they feel they belong, both professionally and socially. Where women perceive they are unequal in number or status, exposure to archetype-breaking female role models is often seen as inspirational, especially for early career professionals. More structured approaches exist based on various models of mentoring – a partnership between two people at different stages in their career – working in a similar field or sharing similar experiences.

Meanwhile, the experience of work is also significantly shaped by other social interactions – grabbing a cup of coffee with colleagues, discussing projects over lunch or socialising outside formal working hours.

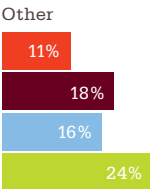
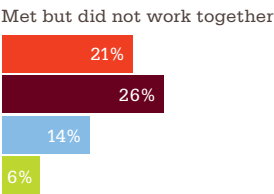
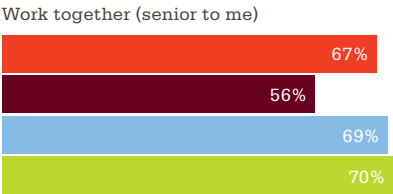
The study sought to uncover the importance of positive female role models and mentoring support to women in early career, and to explore what were the desirable positive features and qualities of each approach. It also quizzed respondents on how the wider social culture affected their experience of working for a company.

While it was not identified as the most important factor, women often feel more comfortable being mentored by another woman, as they find that there are specific issues and challenges experienced by female engineers. The overwhelming trend among all the professions was for mentors and role models to be senior to their mentees, highlighting the fact that as women progress in their career, they will find it increasingly hard to find role models with experiences similar to their own (Figure 12). There are many benefits to finding mentors and role models for female engineers who can provide additional help, advice and support in a male-dominated workplace.

Approximately half of the female engineers who stated they had a role model, indicated that this person was also a woman and that shared characteristic was valuable. However, in common with their medical peers, female engineers tended to choose their role models for their technical knowledge and ability; having similar professional interests or specialisms was deemed more important irrespective of their gender (Figures 13 & 14).

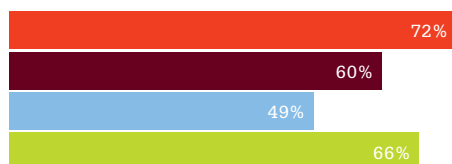
“I look up to two people in my organisation. One is the managing director, the other is my line manager. Both are men....What I admire is their attitude to research and development, and the way they have encouraged those who are interested in getting involved.”

12 I know my role model through:



## 13 I admire my role model's:

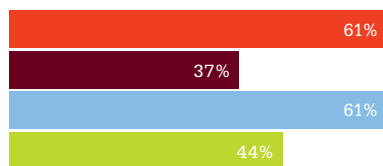
Technical ability/knowledge



Management skills/mentoring



Success in the field



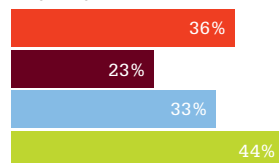
Way of collaborating/working with others



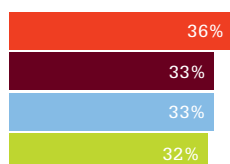
Determination



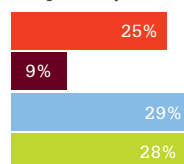
Way they overcame obstacles



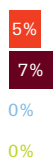
Ambition



Adaptability



Other



While quality of work or technical ability are vital for advancement in engineering, networks and social connections can also be seen as important factors. Almost two-thirds of all engineers in the UK, and over half of their finance sector counterparts, felt that building successful networks was key to advancement in their sector; significantly more so than in Germany where 'quality of work' was cited as the most important factor for career progression (**Figure 15**).

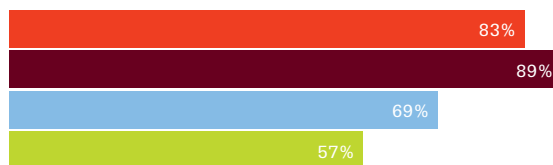
'Networking' covers a broad range of activities. Engineers in the UK appear significantly more likely to enjoy socialising with colleagues than any of the other professions. A quarter of female engineers in the UK indicated that they did not feel comfortable socialising with colleagues or that some social events were unwelcoming to women; which may lead them to miss out on an important aspect of career progression. This was slightly higher than both the financial and medical professions where less than a fifth of respondents found social events similarly uncomfortable.

## 14 These shared characteristics were important to me:

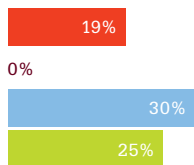
Similar professional interests/specialisms



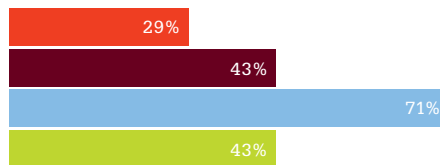
Both women



Similar ethnic backgrounds

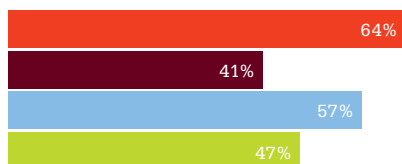


Similar backgrounds (eg economically)

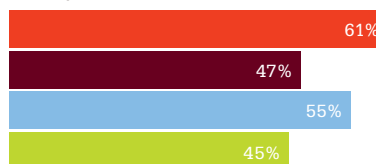


## 15 Advancement in my sector is based mainly on:

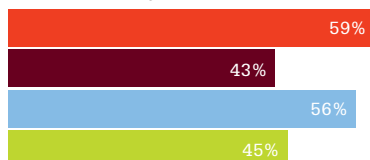
Networks



Quality of work



Technical ability



“““

While at university, another student told me that I shouldn't be an engineer because I am a woman and others suggested that I got better marks because I am female.





# HOW UNIVERSITY SETS THE SCENE

In the UK, the current standard career path for many professional engineers starts with enrolment on an undergraduate degree at university. The research study explored whether this first step was a contributor to sense of alienation and not belonging experienced by female engineers.

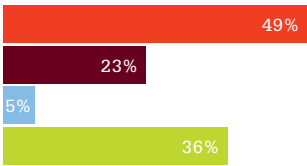
Half of UK female engineers stated that they had been ‘treated differently’ before graduation, as a student or while on work experience. This figure was significantly higher than reported in Germany. By the time they had completed a year of work, almost three quarters of UK female engineers had experienced differential treatment – a higher level than that expressed from women in medicine and finance (**Figure 16**). Some of these experiences were identified as being negative, both in intent and outcome, whereas others, though intended as supportive, were seen to have unintended detrimental effects.

“““

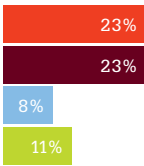
Positive action has been a longstanding and sometimes contentious policy designed to redress the biasing effects of working in a discriminatory environment.

16 I first observed women being treated differently during:

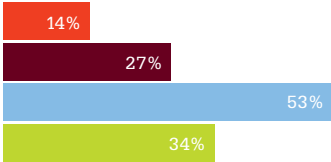
Studying/before qualifying



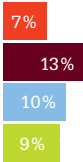
Graduate scheme/first year of work



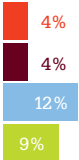
First three years in industry



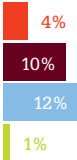
Between three and five years in industry



After five years or more



Don't know



“”

Being told at school that I shouldn't pursue a career in engineering because it's a man job.



Positive action has been a longstanding and sometimes contentious policy, designed to redress the biasing effects of working in a discriminatory environment. Simply put, positive action is the implementation of policies that offer greater access to members of a group who are seen to be at a disadvantage in a prevailing landscape of inequality.

When applied in university engineering courses, it seems that despite initially feeling a benefit from this positive differentiation, over time, students often described detrimental outcomes. Such an experience was expressed by one study participant, though echoed by others:

**“I was given ‘Young Woman Engineer’ award. There is no ‘Young Male Engineer’ award. This made me very uncomfortable talking about this award with male colleagues. There were a lot of sarcastic comments and criticism of the award.”**

But even where there were no dedicated awards, requests for additional support or to act as a role model for other women was sufficient to generate resentment. A study of female engineering students on one college campus in the US, has shown that the provision of additional support placed doubts on individual students’ level of competence. Meanwhile, being put forward for awards or being repeatedly asked to take part in public-facing events made some students feel less valued as an engineer and more of a novelty, serving a diversity agenda<sup>[12]</sup>.

This study resonates strongly with the experience of several female engineers in this research, relating to the award of female-only prizes, which were thought to generate scepticism among male peers. Perhaps the most disturbing feature of these experiences is the effect they can have on the individual. Echoing the sentiments expressed by many of the engineers, one respondent reported how, over time, she started to doubt her own ability.

**“When I got nominated for an award, the first thing my male counterparts said was: “You only got nominated because you’re a woman.” and not because I am talented. At first, I was furious, but then I was worried that maybe they were right. Maybe that is why I got hired. And then I just start to question everything.”**

The challenge is one for tutors in engineering schools to establish clear and well-communicated principles for positive action as a means of increasing participation in under-represented or disadvantaged groups; and that it is not a reflection of the abilities of individuals within that group. The Athena SWAN Charter, established by the Equality Challenge Unit in 2005, provides guidance and resources for best practice in promoting equality and diversity in the higher education environment with achievements measured against a series of awards ranging from gold to bronze.

## WHAT ARE THE MAIN FACTORS THAT INFLUENCE THE DECISION TO STUDY ENGINEERING?

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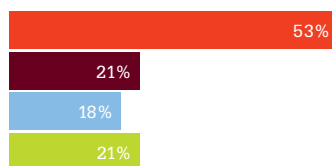
The decision to study or train in a given discipline is affected by a complex array of formative experiences and influences. One of the most influential is exposure to the subject within an individual's school education. Another factor is the extent to which the subject features, is valued or discussed in the day-to-day family experience growing up.<sup>[13]</sup>

Engineering is not prominent in school education, nor in the wider cultural experience of young people in the UK. Engineers often come from families with an engineering heritage. The study considered the extent to which these career-influencing factors had a specific effect on the retention of early career female engineers, who may feel the need to re-evaluate their career choice when the reality of work does not match the expectations generated in their early years.

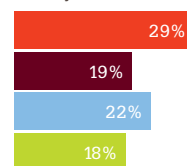
In comparison to those choosing a career in finance or medicine, female engineers were more likely to have made their career choice based on academic success alone (**Figure 17**).

## 17 These factors influenced my choice of career:

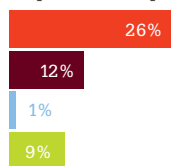
Academic success



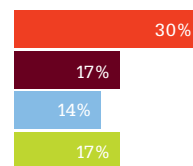
Family



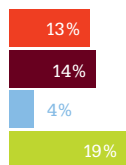
Inspirational experience



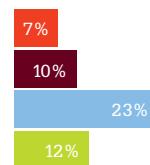
Careers advice



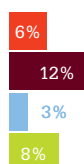
Role model



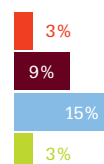
Peers



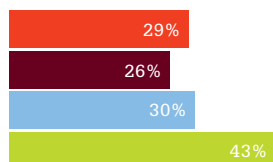
Media



Professional recruiter



Other

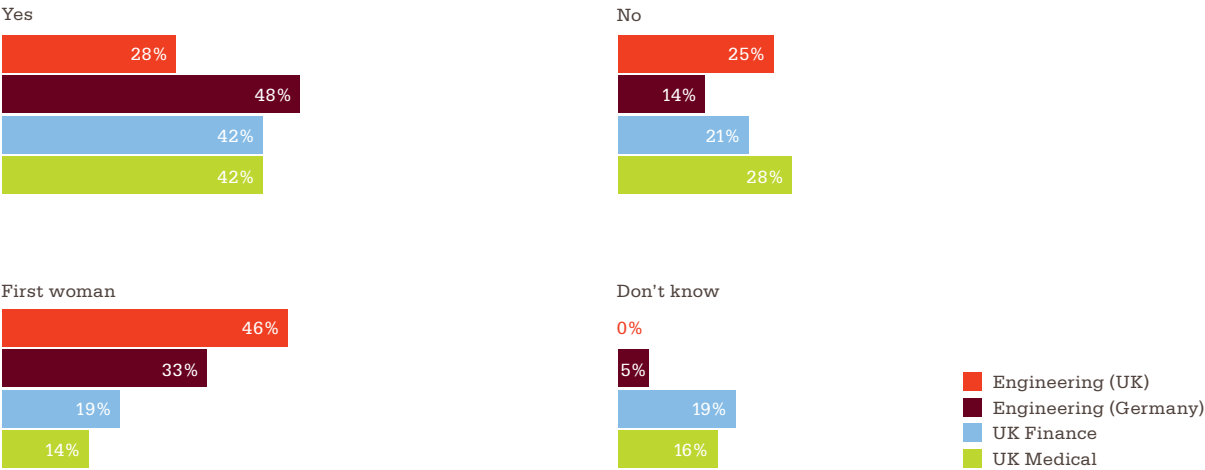


The second factor in determining their choice of career was family influence, through having a close relative or family friend working either in engineering or in an associated STEM role (**Figure 18**). This links closely to a concept called ‘family science capital’, in which exposure to family interest in science leisure pursuits and parents’ occupation and education, provide a more conducive environment for a young person to decide to pursue STEM. While the majority of female engineers were not the first person in their family to work in a STEM profession, they were the first woman in their family to do so.

These findings echo research carried out by the Science, Engineering and Manufacturing Technologies Alliance (Semta) which found how pursuing an ‘interesting job’ was the primary driver for desiring or recommending a career in engineering, especially among women.<sup>[14]</sup>

Though the need for a thorough early foundation also applies to some other professions, such as medicine, engineering requires early decision-making at a point where comprehension of ‘being an engineer’ appears to be poorly understood. Only a quarter of the research respondents felt that they had a good understanding of what a career in engineering involved.

18 I am the first person in my family to work in STEM:



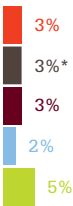


The structure of UK education systems means that the decision to become an engineer usually takes place long before the age of 18 (**Figure 19**). This is because the current linear progression from GCSE through to A-level, and the consequent narrowing of specialisation, forces decision-making sooner than it might otherwise need to be made. The result of such early specialisation is that decisions made at the age of 14 can greatly impact on the options available when choosing a degree.

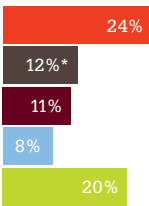
In previous Institution-led research, Professor Louise Archer, challenged the early specialisation that routed young people down arts and humanities or science-based pathways too early, effectively ruling out a career in engineering before students had had a chance to consider it an option. This is particularly acute for girls in school, who are subject to huge peer and cultural pressure at around this time<sup>[15]</sup>. But the ‘Stay or Go’ research indicated the flip-side, where the high-stakes decision to choose an engineering career path had to be made before knowing what was at stake.

# 19 I decided to pursue my current career:

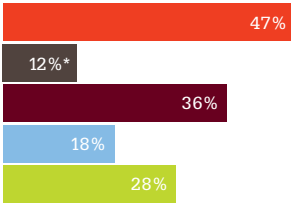
As a child (<11)



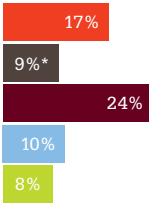
As a teenager (11–16)



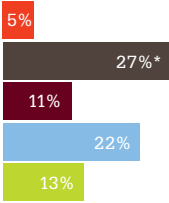
In sixth form/FE College (16–18)



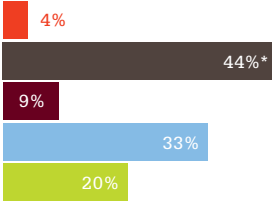
At university



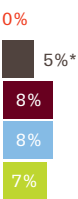
Post-university



Accepting current role



Other



- Engineering (UK)
- Engineering (Germany)
- UK Finance
- UK Medical
- \*Engineering (UK)  
% of respondents who first understood what their career would involve



“““

I often find that men will  
'talk over' me in meetings.  
I have also been described  
in discriminatory terms  
'she's only a woman,  
what does she know.

The requirement to have studied both mathematics and physics at Higher or A-level for entry onto most engineering courses, forces decision-making much earlier. Despite an increase of almost 30% in the cohort of students in England choosing A-level physics over the last decade, girls continue to account for only 22% of entries.<sup>[16]</sup> Students with a wide range of abilities may find it difficult to prioritise between scientific and creative options, if they are unsure about what career they ultimately want to pursue. When the requirement for A-level physics was dropped from one civil engineering undergraduate degree course, the number of female applicants tripled.<sup>[17]</sup> This correlates with the study's findings that both the medical and financial professions, along with engineering in Germany benefit from allowing these choices later in education (**Figure 20**).

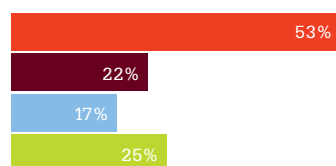
In order to increase the number of female engineers and, then crucially, keep them in the profession, girls need to know what an engineering career involves and the broad range of skills which are valuable to engineers. Current heavy reliance on 'an engineer in the family' and faith in the belief that success in mathematics and physics alone are precursors for a fulfilling engineering career, as attractants to the profession, may be misrepresenting the sector.

On the one hand, talented young women may feel discouraged from considering study or training in the discipline. On the other hand, the absence of exposure to modern engineering working environments perpetuates an unrealistic notion that may come as something of a shock later on.

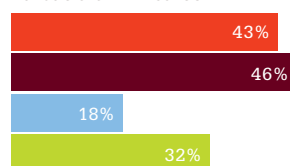
There is some consensus within engineering on the need for better careers education in our schools and colleges to help encourage more young people into engineering. These findings further reinforce this critical need.

## 20 Rationale given for studying STEM subjects:

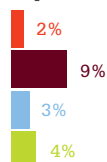
### Personal interest



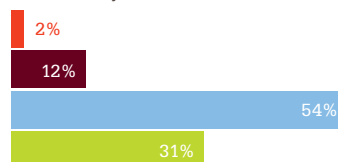
### Pursue a STEM career



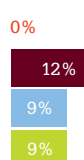
### Expectations of others



### Didn't study STEM



### Don't know





# DISCUSSION

The culture of engineering and its restricted social narrative may have prevented the sector from adjusting to the very societal changes it has been partly instrumental in bringing about. To some degree, engineering in the UK may lag behind other sectors, in its ability to attract and retain people who do not conform to its longstanding archetypes.

Within the engineering community, the need to address a lack of diversity is often couched in terms of a lost reservoir of talent, and though this is almost certainly true, the case for taking action to ensure that engineering as a sector better reflects society, should go beyond simply meeting the skills' needs of our economy. There is no obvious reason why what is appropriate for the medical or financial sectors, should not also be right for engineering.

The report highlights how the structure and culture of engineering and many of its organisations, perpetuate attitudes and behaviours that make women feel uncomfortable and undervalued. This is notwithstanding the UK's progressive employment legislation and regulation, and a widespread acceptance that gender equality is both desirable and right.

While a significant proportion of women flourish in the sector, there is clearly room for improvement in many engineering workplaces. Since they possess the highly marketable skills of the engineer, women who feel unfairly treated may have the opportunity to move into different lines of work where they will be more valued and respected which, regrettably, is what too often comes to pass. This both represents a significant loss of talent to the engineering profession and perpetuates the gender imbalance.

There is no easy mechanism for addressing these issues, but by implementing the recommendations highlighted within this report, progress is possible. The Royal Institution of Chartered Surveyors has seen a significant take-up of its Inclusive Employer Quality Mark, with over 130 companies recognising the benefits of a clearly defined code of practice, designed to promote diversity.

Many engineering companies have made real progress in recent years, but to achieve the level of cultural change experienced by other sectors, requires co-ordinated effort across the entire profession. Acknowledgement by senior management of the masculine culture of engineering workplaces is a good starting point. There are a great many successful mentoring schemes within engineering, which can be developed to ensure they suit the preferences of women. A further target area is for greater transparency in how awards and rewards are made and for what reason. Awards that exist solely to promote diversity may be counterproductive, if they exist in a contextual vacuum.

The overarching narrative of this report is, however, that it is not female engineers themselves who need to change, but the environment in which they are operating. Though historically engineering had close links with the dark satanic mills imagery and experience of the first industrial revolution, the reality of modern engineering is very different. The fourth industrial revolution is almost certainly aligned with brain rather than brawn, so there cannot be an excuse for expecting women or anyone else to have to 'toughen up' to take part.

But of course, not everyone will be suited to a career in engineering. Currently in the UK, the sector seemingly relies on family ties, and a narrow conception of academic ability, as major influencers of who chooses to study and train as an engineer in the first place. More and better quality careers education provision in schools and colleges, along with a greater profile for engineering in our education system, would ensure that more young people would be in a position to embark on a career in the sector, and from an informed perspective. It cannot be morally right that many female engineers based their decision to become an engineer primarily on academic performance or family experience, without exposure to the workplace.



Engineering can no longer afford to remain a sector in which women who join the profession are expected to change their personality in order to 'fit in'. Neither is it possible to rely solely on changing the attitudes of engineers to improve the working experience. Change must be driven from the top down and to achieve real cultural shift, it is necessary for institutions to become more accommodating and offer greater employment agility.

The cultural features of engineering in the UK are deeply ingrained and will take significant effort to change. The actions recommended in this report will significantly benefit the entire engineering sector. Companies will have the skills they require, employees will feel valued and fulfilled, while the nation will see a more productive, flexible and resilient workforce – essential for our economic future.

While there is much work still to do, there are many reasons to be hopeful that positive change can be achieved. Furthermore, many sectors in the UK which have traditionally been seen as male-dominated fields, such as finance and medicine, have experienced a sustained increase in the number of women choosing them as a career. Engineering must now turn its innate ability to develop innovative solutions inwards, to improve the working environment for all.

“““

I wish other women didn't feel they have to 'toughen up', which I have noticed and makes them more difficult to get along with. I don't think it's necessary, in my experience.



“”

Everyone assumes you're the secretary or there to take notes and make coffee in meetings until you stand up and present and lead the project.

# CONCLUSIONS

Female engineers are working in an environment where many will experience or witness some form of discriminatory attitude or behaviour. To survive, they often feel compelled to compromise or adapt their personality to fit in with the prevailing culture. This unequal treatment can act as a major push factor for women considering leaving the engineering profession, and must be addressed if retention of female engineers is to be improved.

Though this experience is not the sole preserve of engineering, female engineers experience of differential treatment occurs earlier than in other professions, often while still at university.

Well-intended efforts to encourage greater participation of women in engineering through 'positive action' can have unintended negative consequences. The reality is that female engineers wish to be properly recognised for their accomplishments through positive feedback from managers and colleagues. While financial rewards are important, these engineers also seek informal recognition, promotion and additional seniority and responsibilities, appropriate to their achievements – but not special treatment.

Female engineers value having technically accomplished role models more than other professionals. While having a female mentor is seen as valuable, a shared professional interest is more highly valued.

The reasons why women choose to enter engineering employment and subsequently stay or leave, are as complex and diverse as the people who make up the profession. There is no single action that will bring about the desired change, but the majority of the responsibility to achieve a significantly improved gender balance, lies with the companies, their management and workforce to provide a working environment that supports all employees to be productive, fulfilled and serene.

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