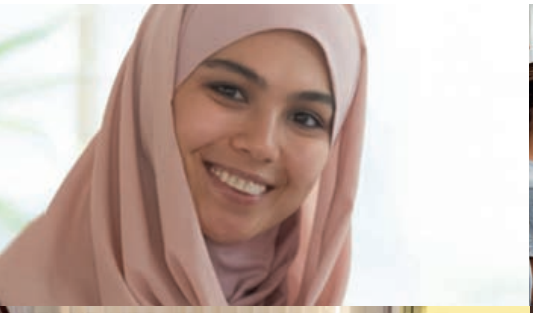
Royal Academy of Engineering





Inclusive Cultures in Engineering 2023

Commentary






Contents

Foreword

In 2017 the Royal Academy of Engineering (the Academy) published a report titled *Creating cultures where all engineers thrive*. Much has changed across the world since its publication, particularly in regard to societal movements such as #MeToo and Black Lives Matter.

Building on this, the Academy commissioned research to better understand how engineers perceive the current culture of the engineering profession. This new research involved over 1,600 respondents and explored perceived changes in the culture of engineering. It notably indicates that more than three quarters of engineers in this report have seen inclusion in the profession improve.

With nearly 6.9 million employees[1] working in engineering in the UK, this is an encouraging shift but there is still much to do to truly make engineering an inclusive profession to work in. The report identifies that while many engineers feel they can be authentically themselves at work, underrepresented groups continue to face a profession that is less inclusive, where microaggressions are overlooked, and bullying, discrimination and harassment are still tolerated.

Mission Zero[2] identifies the critical role engineering plays in the extensive transformation needed in the UK by 2050 and, with projected shortfalls, the need to remain competitive in a global race for engineering skills. To do this requires a real focus on how the profession can work more innovatively and collaboratively to keep up with the pace of change required.

The report findings show there is a real sense of pride in working in the profession and many engineers are keen to promote it as a career. Building and sustaining inclusive cultures is key to the attraction, development, and retention of engineers in the profession, and this requires clear investment in, and leadership of, inclusion. Employers, professional institutes, and the Academy itself all have a key role to play in this.

The recommendations the report calls for are essential if we are to make engineering a truly inclusive profession to work in and for UK engineering to continue to be a key player in that global race.

Louise Parry FCIPD, Director of People and Organisational Development, Energy and Utility Skills, and Chair of the Inclusive Cultures Advisory Group

Acknowledgements

The *Inclusive cultures in engineering 2023* research project upon which this and the full report are based on would not be possible without the input from the advisory group who provided their valued time and expertise.

Advisory Group

Name	Organisation	Job title
Louise Parry FCIPD (chair)	Energy and Utility Skills	Director of People and Organisational development
John Bradbury	InterEngineering, Eunomia	Director, Senior Consultant
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Dr Eugenie Hunsicker	Athena Forum	Chair
David Jenkins	Atkins	Operations Director and ED&I Business Lead
Jenny McLoughlin	Heathrow	Project Manager

We are grateful to DJS Research who were commissioned by the Academy to undertake the research and produced the full report.

Thank you to all the employers and other stakeholders who shared the research survey, encouraging their employees and engineering colleagues to participate.

Lastly, particular thanks go to all of the engineers who took time to share their views. We are aware that it can be a painful subject for some and that, in addition to positive stories, many people shared profoundly difficult experiences of the profession. Their generous contributions have enabled us to take a detailed look at inclusion in engineering.

Glossary

Black Lives Matter: Black Lives Matter (BLM) is an international social movement, formed in the United States in 2013, raising awareness of and tackling racism and anti-Black violence, particularly as related to police brutality.[3] References to Black Lives Matter have been recorded throughout the civil rights movement.

Culture: The day-to-day experience of working in engineering. This includes: how people typically behave with each other; values and behaviours seen as important; and the rules and routines of people working in engineering.

Diversity: Diversity, in the context of this report, refers to whether a single profession or workforce is representative of the wide variety of people, characteristics, backgrounds and identities that exist in wider society and the findings presented throughout are participants' perceptions of diversity across the engineering community.

Engineering community: For the purpose of this research, the engineering community can be defined as chartered and non-chartered engineers, technicians and individuals working on engineering projects as project managers, directors, or co-ordinators as well as the organisations they are a part of and the professional engineering institutions (PEIs).

Employers: This term includes individuals working in diversity and inclusion (D&I), human resources (HR), or the heads of smaller engineering organisations.

Inclusion: The extent to which people feel valued for who they are (their personal and professional background, experience, and skills) and the extent to which people feel they belong or 'fit' in the engineering profession and their organisation.

Intersectionality: Intersectionality is a theory and metaphor, deriving from Black female scholarship, which articulates how multiple inequalities shape the experiences and outcomes for underrepresented groups.

#MeToo: The #MeToo movement was founded in 2006 to support survivors of sexual violence, particularly young women of colour.

Microaggressions: A statement, action, or incident regarded as an instance of indirect, subtle, or unintentional discrimination against members of a marginalised group.

Protected characteristics: Characteristics of a person that are identified in the Equality Act 2010 and relating to a number of legal rights and obligations. These are age, disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion or belief, sex, and sexual orientation. Among other things, individuals have a legal right to not be treated less favourably by their employer because they have or are perceived to have a protected characteristic.

Trans history: A term sometimes used by people who have had a trans/transgender/transsexual experience, and regard this as just another factor of their history, life, and experience.

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Executive summary

Key findings

Throughout the report we explore the interrelationship between cultures, inclusion and diversity within the engineering community. Some of the key highlights are presented below:

1. Three-quarters of engineers responded that inclusion in the profession has improved since 2017, with engineers who identified as transgender seeing the most improvements. The effect of company policy in creating inclusive cultures was most felt in large companies, and less so in medium and small companies.

2. Engineers tend to describe the culture of the profession in terms of productivity and creativity with a focus on words like 'solutions orientated', 'innovative' and 'collaborative', all of which describe a culture that allows inclusivity to flourish.

3. Despite this, some see the profession as 'slow to change', 'siloed' and 'hierarchical', with women more likely to use these negative descriptors than men.

4. The behaviours valued within the profession tend to align with the descriptors of the culture of engineering, backing up the image of a culture concerned with production, through problem-solving, collaboration, and delivering to time and budget.

5. However, while 'creativity' was a descriptor of engineering, it was reportedly less valued as a behaviour within the profession along with 'speaking up' and 'taking a stand', which may impact, or be impacted by, the existent culture of inclusion in the profession.

6. The engineering community generally feels that the culture is inclusive, however, those who are underrepresented within the profession are less likely to view the culture in this way.

7. Masculine and macho culture persist in the profession in the form of offensive 'banter' and 'mickey-taking', which engineers are expected to be resilient to. However, there is a split, with this culture more present in 'on-site' locations, less so in an office environment.

8. Underrepresented groups continue to report experiences of bullying, harassment and other forms of discrimination in the workplace. The rates are higher for those from multiple underrepresented backgrounds.

9. Engineers reported having a good work–life balance, that they could be authentic at work, and could be open with colleagues about their lives. However, many engineers, particularly those from underrepresented groups, responded indicating they feel isolated.

Background

Before the Academy's 2017 study on inclusive cultures, it was well recognised that D&I may help close the growing skills gap and solve the scarcity of engineering workers. However, attempts to diversify the engineering workforce have been slow, and thus failing to alleviate the skills and personnel shortages.

A lot has changed both globally and within and beyond the engineering community. The Academy wanted to revisit this subject with a new research project that would update our understanding of the major problems, and examine how much has changed since the original study. The Academy's summary and further analysis, gleaned from DJS Research's study, are presented in this commentary.

Approach

In 2022, the Academy commissioned DJS Research to conduct a literature review, focus groups, and a sizeable survey that resulted in a comprehensive report. A total of 1,657 people participated, including 1,507 survey respondents and 150 people who took part in focus groups and interviews. This commentary focuses on the rich and multi-layered primary research findings from the DJS report. We present key highlights and themes deriving from further reflection and analysis of the longer DJS report, with a focus on exploring recent perceptions of inclusive cultures in engineering, and responding to the below questions:

- What does a culture of inclusion in engineering look like?
- How do people working within engineering perceive the culture?
- What can the engineering profession do to embed inclusion as a core part of the culture of engineering?

Findings

Culture in engineering

Engineers frequently use adjectives like "solutions orientated," "creative," and "collaborative," to describe engineering cultures, all of which suggest a culture that fosters inclusion. Some people describe the profession as "slow to adapt," "siloed," and "hierarchical," with women using these terms more frequently than males.

The professional behaviours that the respondents appreciated tend to match the characteristics of the engineering culture, supporting the idea that this culture is focused on production via problem-solving, teamwork, and on-time and under-budget delivery. Nonetheless, the profession placed less significance on innovation as a behaviour as well as "speaking up" and "taking a position," which may have an influence on or be affected by the profession's current inclusive culture.

Masculine and macho cultures were reportedly present within the profession, and participants throughout the research often remarked that this manifested itself in the form of offensive "banter" and "mickey-taking," which engineers are expected to be tolerant of. The research did, however, find difference across the engineering community, with macho culture being more prevalent in 'on-site' locations and less so in the office.

Positively, three-quarters of engineers reported that inclusivity in the field has increased since 2017, with transgender engineers (and those with a trans history) reporting the greatest advancements. Large corporations felt the effects of corporate policy on fostering inclusive cultures the most, as opposed to medium-sized and smaller corporations.

Inclusion in engineering

The engineering community generally feel that the culture is inclusive, and **three-quarters of engineers believe that inclusion in engineering has improved in the past five years**. However, those who are underrepresented within the community are less likely to view the culture in this way.

Underrepresented groups continue to report higher rates of bullying, harassment, and other forms of discrimination in the workplace, with one in three engineers (35%) responding that they had experienced bullying and harassment with a quarter having witnessed bullying or harassment of someone else, and one in five (20%) experiencing bullying or harassment personally. The rates are higher still for those from multiple underrepresented backgrounds. Added to this, engineers reported being less confident to speak up or report inappropriate behaviour or suggest better approaches to work. Again, this is higher still for those from underrepresented backgrounds. Positively, engineers are confident to speak up where there are safety concerns, however, those who are underrepresented are less likely to speak up, emphasising the link between inclusivity and safety. When looking at areas specific to belonging, engineers reported having a good work–life balance, that they could be authentic at work, and could be open with colleagues about their lives. However, many engineers, particularly those from underrepresented groups, responded indicating they feel isolated within the engineering community.

Diversity, retention, and success in engineering

Engineers are enthusiastic about their job and keen to encourage others to pursue engineering as a career, but they are less enthusiastic about promoting their workplaces. There are many reasons to promote the profession, such as working in a position where you can make a real impact. But

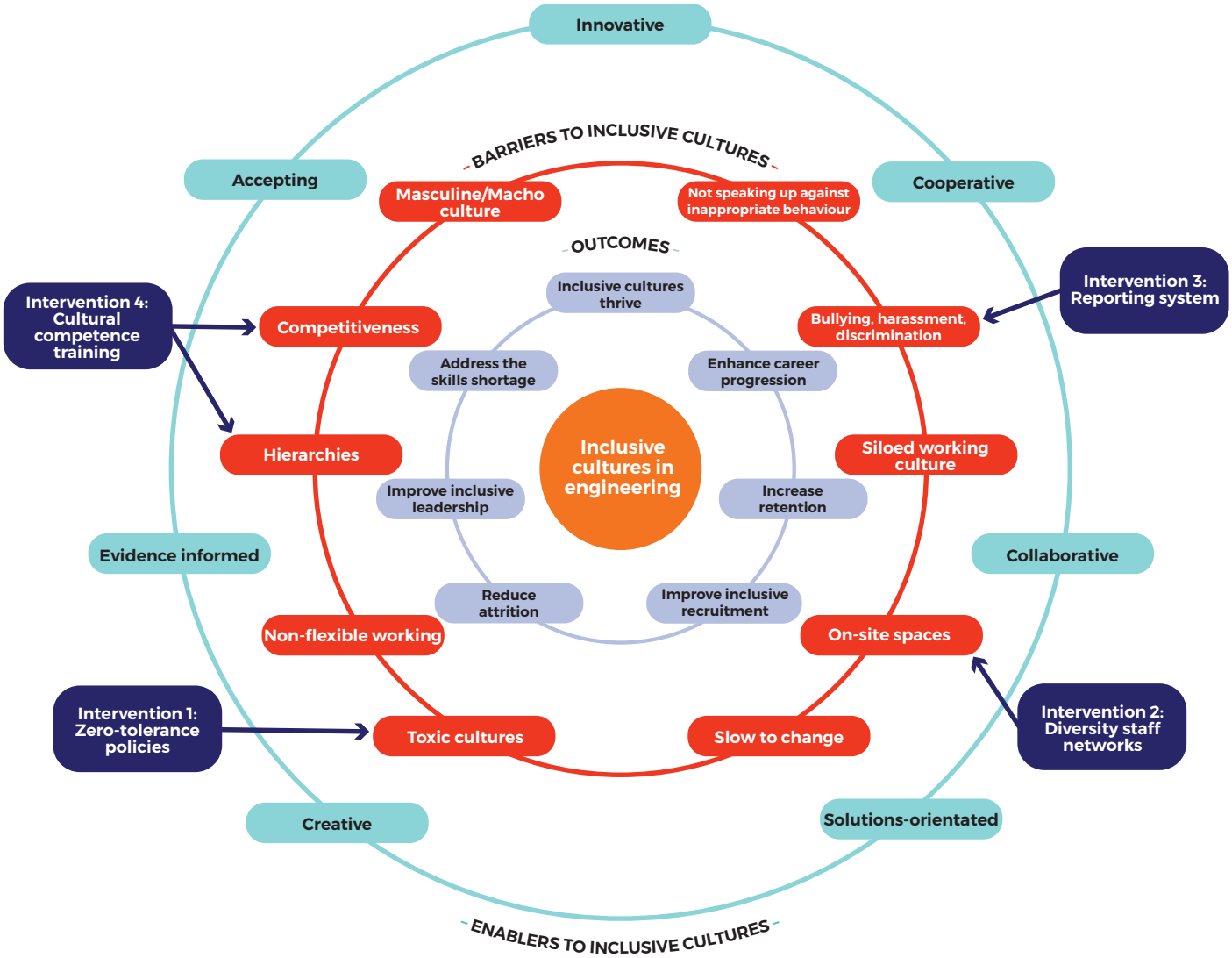
problems with microaggressions and unfavourable banter are drivers for not recommending engineering.

Younger respondents and those with transgender backgrounds were more likely to suggest they were contemplating leaving engineering, even though the majority of respondents said they were not considering leaving the field within the next year. While being able to secure entry-level positions, engineers from underrepresented groups reported finding it difficult to advance, resulting in the feeling and perception that the advancement methods within engineering are unfair.

According to the respondents, the engineering field is steadily but gradually diversifying. In most industries, it was thought that gender discrepancies were the main cause for worry.

Conclusions

The research reveals that, across the engineering community, there are micro-climates of inclusion that have improved since the 2017 report; however, progress has not been as quick as participating engineers would like. The evidence has highlighted different facets of what an inclusive culture across the engineering profession looks like along with the values and behaviours that can enable or inhibit an inclusive culture from thriving. The schematic below brings together those presented throughout the report into a comprehensive visual of inclusive cultures in engineering. It outlines the enablers of inclusion focusing on values of innovation, acceptance, evidence-informed, solutions-orientated, collaboration, and creativity (the inner ring). However, barriers to inclusive cultures remain in engineering that can adversely impact outcomes pertaining to career progression, success, and retention. The barriers to inclusive cultures include machoism, siloed working, and not taking a stand. Interventions may focus on addressing barriers to inclusive culture. Interventions that directly address these barriers can facilitate progress towards inclusive outcomes and cultures in engineering, and are inserted as examples in Schematic 1.



Schematic 1: Representation of inclusive cultures in engineering with exemplar interventions

Recommendations for inclusive cultures

Our overarching recommendations for the engineering profession to cultivate a more inclusive future are grouped under four themes, based on feedback from the engineers who participated in this research. Recommendations are made to the engineering community as a whole, with some recommendations more suited to engineering industry, organisations, and bodies.

Improving inclusive cultures

The following recommendations highlight actions engineering organisations can take to enable and accelerate the growth of inclusive cultures across engineering. These include:

Recommendation	Who
Ensuring that some of the cultural issues in engineering (as shown earlier) are properly addressed to encourage and retain staff from underrepresented backgrounds.	PEIs; employers
Socialising clear and honest guidance on inclusive behaviours and relationships.	PEIs; employers; engineering bodies
Assign budgets and resources to curating D&I events, taskforces, and support groups to enable sustainable impact. These could also be in the form of D&I networks and ally groups to embolden inclusive cultures in the engineering community.	Employers
Develop resources, guidance, and training on empowering engineers to speak out and take a stand against inappropriate behaviours.	PEIs; employers; engineering bodies

Nurturing belonging

The following recommendations are highlighted to improve belonging among the engineering community:

Recommendation	Who
Make a proactive effort to celebrate and encourage diversity, including embracing different attitudes, working styles and ways of communicating, to enable underrepresented groups to feel a sense of safety and belonging in professional spaces.	Employers
While D&I is a collective responsibility, organisations should invest in D&I personnel to take on the responsibility of leading, managing and co-ordinating groups and activities so that the responsibility does not fall on underrepresented staff with full-time duties. This must be underpinned by organisation and company leaders who show a commitment at senior levels for D&I.	PEIs; employers; engineering bodies
Engineering industry bodies must publish their diversity of representation and data within their own organisations, particularly data pertaining to leadership teams, through reviewing continuing professional development initiatives and membership requirements.	PEIs; employers; engineering bodies

Tackling bullying, harassment, and discrimination

The following recommendations are noted to address the issues of bullying, harassment and discrimination:

Recommendation	Who
Organisations should consider the scoping and development of a safe and diligent reporting system for underrepresented groups to raise concerns, with a view to incorporating clearer guidance on systems that support the reporting of microaggressions.	Employers; PEIs
Engineering bodies should continue to socialise, professionally develop and support engineers to learn about the value of inclusive cultures, while developing guidance on behaviours that are exclusionary and inhibit the growth of inclusive cultures.	Engineering bodies; PEIs; employers
Further actions should be taken to strengthen the relationship between inclusion and the role of safety in engineering.	Employers; PEIs

Improving retention and success

The recommendations support the retention and development of underrepresented groups in engineering:

Recommendation	Who
Engineering employers should set up sponsorship, mentoring, and reciprocal mentoring schemes for underrepresented staff to support career progression beyond entry and mid-level positions.	Employers; PEIs
There is a need to develop the engineering community's confidence in recommending the profession to others.	Engineering bodies; PEIs; employers
Organisations should invest in developing line managers' cultural competence and mandating inclusion training and capacity building through performance objective setting and appraisals.	Employers; PEIs
Employers should interrogate and report their diversity data at all levels and roles to ensure that any data are not inflated by those in non-engineering roles, while sharing good practice on ways to disclose diversity data to the engineering community sensitively.	Employers; PEIs

Further research

The scope of the research was limited in some ways, which meant further analysis and investigation was not possible. Throughout the research, we identified a number of areas that warrant further research and investigation. These areas of research include:

- Further interrogation of the relationship between masculinity, machoism and sexual harassment, with a clear remit to explore the influence of masculinity and machoism on engineers' attraction and retention.
- Curating more evidence on the experiences of carers within the engineering community.
- The qualitative research identified explicit cases of Islamophobia present in engineering and require further investigation that were beyond the scope of this commentary and research.
- Further investigation and action to address mental health and wellbeing in relation to inclusion within the context of the engineering community.
- Developing a clearer understanding of the drivers behind why some characteristics and underrepresented groups have been accounted for more than others could help tackle a hierarchy of inequalities.

Introduction

In 2017 the Academy published *Creating cultures where all engineers thrive*, a report that explored workplace culture and the culture of inclusion across the engineering profession. The study was informed by 6,799 engineers through focus groups and a survey that helped shape the report's findings and recommendations.

Much has changed across the world and within the engineering community since 2017. Therefore the Academy wanted to revisit this topic with a new research project that would build on the themes from the original report, update our understanding of the key issues, and explore the extent to which changes can be discerned since the original piece of research. In 2022, the Academy commissioned DJS Research[4] to conduct a research project consisting of a literature review, focus groups, and a wide scale survey that resulted in a detailed report.

This commentary presents the Academy's summary and further analysis, derived from DJS Research's report. We identify key findings from the report, by outlining and synthesising the main themes, insights and opportunities for innovation that have emerged from the research. Our commentary focuses on the primary research findings and also explores intersectional data from underrepresented groups, to look at some of the nuance that is lost if focus remains solely on individual protected characteristics.

This commentary explores:

- What does a culture of inclusion in engineering look like?
- How do people working within engineering perceive the culture?
- What can the engineering industry do to embed inclusion as a core part of the culture of engineering?

In addition to these questions was the need to understand views about the increasing drive to diversity, and to pay particular attention to the experiences of people from underrepresented backgrounds to learn if the level to which they feel included has impacted on their access, retention, and success in engineering. The Academy recognises the role D&I plays in harnessing the power of engineering to build a sustainable society and an inclusive economy that works for everyone. Our core priorities as an Academy are to work with our Fellows and partners to grow talent and develop skills for the future; drive innovation and build global partnerships; and influence policy and engage the public. This commentary strives to further the conversation on the influential role inclusive cultures can play in working towards a more inclusive and sustainable society and economy.

We acknowledge that some of the research presented in this commentary may be sensitive and triggering to the reader, particularly that contained in direct quotes from participants. The commentary references the experiences of real engineers and should not be taken as a reflection of the views of DJS Research or of the Academy. We encourage the reader to take care and refer to relevant wellbeing services if required.

Inclusive cultures in 2017

In this section we provide a brief background to the 2017 *Creating cultures where all engineers thrive* report, which contextualises the findings presented in this commentary. The positive influence D&I has in addressing engineering workforce shortages and the increasing skills gap was known before the Academy published the 2017 report. However, progress in D&I has been slow in engineering, which has not helped to address skill and workforce shortages. The Academy undertook research to explore the relationships between diversity, inclusion, and culture to continue to help address this issue.

The 2017 report explored the state of inclusion across the engineering profession and identified what more could be done to nurture a profession

where all engineers can thrive, while capitalising on the systemic benefits of inclusion to the entire profession. To explore this, the researchers who completed the 2017 report conducted focus groups with 300 engineers from across the profession, which informed a project survey that attracted 6,799 responses from people working in engineering roles, or on engineering projects, in the UK.

The report found that each engineering employer has its own organisational culture that can shape the experience of inclusion. It was further identified that although disparate organisational cultures exist, engineers as a workforce share commonalities in terms of their predominant values, beliefs, behaviours, perceptions, experiences, and relationships. It is from these commonalities that the 2017 report started to construct a picture of the culture of engineering in the UK. An intention of the Academy with this new report was to reach out to a more diverse representation across the profession, ensuring that the research captured voices from small and medium enterprises, multinational corporations, and underrepresented groups, which was less of a focus for the 2017 research.

Six of the nine elements identified by the 2017 report describe the culture of engineering as problem-solving; safety-consciousness; pride; loyalty; team orientation; and flexibility. Three themes represent the conflicts in the culture, where it is defined as pleasant but not personal; where it is solutions-focused yet strongly rooted in tradition; and where there are high levels of work satisfaction but a lack of guidance and assistance for career development. The results also showed that seven factors drive the views of inclusion in engineering: openness; respect; connections; career development assistance; flexibility; leadership; and diversity.

The findings also revealed that inclusion boosts individual engineers' performances, with 80% expressing higher motivation, 68% reporting increased performance, and 52% reporting increased devotion to their organisation, highlighting a strong business justification for strengthening inclusion within the culture. The more involved engineers feel, the more likely they are to grasp business goals; to feel confident speaking up about improvements, errors, or safety problems; and to envision a future for themselves in engineering. Inclusion promotes organisational performance.

The research indicated that there is an 'inclusion privilege,' which means that those who already feel included are less likely to take action. White men engineers believe that the culture of engineering is more inclusive than engineers who are women, who in turn believe that it is more inclusive than engineers from Black, Asian, and minority ethnic backgrounds.

A key part of the new research was to consider how the culture of engineering has changed over the past five years since the original research was carried out in 2017. This could not be done by using a straightforward comparison of the data from 2017 to the 2022 data. This is because both research projects have used different sampling and survey methodologies and spoken to different groups of engineers, meaning any comparison would not be valid. What is presented in this commentary and the larger research report was not intended to produce a detailed comparative analysis, but to highlight key themes and findings that could tell the story of the relationship between inclusion and culture across engineering today. As a result, the findings of this survey are reflective of engineering employers of all sizes and captures the views of engineers from varied backgrounds on how the culture has changed. We also comment on what has changed over time with regards to culture, inclusion, and diversity in engineering.[5]

Approach

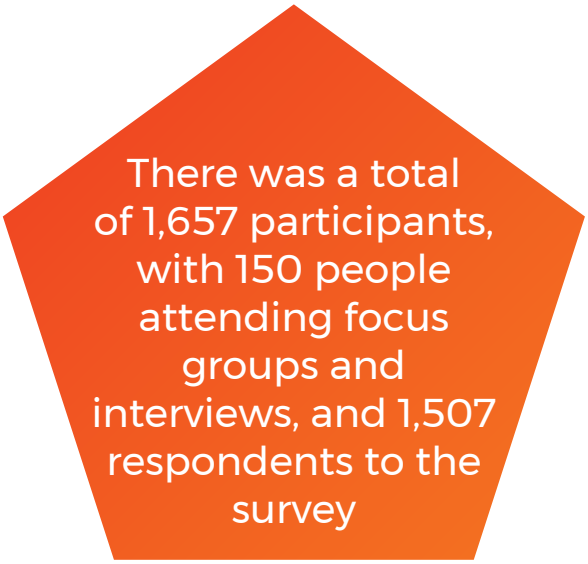
The Academy commissioned DJS Research to establish the perceptions and experiences of individuals working in the engineering profession, in particular regarding the culture of inclusion. To do this, DJS Research undertook a literature review before embarking on a detailed period of qualitative and quantitative fieldwork in 2022.

There was a total of 1,657 participants, with 150 people attending focus groups and interviews, and 1,507 respondents to the survey.[6]

All participants had to have worked in engineering in the UK and were categorised as either 'engineers' or 'employers'. Engineers for the purpose of the research included both chartered and non-chartered engineers, as well as technicians, and individuals working on engineering projects as project managers, directors, or co-ordinators. The term 'employers' included individuals working in D&I, HR, or the heads of smaller engineering organisations.

While the research and findings derive from a diverse sample, we acknowledge that the findings represent a collection of perspectives on the engineering profession and culture rather than a representative view on behalf of the entire industry. Throughout the report, the qualitative research is presented on emerging insights and themes that highlight the perspectives of participants, as conducted by DJS Research. This means that while we are not able to state the specific number of participants that reported on each topic, the analysis and themes were identified across multiple responses.

The data and insights gathered are rich and multi-layered. The Academy is publishing this commentary to accompany the research. We present key highlights and themes derived from further reflection and analysis. While the report explores what has changed since 2017, the focus is on exploring recent perceptions of inclusive cultures in engineering.



Sample

While the 2017 Inclusive Cultures report gave us valuable insights into the culture of engineering, it was unable to properly capture the views of underrepresented and marginalised groups working within the profession. To ensure we were able to analyse the responses to the 2022 survey at an intersectional level, we felt it was important to seek out perspectives that may have been previously overlooked.

By working closely with the Association for Black and Minority Ethnic Engineers (AFBE-UK), the Women's Engineering Society (WES), and InterEngineering to promote the survey, we were able to amplify the voices of underrepresented groups and shed light on their unique experiences and opinions. At the same time, by working with our partners across the professional engineering institutions (PEIs), the wider industry, and a number of research panels across the country, we were able to ensure those groups who make up the majority of the profession also had their voices and views heard.

As a result of these efforts, some groups represent a higher proportion within our research sample than in the UK engineering workforce, such as women (37% in the sample compared with reported 16% of women make-up the engineering workforce) and Black, Asian, and ethnic minority groups (25% in the sample vs 9.9% of the engineering workforce make-up Black, Asian and minority ethnic groups). While we have not applied weighting to the total results to adjust for these differences, we present results disaggregated by characteristics where there is substantial variation between groups.

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Findings

The findings are presented in three key sections on the areas of culture, inclusion, and diversity in engineering. Each section also considers what has changed over time and outlines our key takeaways.

Cultures in engineering

This section explores the broader culture of engineering and where and how inclusion is part of it. The collective perceptions of engineers presented in this section can help us to better understand the culture of engineering in relation to inclusivity. The findings in this section of the report focus on the views and experiences of those working within engineering and there is little difference in how it has been described in 2022 from how it was described in 2017. Overall, when restricted to using no more than five words, participants used language related to the productivity of the profession, with 'solutions-orientated', 'innovative' and 'collaborative' most cited. While some words focus on the productive nature of the profession, it is noteworthy that:

- Three in ten reportedly describe the culture of engineering using the phrase 'slow to change'.
- One in four describe the culture as hierarchical.
- One in seven describe the culture of engineering as 'siloed'.
- Only one in five describe the culture as 'friendly'. (Figure 1)

Within the qualitative phase, the researchers identified that participating engineers had great pride in their work and noted several positive aspects about the culture of the profession. Engineers pointed to key positive aspects of the profession such as:

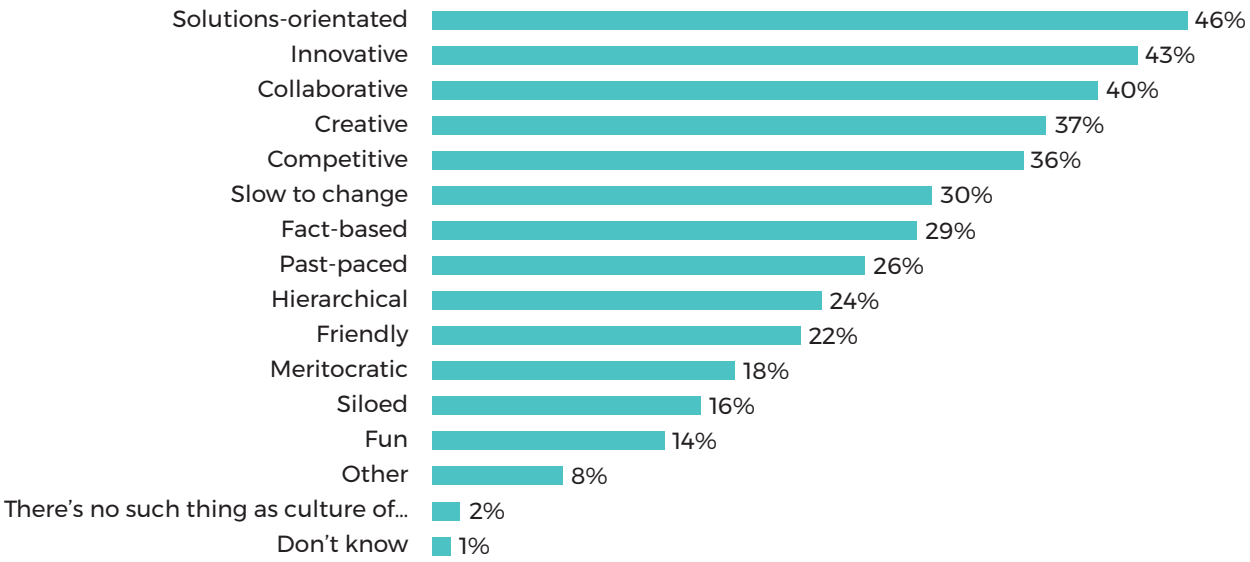


Figure 1: Words to describe the culture of engineering (Source: Q01. In your experience, which of the following best describes how you view the culture of engineering in the UK? Base: all respondents (n=1,507).)

> "Where we are there's a lot of banter. And a lot of things are said which people don't know if they actually mean it or not. And where do you draw the line?"
>
> **Engineer, Rail, Man, LGBTQ+**

- A strong culture of teamwork and creative problem-solving.
- A strong focus on personal development that gives opportunities for engineers to push themselves.
- Ability to make a difference by working on meaningful projects with social purpose.

However, there are some important differences in gendered perceptions among different sub-groups. For example:

- Men are more likely than women to perceive engineering as creative, fun, and innovative – words that have more positive sentiments.[7]
- Women are more likely than men to perceive engineering as hierarchical, siloed, and slow to change – words that have more negative sentiments.[8]

This finding highlights different perceptions of the culture of engineering and offers some indication of the ways in which engineering experiences and environments are gendered. In particular, it shows the increased adversities women experience in engineering environments[9], which are reflected in the words they use to describe the culture.

Individual qualities beneficial in engineering

Participants were asked to identify qualities within engineering they felt were valuable to the profession. These qualities represent behaviours, skills and characteristics that were attributed to engineering. For instance, problem-solving (68%), delivering to time and budget (60%) and the ability to collaborate with others (52%) are among the highest valued qualities perceived by engineers. Interestingly, participating engineers identified feeling less comfortable engaging and building relationships with non-engineers.

However, while creativity (25%) is a cultural descriptor of engineering, it was reported less as a valued quality along with speaking up in disagreement with something or someone (19%) and taking a stand against offensive behaviour (9%). Engineers who did not identify with any protected characteristics were more likely to select 'able to give and take banter' (40%) than those with protected characteristics, with just 29% of engineers from a Black, Asian or minority ethnic background selecting this statement. This finding opens questions about the nature of the banter and its adverse impact on underrepresented groups across the engineering community.

In the qualitative research, the role and influence of masculinity and machoism on engineering cultures was highly reported. The masculine and macho culture was reported to manifest in the form of offensive 'banter' and 'mickey-taking', with participants describing having to be prepared and develop resilience in order to cope. One participant who had family members that were engineers who had informed them about their experiences of the culture within engineering said they felt more prepared for navigating masculinities and machoism in the industry. When exploring

> "There has been, for many years, this reluctance to allow those in management positions to work part-time or work flexibly and it just doesn't make sense because you can guarantee that those asking for this, who are mostly women, would absolutely make this work. As a result, we just end up losing really good female talent"
>
> **Engineer, Defence, White, Man**

masculinity and machoism in organisational structures and processes, participants reported:

- Reluctance to embrace new and flexible working patterns.
- Long hours and a heavy workload.
- A culture wherein sometimes offensive 'banter' is normalised as 'part of the job'.
- A lack of support for the importance of mental health.
- A culture where engineers felt ongoing pressure to not get things wrong.

While it was not identified in the remit of the research, we acknowledge and recognise that sexual harassment is also often attributed to masculine and macho cultures.[10] Further research in this area within the engineering community could explore these links in more detail.

These qualities were identified from the qualitative research where participants described masculinity and machoistic together when talking about cultures in engineering. However, further investigation in this area is needed to understand how gendered cultures and masculinity can affect engineers' recruitment, retention, and success in the profession.

> "I think my line manager won't be happy until I start talking like him, acting like him, doing things he likes, working in exactly the same way he does. There's no acceptance of difference. They can accept employees who have different skin colours, but it really boils down to acting like a white, middle-class man who's had a private education"
>
> **Engineer, Automotive, Asian, Man**

> "There are definitely more microaggressions in the constructions side of the business because of the lad culture... there's much less of it [lad culture] in the corporate and planning side of things"
>
> **Engineer, Construction, Asian, Woman, LGBTQ+**

> "I consider myself to be really lucky as I happen to work in an office with – by chance – a number of other gay men so the representation is great and the culture is great but I know this is not the case when you look at the production side of the business and you do hear of there being more issues there when it comes to how inclusive it is"
>
> **Engineer, Mechanical Engineering, White, Man, LGBTQ+**

During the qualitative research, participating engineers reported a difference in culture between operational/production-based work and more office-based roles. The former was often described as being most likely to be macho and 'laddish'. Some participants noted that this macho culture had an impact on how underrepresented groups are exposed to more discriminatory behaviours. Participants reported there is considerably less diversity in the operational/production side of many engineering organisations than the office, and that the statistics of people from underrepresented groups working in engineering are often boosted by those working in more office-based roles.

Has the culture of engineering changed?

In commissioning the research we acknowledge that over the last five years, there have been significant global challenges and social justice movements, owing to both the onset of the COVID-19 pandemic and the 2020 wave of the Black Lives Matter and #MeToo movements.

As part of the research, participating engineers were asked whether the culture of engineering had changed (Figure 2). Participants were also asked their views on how the culture of engineering has responded to the COVID-19 pandemic and wider social movements. Approximately half of the respondents believe that the culture of engineering has

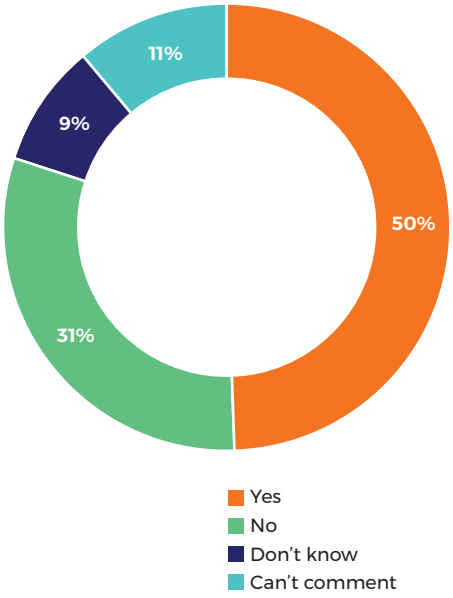
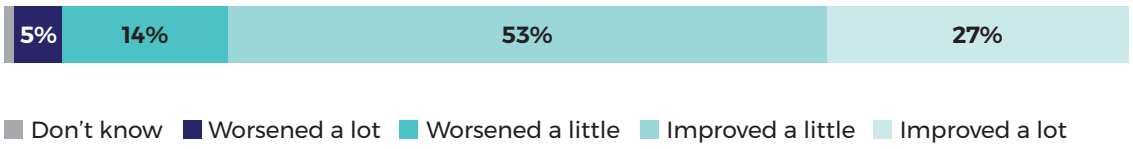


Figure 2: Has the culture of your engineering sector changed over the past five years?



Base: Those who think the culture of engineering has changed over the past five years (n=750).

Figure 3: Source: Q06a. Do you think the culture of your engineering sector has changed for better or worse?

changed, with three in ten saying it hasn't. One in ten say they don't know and another one in ten told us they haven't worked in engineering long enough to comment. Of those who said in has changed, just over half said it has improved a little. However, almost one in five think it has worsened. This aligns with the culture of the engineering community being seen as 'slow to change'.

Participants who said that the culture of engineering had changed mostly felt that the culture had improved (87%). When exploring nuances in the data, participating engineers who identify as transgender or those who have a trans history were significantly more likely to say the culture had changed. Interestingly, women engineers are more likely to say culture has improved (86%) compared to men (78%). However, it is unclear from the data what aspects of the culture have improved for underrepresented groups.

Over half of the respondents think that the COVID-19 pandemic has influenced the culture of engineering, with just over a third believing it has had a positive impact, and one in five feeling it has had a negative impact (Figure 4).

Men in the profession are more likely than women to say that it has had no impact (34% vs 29%). Interestingly, engineers from Black, Asian and minority ethnic backgrounds are more likely to say

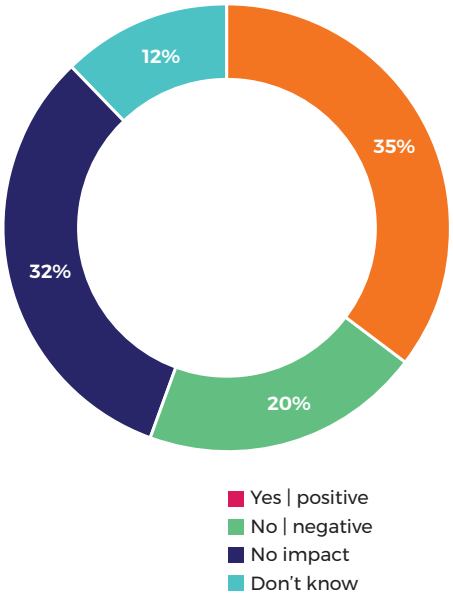


Figure 4: Has COVID-19 had an impact on the culture of engineering?

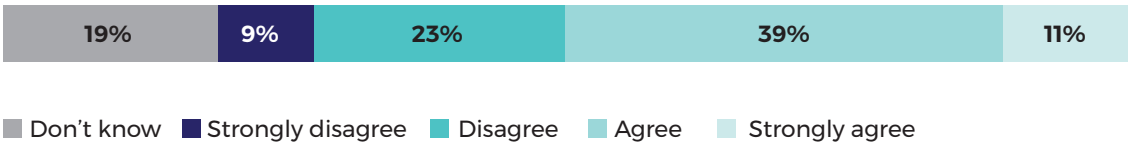


Figure 5: Impact of societal movements on the culture of engineering

that COVID-19 has had a positive impact on the culture of engineering (43%) compared to white engineers (34%). However, LGBTQ+ engineers and those who have a disability are more likely to say that the pandemic has had a negative impact (24% and 25% respectively).

The extent of the impact of broader societal movements such as #MeToo and Black Lives Matter on the culture of engineering divided opinion among those surveyed. Half of respondents believe that the movements have had an impact, however three in ten disagree. One in five said they 'don't know' (Figure 5). When looking at engineers particularly impacted by these issues, there are some key differences. For example, engineers from Black, Asian or minority ethnic backgrounds are more likely to agree (60%[11]) compared to white engineers (48%) and women are more likely to agree compared to men (44% vs 36%).

Overall, the findings in this section suggest the culture of engineering changed more slowly than participating engineers would like to see. However, despite this noted slower pace of change, participants highlighted that the recent onset of a global pandemic and social justice movements has meant that the engineering profession has become more responsive to cultural change and engaging in difficult conversations about inclusion than what was reported in 2017. Further exploration of the pace of change in engineering cultures would help identify the barriers and enablers to inclusion and allow for them to be addressed.

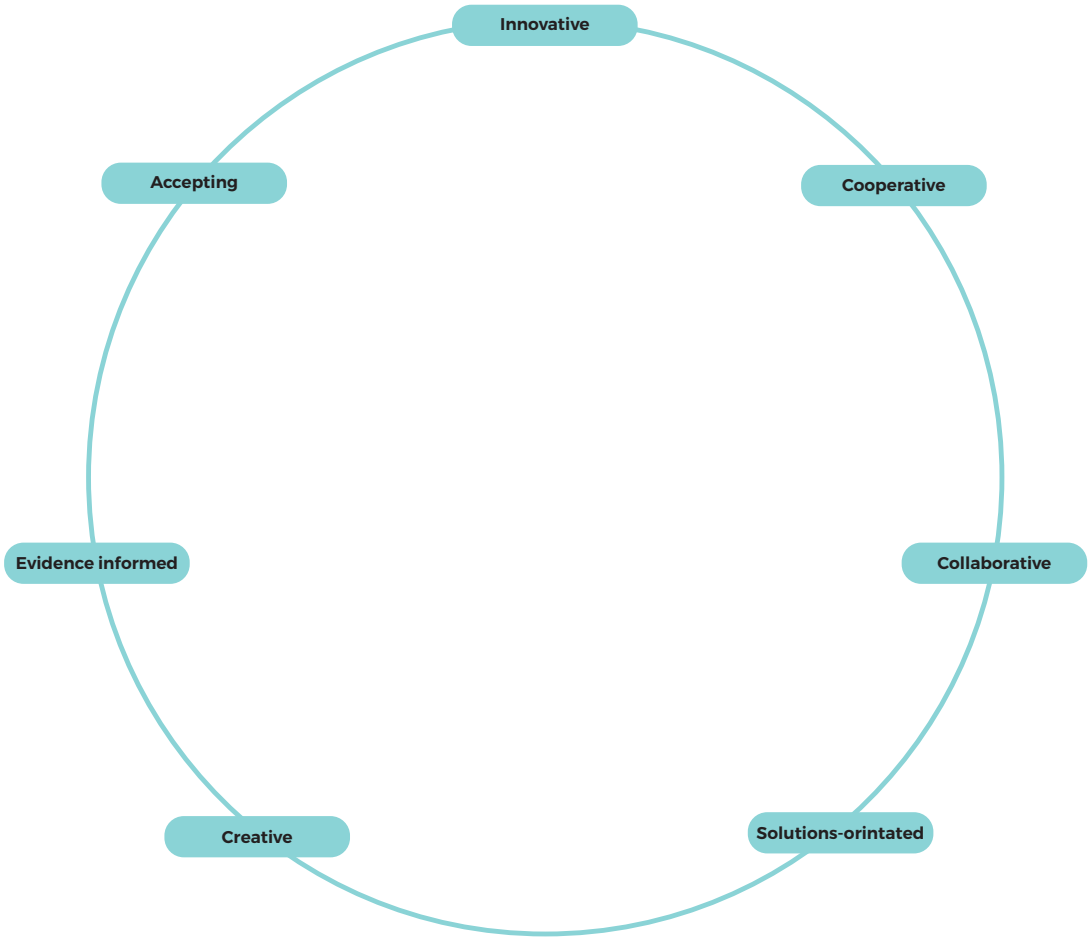
Summary

The below points summarise the key insights from this section of the commentary:

- Engineers tend to describe the culture of the profession in terms of productivity and creativity

with a focus on words like 'solutions-orientated', 'innovative' and 'collaborative', all which hint at a culture that allows inclusivity to flourish.
- Despite this, some see the profession as 'slow to change', 'siloed' and 'hierarchical', with women more likely to use these negative descriptors than men.
- The behaviours valued within the profession tend to align with the descriptors of the culture of engineering, which supports the image of a culture concerned with production through problem-solving, collaboration, and delivering to time and budget.
- However, creativity was less valued as a behaviour within the profession along with 'speaking up' and 'taking a stand', which may impact, or be impacted by, the existent culture of inclusion in the profession.
- Masculine and macho culture persist in the profession in the form of offensive 'banter' and 'mickey-taking', which engineers are expected to be resilient to. However, there is a split, with this culture more present in on-site locations and less so in offices.
- Three-quarters of engineers responded that inclusion in the profession has improved since 2017, with those who identified as transgender seeing the most improvements. The effect of company policy in creating inclusive cultures was most felt in large companies, and less so in medium and small companies.

From the findings, the schematic below shows some of the key facets that are currently present in an inclusive culture within the engineering community. This schematic highlights that, practising innovation, cooperating with colleagues and in teamwork, collaborating on ideas, being solutions-orientated, creativity, being evidence-informed and accepting of others, compose an inclusive culture in engineering (Schematic 2). We recognise that there are a variety of facets of inclusive cultures, and there may be more that could be identified that are beyond the scope of this research. Future research may build on the complexity of this model. Throughout the report we continue to build on this schematic to illustrate the different facets and drivers of inclusive cultures.



Schematic 2: Representation of the enablers to inclusive cultures in engineering

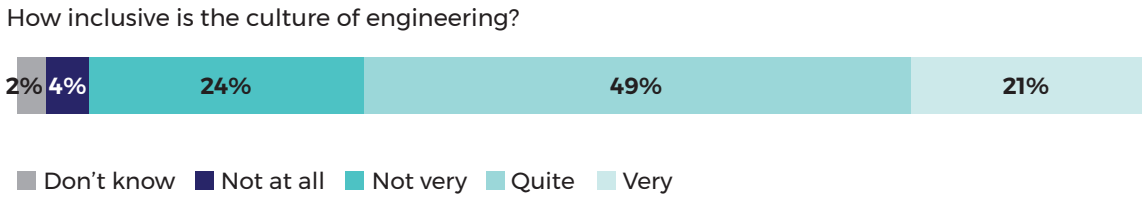


Figure 6: Inclusivity of the engineering profession

Protected characteristic	% NET Inclusive (Quite+Very)
Women	59%
Black, Asian or minority ethnic	68%
LGBTQ+	63%
Those with a disability	62%
None	79%

Table 1: Inclusivity of engineering profession by subgroup

Inclusion in engineering

This notion of inclusion was explored through participating engineers' perception of professional environments. However, we recognise that inclusion can be experienced by different groups, which is highlighted in the qualitative findings.

When asked about inclusion in the qualitative research, some participating engineers reported that achieving inclusion may not be enough and that they would like to feel they can be their authentic self in their professional spaces, while feeling empowered and emboldened to participate without changing or minimising parts of who they are. This finding reflects that there may be some dissonance in what inclusion means to different members of the engineering community. Overall, the majority of respondents feel that the culture of engineering is inclusive (69%), with just under three in ten saying engineering is not inclusive (28%).

Similar to the findings in 2017, there are differences in perception from underrepresented groups who typically reported feeling less included in engineering. For example, white engineers (71%) feel more included than Black, Asian and minority ethnic engineers (68%), and men (76%) feel more included than women (59%).

Although the sense of belonging and inclusion was increased for participants, there are still disparities between underrepresented groups, with Black, Asian and minority ethnic engineers, women engineers, and engineers from LGBTQ+ communities having a lower sense of inclusion and belonging in the profession (Table 1).

Within the LGBTQ+ community, those who are the least represented in this sample appear to feel the least included. Of the 12 respondents who identify as 'queer', only 58% feel included. Similarly, 7 of the 14 respondents who identify as pansexual feel included and 6 of the 12 respondents who prefer to self-describe their sexuality feel included. In contrast to this, 80% of gay men and 85% of gay women/lesbians reported feeling included across engineering. While these sample sizes are small, the findings indicate that sense of belonging within and across the LGBTQ+ community can vary and may require further exploration.

Participants reported that the relationships with their line managers can be pivotal to their sense of inclusion and belonging, with some reporting directly positive and negative impact on their experience. Behaviours in managers that enabled inclusion were:

- being supportive

- setting clear expectations
- providing flexibility to staff ways of working.

Line managers were also reported to play an important and valuable role in promoting the work of employees. Line managers that champion and promote the work of their teams are perceived as more inclusive. In contrast, there were also several reports of line managers enacting discriminatory behaviours, not taking a stand against discrimination, enabling cultural isolation, and performing microaggressions. Participants who reported adverse experiences in larger organisations said that D&I were seen as tokenistic (tick-box exercises), rather than actively practised and embedded. Small/medium organisations were noted to not have capacity and resources to develop and embed formal D&I policies, and practices.

There are some small differences in the responses, which may be worth further examination in future research. For example, when disaggregating the data by organisation size and management level, findings show that:

- Engineers working in medium-sized firms were more likely to say inclusion has improved (82%) compared to those in small and large organisations (73% and 74%).
- Those in management roles were more likely to say inclusion has improved (82%) compared to 72% for graduates/non-management and 75% for interns/ apprentices.

These findings show that tackling discriminatory behaviours require interventions that are suitable for different-sized organisations. For example, a large organisation tackling discrimination may need stronger and bolder inclusion objectives, policies, and reporting systems, whereas small/medium may need further support in D&I training and capacity building.

> "I have worked in a few different organisations now and I have had some fantastic experiences and some terrible experience in terms of inclusion, it's very much dependent on the mix of people you work for and how accepting they are, and also how familiar they are with gay people. If you're on a shop floor with mostly men in their 50s and 60s they may never have come across a gay man in the workplace before and may need to be educated on what is and what isn't acceptable"
>
> **Engineer, Manufacturing, White, Man, LGBTQ+**

Bullying, harassment and discrimination

The research identified that members of underrepresented groups within the workforce continue to experience concerning bullying, discrimination, and harassment. These play a critical role in the exclusion and marginalisation of those from underrepresented groups to fully participate in the engineering community. Bullying and harassment in the research is defined as any unwanted and unsolicited behaviour that adversely impacts an individual's experience, wellbeing and outcomes.

The research highlights that:

- One in three engineers (35%) responded that they had experienced bullying and harassment with a quarter having witnessed bullying or harassment of someone else.
- One in five (20%) had experienced bullying or harassment personally. White heterosexual men were, by some margin, the least likely to personally experience (7%), or witness (17%), bullying and harassment.
- Women and LGBTQ+ engineers were more than twice as likely as white heterosexual men to experience bullying and harassment (25%), while Black, Asian and minority ethnic engineers (31%) and engineers with a disability (32%) were more than three times as likely.

When exploring intersectionality within the data, participants who identified as both LGBTQ+ and Black, Asian or minority ethnic (70%), and those who are Black, Asian or minority ethnic with a disability (70%), were more likely to report witnessing and/ or experiencing bullying and harassment (Table 2).

The percentage of white heterosexual men who have witnessed bullying or harassment is approximately

Protected characteristic	% Experienced bullying/ harassment personally	% Experienced bullying/ harassment of someone else
Women	25%	29%
Black, Asian or minority ethnic	31%	36%
LGBTQ+	25%	32%
Those with a disability	32%	34%
White heterosexual men	7%	17%

Table 2: Experiences of bullying and harassment – by subgroup

half of the percentage for those with a protected characteristic, which suggests that either those in the majority do not see what is happening or avoid situations where they might witness it. This finding suggests that more work needs to be done around promoting allyship.

The themes of discrimination and microaggressions were identified from across the research, with negative behaviours and abuse typically reported by underrepresented gender, racial and ethnic participants. There were reports of direct discriminatory speech and respondents highlighted that these behaviours were often actively challenged. However, microaggressions were not challenged or reported due to concerns and a lack confidence that claims would be taken seriously. It was noted that the impact of microaggressions was severe in adversely impacting the individuals' lived experience and wellbeing. Experiences of bullying, harassment, and discrimination are unique to different underrepresented communities. In particular, the Academy acknowledges that underrepresented groups do not have a homogenous experience of bullying, harassment, and discrimination, noting that some groups experience singular and multiple overlapping adversities and inequalities. The following section explores the perspectives of underrepresented groups on characteristics across the engineering community. The findings below showcase perspectives from all participants and viewpoints disaggregated by underrepresented groups.

Exploring experiences of different underrepresented groups

This report explores responses to each of the survey questions by subgroup as some questions were more specific to underrepresented groups. For example, participating engineers were asked about the relevance of gender to their work, and about openness around sexuality in the workplace, among other ideas. In this section, we present responses to questions that were directly related to gender, ethnicity, LGBTQ+ status, disability, religion, and those with caring responsibilities. A more holistic intersectional analysis of the most underrepresented groups was beyond the remit of this research. However, given our recognition of the particularity of experiences of individuals who identify with multiple protected characteristics, we have explored disaggregated data to provide some insight (for example, exploring responses to questions and statements from participants that selected multiple characteristics). We present some of the key data and findings to illustrate and

> "I love wearing colour but I found if I ever wore anything remotely feminine – so not black or blue – it was always commented on and pointed out so I stopped [...] I even started smoking in order to try and make some male allies as that seemed to be the place where the lads would hang out"
>
> **Engineer, Energy, White, Woman**

> "Our women's group reported women being talked over in meetings, not being acknowledged by a man when there are other men around, not being included in conversations"
>
> **Employer Renewable Energy**

> "The amount of time people have assumed that I was some sort of secretary of assistant. I worked as a senior engineer for years"
>
> **Engineer, Automotive, White, Woman**

present nuances of inclusion within engineering perceived by gender, ethnicity, LGBTQ+, disability and religion/faith. The findings presented are key highlights from different underrepresented groups, and further findings are presented in the larger research report.

Gender

The researchers asked respondents whether they agreed that gender is irrelevant to their professional practice and how they are perceived at work:

- Two-thirds agreed, and a quarter strongly agreed that gender was not relevant to their professional practice.
- A quarter of respondents disagreed that their gender is irrelevant to how they are perceived at work, with women being twice as likely as men to disagree.
- However, while 77% of men agreed that gender is not relevant to their professional practice, only 52% of women did.

These findings highlight that underrepresented gender groups are more sensitised to the role gender plays in their professional practice. When exploring the data across respondents that identified with multiple characteristics, it was found that LGBTQ+ women (50%) and women with a disability (47%) were less likely to agree with the statement that gender is irrelevant to their professional practice than LGBTQ+ men (65%) and men with a disability (67%).

From the qualitative feedback, women engineers described a catalogue of instances of verbal and physical bullying, harassment, and other forms of discrimination. Examples include:

- Women engineers experiencing unwanted advances or comments of a sexual nature or inappropriate comments about their clothing in the workplace.
- Silencing of women engineers in contrast to engineers who are men.
- Women engineers being assigned less meaningful work or tasks than men.
- Incorrect assumptions made about women engineers' seniority in the organisation.

The quote below highlights the gendered experience of a man who transitioned while working in engineering and was able to recognise the intersectional disparities in the experience of engineering in different gendered roles:

Ethnicity

In the survey, participants were asked their level of agreement with the statement that 'people make

> "Being someone that has transitioned and experiencing both as a female and a male in the profession, I can say I have noticed the difference in the way I am treated and listened to as a man and how women just can't really get away with saying things that men can"
>
> **Engineer, Utilities, White, Man, LGBTQ+**

Protected characteristic	% Agree (NET)
Women	61%
Black, Asian or minority ethnic	71%
LGBTQ+	64%
Those with a disability	64%

Table 3: 'People make assumptions about me at work because of my background' – by subgroup

Protected characteristic	% Agree (NET)
Black, Asian or minority ethnic	71%
LGBTQ+	64%
Those with a disability	64%

Table 4: 'People make assumptions about me at work because of my background'

Sexual orientation	% Agree (NET)
Asexual	77%
Bisexual	59%
Gay man	62%
Gay woman/lesbian	90%
Queer	58%
Straight/heterosexual	88%
Pansexual	57%
Self-describe	58%

Table 5: 'I am open at work about my sexual orientation' – by sexual orientation

> "I'm born and raised British but sometimes I feel like I'm from a different planet [...] I find myself having to hide aspects of my culture to try and avoid standing out and more than I do"
>
> **Engineer, Motorsport, Black, Man**

> "I think for Black women in particular we face a barrier when trying to be assertive as we are often misrepresented as being 'aggressive'"
>
> **Engineer, Oil & Gas, Black, Woman**

assumptions about me at work because of my background'. While this question was asked to all participants, the findings above are from the perspectives of Black, Asian and minority ethnic respondents (Table 3).

When disaggregating the data, engineers from Black, Asian or minority ethnic backgrounds were most likely to agree with the statement (71%).%) as shown in Table 4.

> "No one knew I was gay for months and there was no problem until I happened to mention my husband, and then attitudes changed straight away. I was told to 'tone it down'"
>
> **Engineer, Manufacturing, White, Man, LGBTQ+**

From the Black, Asian or minority ethnic groups, 73% Asian/Asian British, 68% Black/Black British and 67% mixed/multiple agreed with the statement. Examining the responses of minority ethnic groups further, when disaggregating data for gender, race and disability, Black, Asian or minority ethnic women (78%) and Black, Asian or minority ethnic participants with a disability (78%) agreed with the statement.

During the qualitative research, Black, Asian and minority ethnic respondents reported experiencing many forms of verbal and non-verbal bullying, harassment, and discrimination. For example, Black, Asian and minority ethnic individuals recounted:

- Racist comments about skin colour and comparisons to food items.
- Being silenced.
- Incorrect assumptions being made that underestimated their seniority.
- Experiences of harassment in relation to clothing or hair (particularly global majority clothing and hairstyles).
- Colleagues assuming they do not speak English or are not British.

LGBTQ+

There were 230 (15%) participants who identified as part of the LGBTQ+ community. When participants were asked if they were open at work about their sexual orientation, 66% of LGBTQ+ identifying participants agreed or strongly agreed, compared with 88% of straight/heterosexual participants. 13% of LGBTQ+ participants disagreed or strongly disagreed compared with 3% of straight/heterosexual participants. It is interesting to note that there were significant differences within the LGBTQ+ community:

- 90% of gay women/lesbians[12] and 77% of individuals identifying as asexual[13] reported being open at work about their sexual orientation.
- 59% of those who describe themselves as bisexual[14] and 57% of those who describe themselves as pansexual[15] said they were open about it at work.

When exploring the experiences of those with multiple protected characteristics, respondents who identified as both LGBTQ+ and Black, Asian or minority ethnic (72%) were less likely to agree they were open at work about their sexual orientation than those identifying as heterosexual and Black, Asian or minority ethnic (83%) or heterosexual and white (90%) (Table 5).

During interviews and focus groups, LGBTQ+ participants reported experiencing homophobia, isolation, discrimination, and harassment in relation to their sexual orientation, which ranged from micro to macro aggressive behaviours. These included:

- Unsolicited gossip about their sexuality.
- Devaluing partners that were not heteronormative.
- Verbal abuse (for example, referring to LGBTQ+ partners in heteronormative gendered roles as husband or wife).
- Being silenced by employers from being open about their sexual orientation.
- Homophobic abuse.
- Colleagues expressing disgust in working alongside LGBTQ+ individuals.

While respondents disclosed these negative experiences, some participants had also highlighted the positive role of staff networks, particularly LGBTQ+ networks, in empowering them to disclose their sexual orientation. For example, one engineer said:

"I came out late in life […] I think part of the reason I got to the point of being able to do that [disclose being gay to colleagues] was because I was working in an organisation that had six or seven staff networks [including] a very active LGBT network."

Disability

When asked if participants' workplaces were inclusive of people with disabilities, three-quarters of respondents agreed with the statement. Of the 16% (n=238) of participants who reported having a disability, 70% agreed, compared to 77% for those who do not have a disability. Further, 20% disagreed and 5% strongly disagreed. Analysis showed that all underrepresented

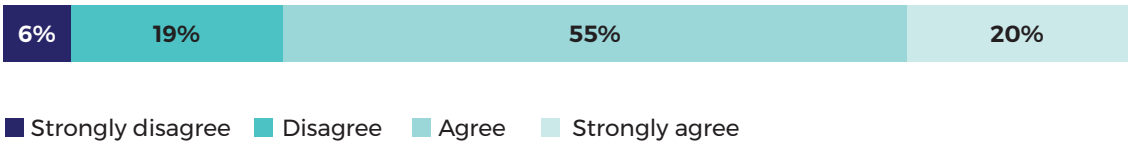


Figure 7: 'I feel I can speak openly about my faith/religious beliefs/non-beliefs at work' – by religion

Religion	% Agree (NET)
None	80%
Christian	76%
Muslim	76%
Other (Buddhist, Hindu, Jewish, Sikh, Spiritual, any other religion or belief)	64%

Table 6: 'I feel I can speak openly about my faith/religious beliefs/non-beliefs at work' – by religion

groups are less likely to agree with the statement that their workplace is inclusive of people with disabilities.

From the qualitative findings, those with disabilities reported a lack of social adjustments to enable them to enhance their sense of belonging and engage with their work. Reported discrimination included:

- Certain jobs and roles not being adjusted to enable those with disabilities (neurodiversity being mentioned specifically within this) to fulfil them.
- A lack of openness to talk about disabilities, and in particular physical/mobility-related disabilities.

> "We have a long way to go in terms of monitoring and approaches with neurodiversity and a lot of that is because of the reluctance to disclose still. There is a fear still, I think, that you would be effectively talking yourself out of progression and that shouldn't be the case especially in an industry where there is a lot of neurodiversity"
>
> **Employer, D&I, Utilities**

Religion and faith

Participating engineers were asked whether they agree that they can speak freely about their faith/religious beliefs/non-beliefs at work (Figure 7). Three quarters of respondents agreed (76%), with one in five strongly agreeing. However, one in five disagreed and 6% strongly disagreed. When looking at differences between religious groups, we see that those with no religion feel more able to speak about their beliefs (80%)[16] than those with faiths. Of those with faiths, Christians[17] and Muslims[18] feel equally confident about speaking out at 76%, whereas those who selected 'Other (Buddhist, Hindu, Jewish, Sikh, Spiritual, any other religion or belief)' felt least able to speak about their faith (64%; Table 6)[19].

Islamophobia was reported across the qualitative findings, where participants reported colleagues making inappropriate references and jokes relating to terrorism. For example, one participant said that,

"People would come into the room and be like 'hey [name removed],' [they would] make a little bomb noise and then just walk out as if it was just banter and they'd laugh it off."

There were also reports of employers questioning Muslim engineers' backgrounds and religious beliefs, and work

> "You would often find that those who would be offered the promotions were the ones that would spend time on the golf course with the boss or go to the bar after work, it's a big disadvantage to those of us who have families or that don't share those kinds of interests"
>
> **Engineer, Oil & Gas, Black, Woman**

events often centred around the consumption of alcohol. These findings highlight a particular issue of Islamophobia present in engineering and require further investigation that were beyond the scope of this commentary and research.

Caring responsibilities

Respondents were asked their level of agreement with the statement 'it's harder for people with caring responsibilities to progress their career where I work'. 66% of those who have caring responsibilities agree with the statement while 56% of those without caring responsibilities disagree, indicating that those with no caring responsibilities believe it makes a difference. Those that identified with protected characteristics (median score – 64%) were more likely to agree with the statement than respondents who did not identify with protected characteristics (median score – 53%). In this section we recognise that caring roles are influenced by gender, and further research can explore how gender and caring shape engineers' experiences of inclusive cultures.

The emerging insights from respondents was a reported lack of flexibility for workplaces to adjust to meet the needs of those with caring responsibilities. These include:

- Not being able to attend business critical professional events due to being out of office hours.
- Feeling forced to take career breaks due to employers not considering flexible working options.
- Assumptions that staff who are new parents will not return to work or want to progress in their career.

Respect and relationships

To explore participants' sense of inclusion in the profession, the researchers invited engineers to share how they feel they are treated at work by others which, for the purposes of this commentary, is described as experiences of respect. For example, if they think they are listened to, and if they feel confident to speak up when experiencing inappropriate behaviour. A key area for enquiry was whether respondents felt confident to speak up where there are safety concerns.

When disaggregating the findings from different groups:

- Heterosexual white men, who are well represented across the profession, are more likely to feel that they are treated with respect by colleagues (92%) and listened to by colleagues (90%) most or all the time compared to those from underrepresented groups.
- Engineers from Black, Asian or minority ethnic backgrounds and those with a disability are least likely to say they are treated with respect by colleagues all or most of the time (78% for both groups). They are also least likely to say they are listened to by

Figure 8: I feel confident speaking up when...

colleagues all or most of the time (Black, Asian and minority ethnic – 73%; disability – 74%).

Engineers across the board felt confident to speak up when safety is at a risk (Figure 8):

- More than half (54%) said they would speak up all the time when safety is at a risk, and 34% said they would speak up most of the time.
- White men were more likely to feel confident speaking up (for all statements) compared to respondents from underrepresented groups.

While these findings may appear concerning, we acknowledge that there's further enquiry needed to explore the relationship between the role of safety and inclusive cultures in engineering.

The ability for engineers to speak up when safety is at a risk points to the strong history and tradition of health and safety being prioritised in engineering. However, it also highlights an important link between safety, and inclusivity. For example, 44% of engineers with no protected characteristics say they would speak up all the time if they can see a better way of doing things, compared to just 24% of those from Black, Asian or minority ethnic backgrounds.

The findings also showed that participating engineers were confident in speaking out against inappropriate behaviour, either towards themselves (72%) or others (73%). This key finding suggests that further understanding of what enables people to speak out could shape interventions to embolden engineers to collectively act against offensive and inappropriate behaviour and could foster respectfulness in engineering spaces.

Researchers explored the ways in which participants reported how comfortable they feel being themselves in the engineering community. In contrast, cultural isolation may be a result of not being able to live and work authentically across the profession. An indicator of respectful environments is if engineers feel they can bring their whole self to the workplace. Overall, most participating engineers agreed that

- they can be authentic (83%), and
- they can be open with colleagues about their personal lives (80%).

However, 33% feel isolated in engineering. When exploring data with engineers from a Black, Asian or minority ethnic background (43%), those with a disability (43%), and those who are LGBTQ+ (38%), they reported

> "It's much better than it used to be. You don't have to walk past a load of nude pin-up calendars anymore, they made them get rid of those a while ago"
>
> **Engineer, Automotive, White, Woman, LGBTQ+**

feeling isolated. These findings suggest that underrepresented groups are more likely to feel isolated in the engineering community, which can inhibit them from being their authentic self at work.

Has engineering become more inclusive?

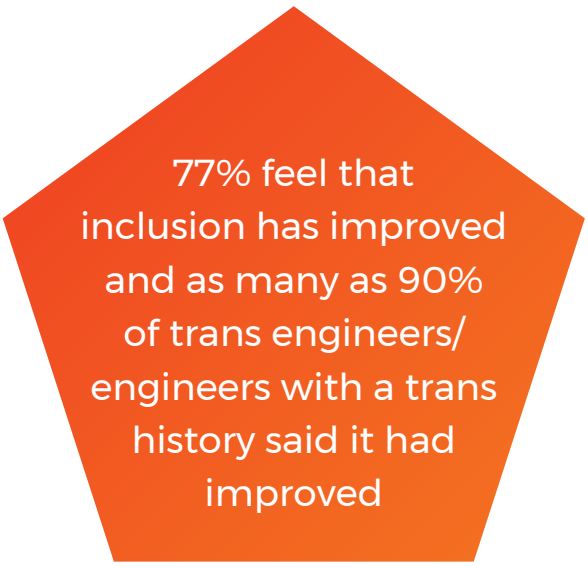
While it can have many facets, the research explores inclusion as the extent to which people feel valued for who they are (their personal and professional background, experience, and skills) and if they feel they belong or 'fit' in the engineering profession and their organisation. In the context of this commentary, the findings show that inclusion can be explored by better understanding sense of belonging and being our true authentic self as part of the engineering community.

To understand whether cultures within engineering have become more inclusive since the 2017 *Inclusive cultures* report, respondents were asked whether they felt inclusion had improved over the past five years. The response was overwhelmingly positive. Three quarters of engineers felt that inclusion had improved either a little or a lot. While there are some small differences when looking at the responses of certain underrepresented groups, the experience is overall positive. For participants who identified with multiple protected characteristics (n=1,394), 77% feel that inclusion has improved and as many as 90% of trans engineers/engineers with a trans history said it had improved.

When respondents were asked **how** inclusion had improved, the most popular response was that there was more open discussion around D&I (62% reported this).

> "I think in a way it's much easier for a company of our size because it just takes one or two senior team leaders to be really committed to D&I to ensure that the company is truly embracing and embodying those values, as we have that visibility of the culture and agility to make improvements quite quickly if needed"
>
> **Engineer and Employer, Construction, White, Man, LGBTQ+**

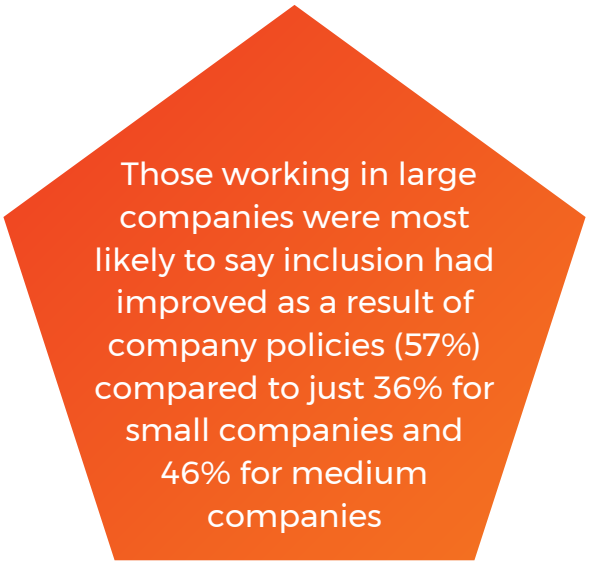
> "I think a lot of the 'dinosaurs' who would express those types of views are gradually [...] retiring. The industry seems a lot better and more inclusive the past few years, and I think with more and more of the next generation of engineers finding these behaviours unacceptable it makes it harder at least for those dinosaurs still remaining to express these opinions openly"
>
> **Engineer, Construction, Man, LGBTQ+**



Those working in large companies were most likely to say inclusion had improved as a result of company policies (57%) compared to just 36% for small companies and 46% for medium companies. Those in large companies were also more likely to report improvement through explicit inclusive recruitment strategies (52%) than medium (45%) or small companies (35%). The findings highlight a correlation between the experience and sense of inclusion and organisational size, processes, and practices.

The qualitative insights indicated that employers are increasingly likely to have D&I working groups in their organisation. Several participants from underrepresented groups reported the positive impact these working groups had on their wellbeing and sense of belonging. Some participants also reported that their organisations had become more explicit with their policies and practices in tackling bullying, harassment, and other forms of discrimination. Participants noted that these improvements have also enabled more conversations and awareness about inclusionary and exclusionary behaviours in their workplaces.

This consensus on improvements is to be celebrated. However, what precedes it in the research indicates that we still have a long way to go as a profession. In addition, it is crucial to highlight a theme that came through the qualitative research in respect of some of the key improvements experienced. The initiative for, and burden of, driving improvements appears to sit disproportionately with engineers from underrepresented groups. Most concerningly, there were numerous reports that these efforts were not recognised or adequately valued. For example, a number of individuals who had taken a lead in organising and contributing to D&I working groups in their organisations reported that the groups were often self-organised without formal protected time, budget, or resource. This signals the importance of further work to ensure that everyone takes responsibility for making engineering more inclusive, to ensure it is not just an added burden for those who are already affected by the current inclusion deficit.



COVID-19

In recognition of the seismic impacts of the COVID-19 pandemic, the researchers asked participants whether it had had an impact on inclusion within the profession. There was no clear consensus. Of the 51% who felt it had had an impact, 33% felt this was positive and 18% felt it was negative. However, 37% felt the pandemic had had no impact on inclusion in the profession.

That said, there were some small but notable differences, with women engineers more likely to report there has been a positive impact (36%) compared to men (31%). Those with caring responsibilities reported there has been a positive impact (37%) in contrast to those without caring responsibilities 31%).

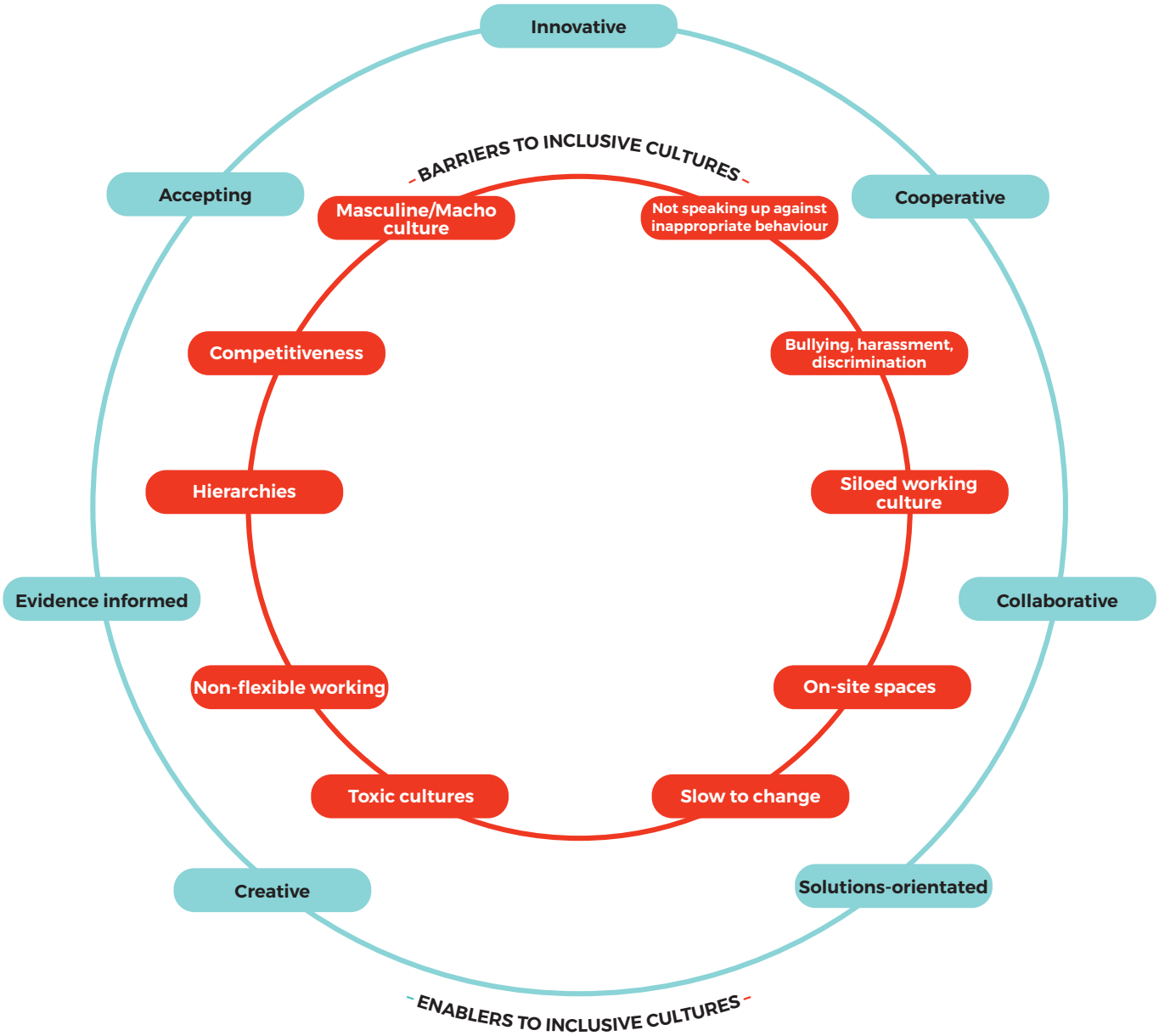
Summary

To summarise the findings on inclusion within engineering:

- The engineering community generally feels that the culture is inclusive, however, those who are underrepresented within the profession are less likely to view the culture in this way.
- Three quarters of engineers believe that inclusion in engineering has improved in the past five years.
- Underrepresented groups continue to report higher rates of bullying, harassment, and other forms of discrimination in the workplace. The rates are exacerbated for those from multiple underrepresented backgrounds.
- Engineers are generally confident to speak up around issues of safety, but less confident to speak up or report inappropriate behaviour or suggest better approaches to work.
- Engineers reported having a good work–life balance, that they could be authentic at work, and could be open with colleagues about their lives. However many engineers, particularly those

from underrepresented groups, reported that they feel isolated.

From the findings in this section, the schematic below depicts the enablers of an inclusive culture as highlighted in engineering and reflects how underrepresented groups can be positively influenced by a culture that embraces innovation, cooperation, acceptance, evidence, collaboration, solution, and creativity. However, the adverse experiences of underrepresented groups as noted throughout this section are illustrated as barriers to inclusive cultures. For example, while not an exhaustive list, the research showed that bullying, harassment and discrimination, toxic cultures, and masculine/macho environments were perceived as the facets of exclusion that can create barriers to achieving an inclusive culture (Schematic 3).



Schematic 3: Representation of enablers and barriers to inclusive cultures

Diversity, retention, and success in engineering

While the bulk of this report has commented on the role of cultures and inclusion in engineering, this section interrogates the relationship between inclusion, cultures, diversity, retention, and success in the engineering community. It is important to note that retention and success have a direct impact on the diversification of the workforce. This part of the commentary is concerned with understanding the perspectives of those from underrepresented backgrounds to determine whether they feel that their attraction, retention, and success in the profession has been impacted by the degree to which they feel included. The findings presented in this section explore the perspectives of issues concerning diversity, retention, and success, rather than the actual lived experiences of retention and success of underrepresented groups. Further investigation of these differences would be recommended. We acknowledge that, given the scope of the research, the respondents were all working within engineering at the time, so the research did not capture perceptions of aspiring engineers and younger people.

Engineers are positive about their careers and are keen to recommend the career to others. When asked about whether they would recommend the profession, eight in ten (81%) agree that they would. When engineers were asked about whether they would recommend their individual workplaces, more than seven in ten (72%) agreed that they would. Although this is a positive finding, it is important to note that there are differences in responses among underrepresented groups. Heterosexual white men represent the majority of the profession and are more likely to agree that they would recommend both engineering as a great career choice, as well as their individual place of work (85%). This is in contrast to engineers from Black, Asian or minority ethnic backgrounds (76%), those who identify as LGBTQ+ (76%), and those who have a disability (78%).

This may be reflective of the adverse experiences of culture and in particular bullying, harassment and other forms of discrimination that underrepresented groups reported in this research.

This highlights a dissonance between how participating engineers feel about the profession (positive) and their organisations (less so).

When considering the movement of staff within and across larger organisations, participating engineers reported hesitancy and reluctance to move to new roles or departments due a fear of not being accepted. This finding was highly prevalent among LGBTQ+ engineering respondents who disclosed that feelings of anxiety about disclosing their sexual orientation deterred them from seeking new opportunities.

Drivers and detractors for recommending engineering.

In identifying the drivers for and against recommending the profession or a specific workplace, the research found the area of inclusion (as a driver) to rank highly from respondents.[20] For example, engineers often commented on the importance of being in companies with flexible ways of working and those which enable staff from a wide variety of backgrounds to be included in work events and cultural activities. Detractors from recommending engineering included staff reporting that companies lack transparency and toxic workplace cultures (Table 7).

While it is not in the scope of this research to explore the links between wellbeing and inclusion, we recognise the interrelationship between inclusion and mental health is well evidenced[21]. The qualitative research highlighted the need for further investigation and action to address mental health and wellbeing in relation to inclusive cultures within the engineering community. Most

> "I know that in order to have a diverse workforce in my business I have to consider candidates that may not have the degrees or the work experience already. If I see that passion and potential, I will invest in them and you find these employees often are the most loyal and give you more back over time"
>
> **Employer, Manufacturing**

Divers to recommending engineering as a profession	Detractors to recommending engineering as a profession
Belonging to organisations where there appeared to be clear and equitable options for progression.	A lack of transparency around promotion, pay and progression.
Being in organisations with a good approach towards helping staff achieve a work–life balance (flexible working policies, work from home options, less expectation to consistently work overtime, etc.).	A 'toxic work culture' where microaggressions and harmful banter are allowed to continue unchecked.
Being in organisations where there is a strong emphasis on promoting a diverse and inclusive culture (staff from different backgrounds feeling well represented, staff from different backgrounds feeling included within work culture and work events etc.)	A work culture that disregards caring commitments.
Entering an industry that makes the most of your skills/natural abilities.	A work culture that appears to work to the advantage of the most represented groups in the organisation.
Entering an industry that makes a tangible difference and you can often see the product of your labour.	Line managers or management teams who are reluctant to embrace new or different ways of working or communicating to them.
Entering an industry that will engage staff in continuous learning and professional development.	Lack of room for development unless you choose to go down a people management route.
The skills shortage helps to ensure that a good job can be attained.	Lack of accommodation, adjustments and management routes for engineers that are neurodiverse.
	Limited pay and progression opportunities in some engineering sectors compared to the finance sector.
	Lack of recognition as a skilled professional (relating frustrations around the lack of protection of the title of 'engineer').

Table 7: Drivers and detractors to recommending engineering as a profession to others

acutely, a severe case was shared concerning work-related stress and burnout, which reportedly led to an engineer ending their own life.

Attrition

This section examines the findings concerning engineers leaving their workplace and/or the profession. In particular, we explore if their experiences of the culture might be relevant.

When asking participants if they are considering leaving engineering, a majority of respondents (75%) replied "no," but slightly more than one in ten stated they did plan to quit the engineering field (outside of retirement) in the coming year

> "My brother-in-law was an engineer and he like many in the sector crumbled under the pressure of a particularly stressful turnaround event. You end up working 80-hour weeks and night shifts to get the job done. It ran into delays and he didn't end up coming back home one day after committing suicide. I also found myself having to pay for stress management counselling after one of these projects too"
>
> **Engineer, Oil & Gas, White, Man**

with a further one in ten reportedly undecided. Respondents aged 18 to 24 were more likely to indicate they intend to quit engineering (21%) than those aged between 35 and 44 (14%) and 45 and 54 (11%).

Respondents who identify as transgender and/or who have a trans history (n=44) were more likely to say they plan to leave the engineering profession in the next year (52%). Although this comprises the outcome from the answers of only 44 people, it is a stark statistic and indicates there is more action to be undertaken to ensure the retention and success of the trans community within engineering. Further interrogation into the experiences of underrepresented groups' career trajectories, attrition and intentions may help develop actions to prevent loss of talent from the profession.

Career progression

When respondents were asked a range of statements relating to progression and development within their organisations, 84% agreed the business priorities are clear and 84% reported receiving support for learning and development. 62% of participating engineers reported that the promotions process is fair, along with seven in ten agreeing there is a glass ceiling effect for engineers. However, disaggregating the data by protected characteristic gives cause for concern that there is work to do on fairness. Respondents that did not identify with any protected characteristics (71%) typically agreed that recruitment and promotions processes were fair and felt involved, when compared to respondents from underrepresented groups, including women (52%), Black, Asian or minority ethnic (60%), LGBQT+ (56%), and disabled (57%).

During the qualitative research, there was a reported increase in awareness of D&I within a range of organisations, however, the notion of 'culture fit' arose as an emerging theme. If participating employees did not 'fit' into the culture of an organisation and fully embrace the values and ways of working, they were more likely to feel excluded. This exclusionary practice was more commonly reported by engineers from underrepresented groups, several of whom described this inhibiting their progression and as an enabler to leaving the profession. The qualitative findings referred to the masculine cultures as a barrier to retention and success, which resulted in women reportedly having to tone down their femininity with regards to attire and behaviours. Black, Asian and minority ethnic engineers described their experience of the culture as centred around 'white middle-class British males' and said this can sometimes be a barrier to seeing themselves fitting into the culture.

The 'glass ceiling'[22] was reported by participants who noted that there were strong drives to increase diversity among entry-level employees, rather than promote staff from underrepresented groups beyond middle-management into senior leadership opportunities. There was a view from some participants that organisations have a lower tolerance for increasing diversity when looking across organisational hierarchies.

Underrepresented participants reported facing unique barriers, particularly with regards to self-promotion as a lever for career progression. Women engineers who venture to provide workplace feedback reported being perceived in a negative light as "moaning" and "nagging," in contrast to male participants' approach to feedback being perceived in a positive light. Black, Asian and minority ethnic participating engineers described being perceived as 'too assertive' or not being taken as seriously when participating in professional conversations as their white counterparts.

Engineers that disclosed they have a disability described experiencing barriers to their career progression. They described feeling that they couldn't disclose their disability due to a fear this would prevent them from progressing. Some participants reported that after disclosing their disability during health and safety assessments, they found themselves placed in different jobs or having their contract terminated where adjustments could not be made. Those that disclosed they were neurodiverse expressed reluctance to share any formal diagnosis due to fear this would prevent them from progressing. The experiences of engineers living with a disability requires further investigation to ensure necessary actions and interventions are developed to support the community's retention and success.

Has D&I changed in engineering?

Diversity refers to whether a single profession or workforce is representative of the wide variety of people, characteristics, backgrounds, and identities that exist in wider society. The findings presented throughout this commentary are the participants' perceptions of diversity across the engineering community. We note that diversity and representation can be monitored

through workforce data, with organisations such as EngineeringUK regularly reviewing diversity within the industry.[23] While diversity is not a clear indicator of an inclusive culture, the two are interconnected in that diversity thrives when we work towards inclusive cultures. In order to unpack this further, respondents were asked if they think that diversity in their organisation has improved over the past year, and three quarters think that it has. However, just over one in ten said 'not at all' with the same proportion saying, 'don't know'.

Through exploring intersectional data, the evidence highlighted that respondents who identified as both LGBTQ+ and Black, Asian or minority ethnic, and those with a disability and who are Black, Asian or minority ethnic agreed that diversity had improved in engineering (87% and 88% respectively). These findings may reflect the increasing role of positive action policies and programmes that enable the retention and success of underrepresented engineers.

From the qualitative insights, respondents reflected on some of the mechanisms that they perceive to have helped to improve diversity across engineering. Examples included organisations setting positive action recruitment targets with a focus on gender and ethnicity; reporting on pay gap analysis (noting this is only mandated for gender for organisations with a headcount of 250 or more); and efforts to try to take some of the opportunities for bias out of the recruitment process (for example removing names and where candidates attended university).

> "I found that when I was in France at university there was a much greater mix in terms of ethnicity and background when doing the courses, so it was a real shock to me to start working in the UK to find pretty much only white, middle-class engineers here"
>
> **Engineer, Biomedical Engineering, Asian, Man**

Evidence highlighted that respondents who identified as both LGBTQ+ and Black, Asian or minority ethnic, and those with a disability and who are Black, Asian or minority ethnic , agreed that diversity had improved in engineering (87% and 88% respectively)

Respondents were asked how seriously they felt their organisation takes issues around D&I:

- Views were mixed with three in ten saying 'very seriously' or 'seriously' and a third saying 'somewhat seriously'.
- Less than one in ten say diversity is not taken seriously at all.
- Respondents from underrepresented groups feel that diversity is taken less seriously than those who form the majority of the profession.

In particular, respondents from underrepresented ethnic/racial and socioeconomic groups described being shocked by the lack of diversity in a country where there is a highly diverse population.

Respondents reported that the engineering profession is slowly but progressively becoming more diverse. However, there was a sense that a truly reflective diverse workforce is a longer-term outcome. In particular, gender disparities were felt to be the area of most concern in most industries. Where some industries were perceived to be more ethnically diverse, they were noted to not actively recruit from the local Black, Asian and minority ethnic population, even when organisations had sites based in places with high levels of underrepresented groups in the community.

Summary

The below points summarise the key insights from this section of the commentary concerning retention and success within engineering:

- Engineers are generally proud about the profession they work in, and are eager to promote the career to others, however they are less positive about promoting their places of work.
- There were several drivers for recommending the profession, including working in a role that allows you to make tangible differences, however, issues around microaggressions and harmful banter serve as forces of exclusion in the profession.
- While most respondents replied that they were not considering leaving the profession within the next year, younger respondents and respondents with trans histories were more likely to indicate they were considering leaving engineering.
- Engineers from underrepresented groups are more likely to feel that progression processes are unfair with reports that, while they can find entry-level roles, they are struggling to progress.
- Engineers living with disabilities said they fear that disclosing their disability would impede their career progression.

Respondents reported that the engineering profession is slowly but progressively becoming more diverse

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Conclusions

The research reveals that, across the engineering community, there are micro-climates of inclusion that have improved since the 2017 report. However, progress has not been as quick as participating engineers would like. This is due to continuing drivers of exclusion and cultures within the engineering community.

There are moral, ethical, and productivity imperatives for inclusive cultures. The sense of belonging and inclusion that engineers feel can enable more engagement with the profession and continue to help address the current skills and workforce shortages. As highlighted in the Academy's 2020–25 strategy, inclusive cultures can help harness the power of engineering to build a sustainable society and an inclusive economy that works for everyone. In sharing this commentary and our recommendations, we hope to support organisations and the profession to take action to grow inclusive cultures. In turn, we are optimistic that engineers will stay in the profession and thrive in their careers.

Engineers reportedly felt that the pandemic and social movements have encouraged more flexibility in ways of working in the profession and allowed them to engage in difficult conversations about racism, Black Lives Matter, gender-based harassment, and other forms of discrimination. However, inclusive cultures within engineering have not been able to fully thrive due to the continuing prevalence of 'macho' cultures, bullying, harassment, microaggressions and other forms of discrimination that disproportionately and adversely impact underrepresented groups. Engineers report that these adversities are negatively impacting their career development, progression, and wellbeing, with reports of underrepresented groups leaving their job and, in some cases, of engineers leaving the profession as a result.

While organisations are being proactive to diversify entry-level talent, evaluating these initiatives was out of scope for this research. The perception has been that these efforts and actions are not addressing the barriers that underrepresented groups face in progressing beyond middle-management into senior leadership roles, which are reported to be predominantly held by white middle-class men. This can mean that there is a lack of role models from underrepresented groups who can support the attraction and retention of diverse talent across the engineering community. The perceptions of inclusive cultures vary in different working environments. From the research we found that D&I was more common in larger organisations and for those in office environments. However, macho cultures still pervade in these spaces and can hamper the growth of an inclusive culture.

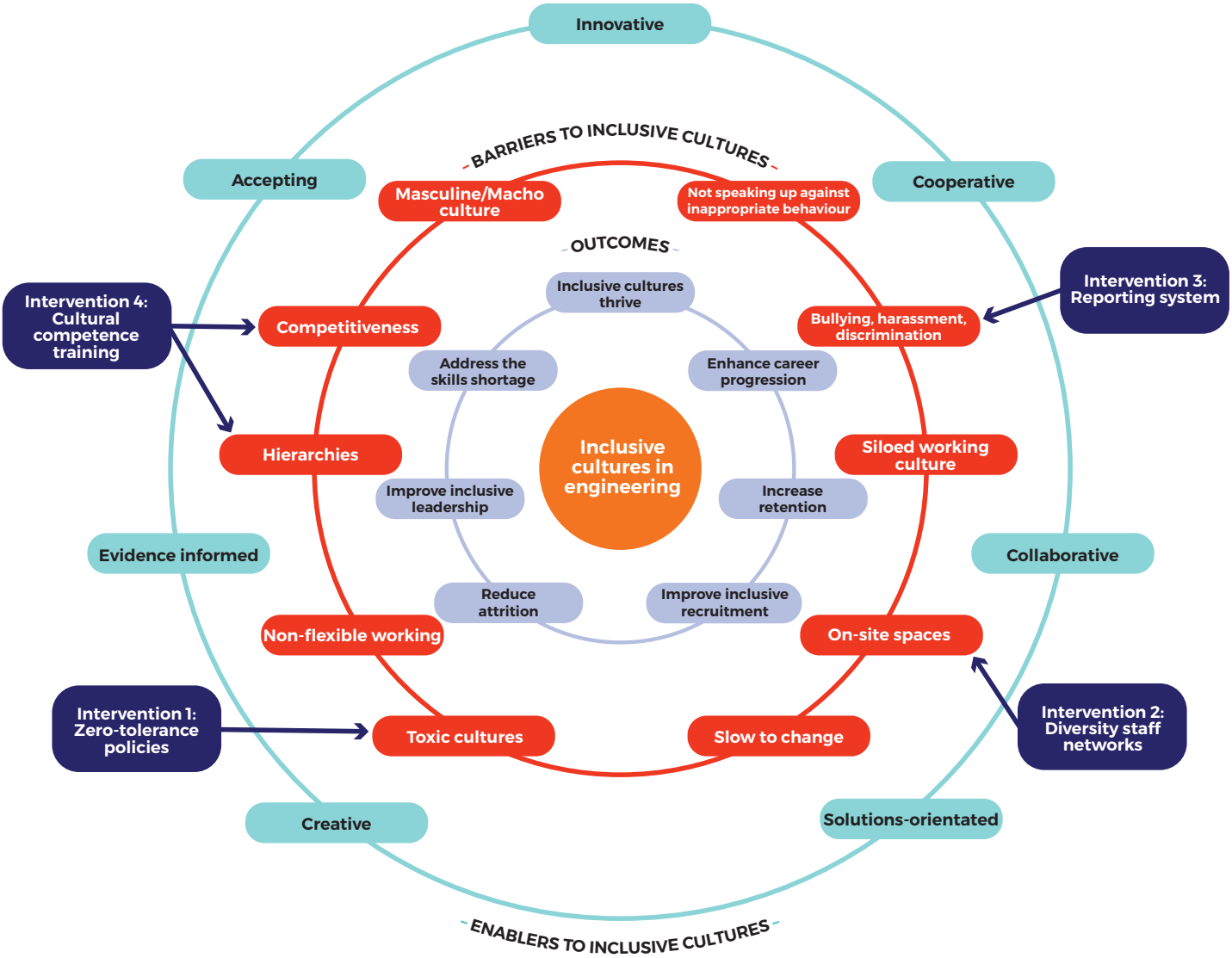
While participating engineers felt that inclusion has improved, there was a clear theme that the profession and employers have been, and continue to be, slow to change. In particular, it was noted that if the profession and employers do not address the lack of impetus to challenge negative stereotypes, assumptions and adverse experiences of underrepresented groups, – particularly women, LGBTQ+ engineers, Black, Asian and other minority ethic engineers, those identifying as Muslim, and those with a disability – will continue to lose momentum on increasing diversity in an effort to address the skills shortage.

Organisations and institutions within the engineering profession continue to make courageous commitments to D&I. The research indicates that these have influenced, socialised, and raised awareness of D&I among engineers. Many participants recognised that inclusive cultures play a significant role in attracting and

retaining engineers. It was also acknowledged that investing in retention will mitigate against attrition in organisations and the profession, and particularly the loss of those from underrepresented groups who continue to have experiences that impact on their ability to be their authentic self. The continuous increase in inclusion can only be sustained and accelerated if causes of exclusion and cultural barriers are robustly and efficiently addressed.

Throughout this commentary and the research, the evidence has highlighted different facets of what an inclusive culture of engineering looks like along with the values and behaviours that can act as enablers or barriers to achieving it. These have been presented as schematics throughout the commentary to visualise the findings. The schematic below (Schematic 4) outlines the enablers of inclusive cultures that pertain to innovation; acceptance; evidence-informed; solutions-orientated; collaboration; and creativity. However, barriers to inclusive cultures remain in engineering and these can adversely impact outcomes concerning career progression, success, and retention, to name a few, and can prevent the achievement of inclusive cultures.

Interventions that directly address these barriers can facilitate progress towards inclusive outcomes and cultures in engineering.



Schematic 4: Representation of enablers, barriers and outcomes for inclusive cultures in engineering alongside exemplar interventions

Recommendations

As with the first Inclusive Cultures report, this research recommends ways in which the engineering community can nurture and grow inclusive cultures for the future. We recognise that there is no single 'right' answer to this multi-faceted challenge. However, the research and our commentary invite the profession to engage with a diverse range of perspectives from a variety of engineers, engineering institutions and organisations, as it continues on its journey to inclusion.

Our recommendations for the engineering profession to cultivate a more inclusive future are grouped under four themes, based on feedback from the engineers who participated in this research. Recommendations are made to the engineering community as a whole with some recommendations more suited to engineering industry, organisations, and bodies.

Improving inclusive cultures

The following recommendations highlight actions engineering organisations can take to enable and accelerate the growth of inclusive cultures across engineering. These include:

Recommendation	Who
Ensuring that some of the cultural issues in engineering (as shown earlier) are properly addressed to encourage and retain staff from underrepresented backgrounds. This means developing diligent interventions, raising awareness and taking actions that address some of the drivers of exclusion at play (including tackling mickey-taking, competition, siloed working, and slowness to change). For example: zero tolerance policies on bullying and harassment, racism, Islamophobia (to name a few); regular place-based training (focusing on professional practice in different engineering environments) that can help ensure that all engineers are respected in the workplace; testing, co-producing, and innovating ways of working with the engineering community to ensure all engineers can engage with their professional practice.	PEIs; employers
Socialising clear and honest guidance on inclusive behaviours and relationships. In particular, employers could invest in facilitating conversations about the types of behaviours that exclude underrepresented groups to enable professional learning. This guidance should include learning on the impact of microaggressions.	PEIs; employers; engineering bodies
Assign budgets and resources to organise D&I events, taskforces, and support groups to enable sustainable impact. These could also be in the form of D&I networks and ally groups to encourage inclusive cultures in the engineering community.	Employers
Develop resources, guidance, and training on empowering engineers to speak out and take a stand against inappropriate behaviours. This could form part of allyship training and capacity building to help tackle these exclusionary behaviours (for example banter and mickey-taking that are associated with masculine and macho cultures).	PEIs; employers; engineering bodies

Nurturing belonging

The evidence highlighted that underrepresented participants had a lower sense of belonging within the engineering profession, and more can be done to enable individuals to bring their authentic self to work should they wish to.

Recommendation	Primary audience
Make a proactive effort to celebrate and encourage diversity, including embracing different attitudes, working styles and ways of communicating, to enable underrepresented groups to feel a sense of safety and belonging in professional spaces. For example, regular communications raising awareness of employee resource groups/equality networks, and resourcing and sponsorship of staff groups, can ensure they maintain their position in organisations.	Employers
While D&I is a collective responsibility, organisations should invest in D&I personnel to take on the responsibility of leading, managing and co-ordinating groups and activities so that the responsibility does not fall on underrepresented staff with other full-time duties. This must be underpinned by organisation and company leaders who show a commitment at senior levels to D&I.	PEIs; employers; engineering bodies
Engineering industry bodies can publish their diversity of representation and data within their own organisations, particularly within leadership teams, through reviewing professional development initiatives and membership requirements. Continuing guidance should be provided by engineering bodies to support members and fellows who feel they are struggling to enter the profession and those looking to leave the profession due to exclusion.	PEIs; engineering bodies

Tackling bullying, harassment, and discrimination

There was a range of examples of bullying, harassment, and other forms of discrimination experienced by underrepresented groups. For example, participants reported issues of sexism, harassment, racism, homophobia, and ableism, and the research showed that engineers were not always confident in reporting experiences of harassment and discrimination.

Recommendation	Who
Organisations should consider the scoping and development of a safe and diligent reporting system for underrepresented groups to raise concerns, with a view to incorporating clearer guidance on systems that support the reporting of microaggressions. There is a need for reporting systems to have transparent processes; for those reviewing queries to be representative of the community; to co-create mechanisms for accountability; and to ensure that all parties are supported in the process. Further investigation and examination of current reporting and support models and frameworks may be required as a pre-cursor to this.	Employers; PEIs
Engineering bodies should continue to socialise, professionally develop, and support engineers to learn about the value of inclusive cultures while developing guidance on behaviours that are exclusionary, can affect underrepresented groups' sense of self, and inhibit the growth of inclusive cultures. This should inform allyship training to ensure that those who are not engaged with D&I are still able to develop inclusive behaviours and build confidence in addressing microaggressions.	Engineering bodies; PEIs; employers
Further actions can be taken to strengthen the relationship between inclusion and the role of safety in engineering. For example, the role of inclusion could be incorporated and mandated as part of health and safety training. Organisations can leverage the practice of safety to further incorporate inclusion and psychological safety .	Employers; PEIs

Improving retention and success

In the key findings we presented data that explored the need for diversity in engineering to address the skills shortage. The recommendations below are aimed towards retaining and developing underrepresented groups in engineering:

Recommendation	Who
Engineering employers should set up sponsorship, mentoring, and reciprocal mentoring schemes for underrepresented staff to support career progression beyond entry- and mid-level positions. For example, co-producing interventions and strategies that offer support and resources to improve the retention of young people and those who identify as trans or have a trans history in the engineering community.	Employers; PEIs
There is a need to develop the engineering community's confidence in recommending the profession to others. Specifically, organisations and bodies could do more to showcase the progress they are making with regards to inclusion to provide engineers with confidence they are recommending an increasingly inclusive profession to others. This would build on public engagement initiatives being delivered by PEIs and others.	Engineering bodies; PEIs; employers
Develop line managers' cultural competence and mandate inclusion training and capacity building through performance objective settings and appraisals.	Employers; PEIs
Employers should interrogate and report their diversity data at all levels and roles to ensure that any data are not inflated by those in non-engineering roles, while sharing good practice on ways to sensitively disclose diversity data to the engineering community.	Employers; PEIs

Further research

As highlighted, the scope of the research was limited in some ways, which meant further analysis and investigation was not possible. Throughout the research, we identified a number of areas that warrant further investigation:

- While this was not identified in the remit of the research, we acknowledge and recognise that sexual harassment is often attributed to masculine and macho cultures. Further research within the engineering community in this area could explore these links in more detail.
- We recognise that child and adult care roles are influenced by gender, and further research can explore how gender and caring shape engineers' experiences of inclusive cultures.
- There were key findings identified from the qualitative research that connected to masculinity and machoistic cultures in engineering. However, further investigation in this space is needed to understand the roles gendered cultures and masculinity play in engineers' recruitment, retention, and success.
- The qualitative research identified explicit cases of Islamophobia present in engineering and requires further investigation beyond the scope of this commentary and research.
- The qualitative research highlighted the need for further investigation and action to address mental health and wellbeing in relation to inclusion within the engineering community.
- Further investigation on the drivers behind why some characteristics and underrepresented groups have been accounted for more than others could help tackle a hierarchy of inequalities.

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Annex

Demographics (Respondents could identify across multiple characteristics and select multiple options)	**Responses**	**%**
Gender	Men	59%
	Women	37%
	Non-binary/Self-describe	2%
	Prefer not to say	2%
Are you trans or do you have a trans history?	No	94%
	Yes	3%
	Prefer not to say	3%
Nationality/ethnicity	UK National	90%
	White	75%
	Asian/Asian British	8%
	Black/Black British	4%
	Mixed/multiple ethnic group	3%
	Prefer not to say	1%
	Non-UK national	9%
	Europe (excl. UK)	5%
	Asia	1%
	Africa	1%
	South and Central America	1%
	North America	<1%
	Middle East	<1%
	Oceania	<1%
	Prefer not to say	1%
Age	18–24	8%
	25–34	25%
	35–44	26%
	45–54	18%
	55–64	12%
	65+	5%
	Prefer not to say	6%

Sexual orientation	Heterosexual	81%
	LGBTQ+	15%
	Asexual	3%
	Bisexual	6%
	Gay man	3%
	Gay woman/lesbian	1%
	Queer	1%
	Pansexual	1%
	Self-describe	1%
	Prefer not to say	4%
Disability (physical and/or mental)	No	81%
	Yes	16%
	Prefer not to say	3%
Experience barriers or limitations in day-to-day activities related to any disability, health conditions or impairments	No	77%
	Yes	20%
	Prefer not to say	2%
Caring responsibilities	No	71%
	Yes	27%
	Childcare	18%
	Adult care	6%
	Both child and adult care	2%
	Prefer not to say	3%
Type of school attended (11–16)	UK state	60%
	UK independent	13%
	UK state selective	11%
	UK other	2%
	School in a country outside of the UK	12%
	Prefer not to say	2%
Parents or guardians completed a higher education degree course?	No	57%
	Yes	39%
	Don't know	3%
	Prefer not to say	2%
Parents or close family work in the engineering profession	No	52%
	Yes – men	40%
	Yes – grandparent	9%
	Yes – women	8%
	Yes – other	4%
	Prefer not to say	2%

	Characteristics					Total (participants)
Data Collection	**Men**	**Women**	**LGBTQI+**	**Black, Asian, minority ethnic**	**Persons with disability(ies)**	
Interview*	7	5	5	6	0	100
Focus Group**	25**	25	5	11	13	50

*50 individual depth interviews with participants who self-identified as being in one or several of the following characteristic groups.
**26 focus groups with an average of three to four participants in each group.

Intersections (respondents could identify across multiple characteristics and select multiple options)	Characteristics			
	Men	**Women**	**Non-binary**	**Prefer not to say**
LGBTQ+	127	107	0	0
LGBTQ+ & Black, Asian and minority ethnic	25	18	3	0
LGBTQ+ & White	87	80	11	3
Trans	21	13	7	0
Heterosexual & Black, Asian and minority ethnic	102	59	0	0
Heterosexual & White	578	335	1	0
Black, Asian and minority ethnic	127	81	6	0
White	677	423	14	5
Disability	177	50	0	0
Disability & Black, Asian and minority ethnic	33	24	3	0
Disability & White	126	128	10	2
Disability & LGBQT+	54	50	10	2
Disability & Heterosexual	121	115	1	0

Table 1: Representation of sample in relation to intersecting characteristics.[24]

Firmographics	Responses	%
Region mostly worked in	England	85%
	Scotland	7%
	Wales	3%
	Northern Ireland	2%
	Across the UK	4%
Number of employees	Small (1–49)	20%
	Medium (50–499)	34%
	Large (500+)	47%
Job level/grade	Intern	3%
	Apprentice	5%
	Graduate	14%
	Non-management	36%
	Management	28%
	Senior management	14%
Years post qualification experience	Less than 2 years	11%
	2–5 years	16%
	6–10 years	20%
	11–15 years	14%
	16–20 years	10%
	Over 20 years	30%
Main job location	Office based	43%
	Manufacturing	20%
	Home based	15%
	Site/field based	11%
	University	7%
	Offshore	2%
	Other	2%
Do you work flexibly?	Yes	69%
	No	29%
	Prefer not to say	2%
Engineering affiliations	I am a member of a professional engineering institution at any grade/level	60%
	I am a registered engineer	57%
	I belong to an engineering network outside work (social or professional)	44%
	I belong to an employee network at work linked to diversity	38%

Table 2: Firmographics from the quantitative sample.

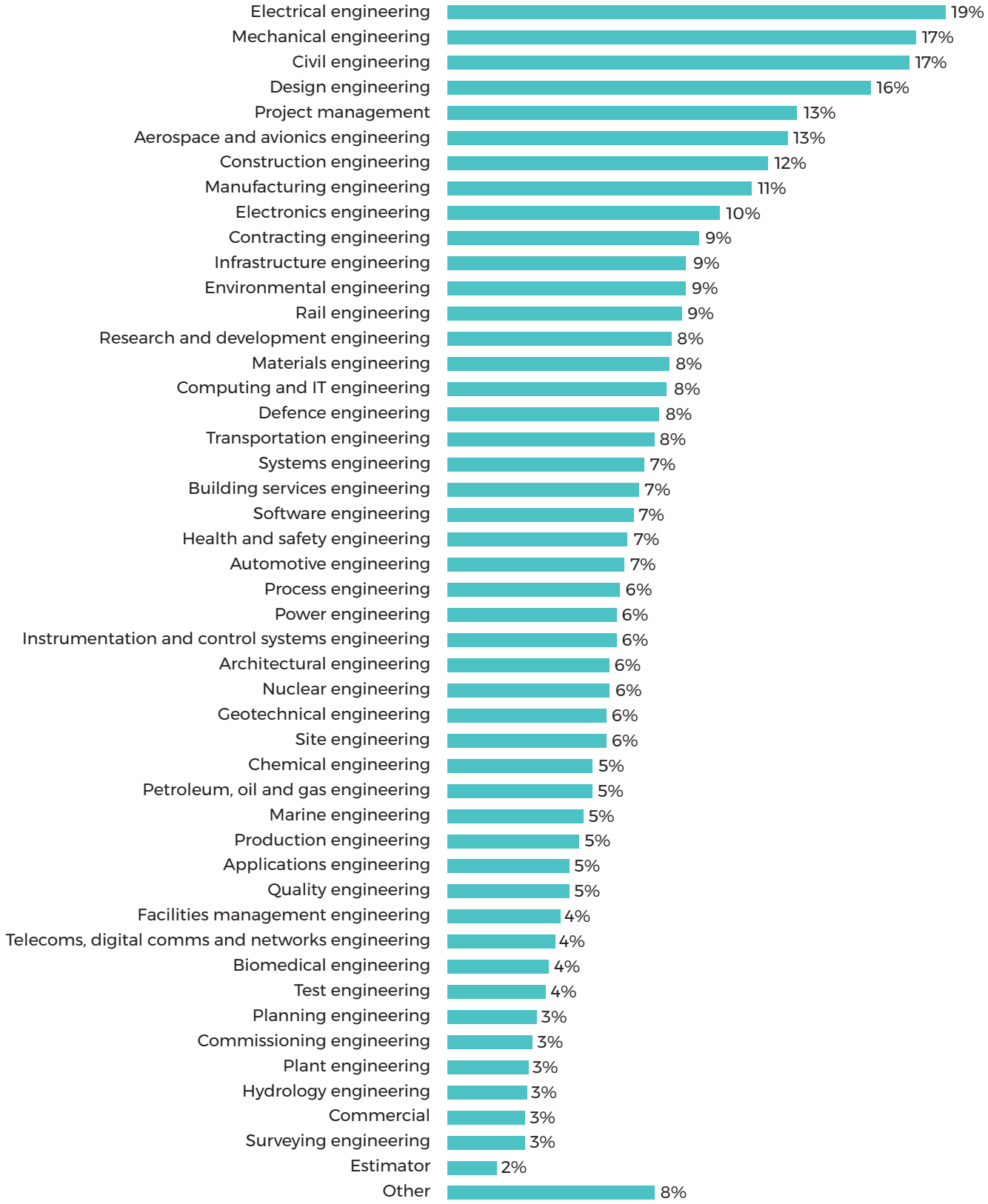

Figure 1: Engineering disciplines.[25]

References

1 EngineeringUK Trends in Employment 2021

2 Mission Zero, Independent Review of Net Zero Rt Hon Chris Skidmore MP

3 www.britannica.com/topic/Black-Lives-Matter

4 www.djsresearch.co.uk

5 While this commentary builds on the narrative of the 2017 inclusive cultures report, it is important to note that the sample and approach were different to that of the 2017 report, and so a full comparison of findings is not possible.

6 Further breakdowns of individual and intersecting demographics are presented in Annex 1.

7 Men engineers are more likely to say creative (43%), fun (16%) and innovative (47%), compared to 28% of women who said creative, 11% who said fun, and 37% who said innovative.

8 Women engineers are more likely to say hierarchical (31%), siloed (19%) and slow to change (40%), compared to 19% of men who said hierarchical, 14% who said siloed, and 24% who said slow to change.

9 As noted in *Women in engineering: A qualitative investigation of the contextual support and barriers to their career choice*

10 www.sciencedirect.com/science/article/pii/B9780128192023000134

11 Data for Black, Asian and minority ethnic has been collated as a net score under the label of BAME.

12 1% (n=20) self-identified as a gay/lesbian woman.

13 3% (n=44) self-identified as asexual.

14 6% (n=83) self-identified as bisexual.

15 1% (n=14) self-identified as pansexual.

16 722 respondents self-identified as having no religion.

17 530 respondents self-identified as being Christian.

19 112 respondents self-identified as being either Buddhist, Jewish, Sikh, Spiritual or another religion of belief.

20 We note the potential for the research's focus on inclusive cultures to have influenced this ranking.

21 https://equalengineers.com/masculinity-in-engineering-report/

22 The 'glass ceiling' is defined as a metaphor that refers to the invisible barriers that act against the progression of underrepresented groups.

23 www.engineeringuk.com/research-policy/industry-workforce/workforce-trends/

24 Frequencies were not represented for those that self-described and participants were able to select multiple characteristics.

25 Respondents could select multiple options. Figure used from the DJS Research Report which can be found here https://raeng.org.uk/policy-and-resources/diversity-and-inclusion-research-and-resources/inclusive-cultures/creating-cultures-where-all-engineers-thrive

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