



**The future of
the engineering
and construction
workforce.**

KEYIS



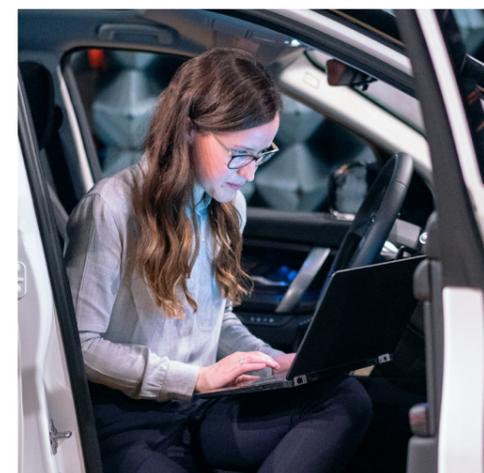
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It is important that we build an inclusive industry that fosters the right talent to engineer our future.

1 A brave new world for STEM

It seems that the engineering and construction industry is at the cusp of a new era, with tech start-ups creating new applications and tools that are changing how companies design, plan, and execute projects. In addition to this, these projects are becoming increasingly complex and thus, managers are facing increasing pressure to improve costs, timelines, and efficiency [1]. As we approach this new dawn for engineering, driven by advanced software, construction-focused hardware, analytics capabilities and innovative start-ups, it is important that we build an inclusive industry that fosters the right talent to engineer our future. Women earn about half of science and engineering degrees, but they make up less than 20 percent of people employed in those fields [2]. This is concerning, especially since there is also something of a talent shortage in the UK in terms of filling engineering roles. This has led over 150 world-leading engineers, scientists and technology giants to join forces to urge the UK government to help tackle this issue. This plea, signed by these industry leading individuals and figures such as; Major Tim Peake, Carol Vorderman MBE, will.i.am, and representatives from Rolls Royce, Vodafone and the MOD, is an appeal to the British Government to work together with educators, and the industry in general, to develop practical support for teachers to embed engineering in their existing science, technology, engineering and maths learning. The University of Manchester's rationale behind this, is that children eagerly learn about science and maths, but the connection to engineering - the link between these subjects, their purpose and application to the world in which we live - is not currently being made. In order to build an engineering workforce that encompasses the best of talent that a nation has to offer, it seems that one must ensure that there are clearer learning outcomes for these subjects linked to engineering [3].





2. The evolving landscape of construction and engineering

Reflecting on the last section's closing point, it seems that this supply shortage is worrying many industry leaders. Deloitte predicts that by 2025 around two million skilled manufacturing jobs will go unfilled. The American Society of Mechanical Engineers reveal that the majority of bachelor degrees obtained in the engineering discipline are in the fields of mechanical engineering and computer science. The least common are in more niche segments such as nuclear and petroleum. The society also projects the greatest increase of job creation for civil and mechanical engineers [4]. Perhaps, part of the staff shortage problem stems from a round peg, round hole approach. At a time where there is great disruption from innovative and enterprising firms and supply chains are under immense strain, it may be advantageous to break out of narrow career silos and invest in transferable skills, the professionals that do so, as per McKinsey, will be the people who unlock new possibilities for our planet [5]. In the light of recent energy supply issues, now is also a perfect opportunity to invest in low carbon energy generation. The ENGC, the UK's regulatory authority for the registration of Chartered and Incorporated engineers, made specific policy recommendations, urging the UK Government to seize the opportunity to develop global leadership both in low carbon energy in order to power a low emission industrial base, and the low energy processes that will make industry efficient and competitive. Their three pillars were to encourage the Government to; put in place

a stable, unambiguous and well communicated policy and regulatory framework, to give priority to research funding for low carbon technologies and to simplify and reduce barriers to market entry and costs of doing business [6]. It is vital that engineers are deployed to build new infrastructures that drive organisations and nations forward both to solve the problems of today and to unlock new possibilities for the future.

The engineering space is indeed changing and becoming increasingly digitised. There is a considerable increase in investment interest in construction-technology firms with such companies having garnered around \$10 billion in investment funding between 2011 and 2017 [1]. These budding startups can disrupt engineering supply chains and processes at any stage of a project, from the digital designing and pre construction stage to the actual construction endeavours and subsequent operations management of the project. As per McKinsey's research, plucky start-ups are most likely to develop tools and solutions to disrupt the construction phase, with around 1,000 companies offering innovative products to impact organisations at that stage. There are many significant use cases for innovation within this phase, including those related to enterprise resource planning systems, which are used throughout the construction industry. This is contrasted with fewer than 200 companies creating products for the design, preconstruction, or operations and management phases [1]. In addition to

this, the same research indicated that, whilst between 2011 and 2016 construction tech players received the greatest amount of venture capital for document, equipment and resource management services, more recently, performance management and productivity tech has caught the eye of investors [1]. Therefore, it seems that the capital flooding into the E&G space is focused on streamlining operations and the use of supplies whilst facilitating the shift of decision making processes more towards data governed management approaches. Perhaps this sudden influx of capital into making engineering and construction more efficient has been accelerated by the bottleneck of talent entering the profession, that is not growing inline with the demand for such individuals.

Hayaatun Sillem, CEO of the Royal Academy of Engineering, in a recent interview, discusses an overemphasis of the distinction between the physical and the digital, between manufacturing and services in engineering. Sillem also acknowledges that engineers inherently work with considerable crossovers of such mediums, as they indeed deliver and facilitate our digital economy, since the software that governs so much of our lives and the hardware that we use to interact with that software, is all engineered. Indeed, E&G and manufacturing firms are increasingly relying on digitisation, as was made clear by the aforementioned stream of capital into digital solutions, whether this

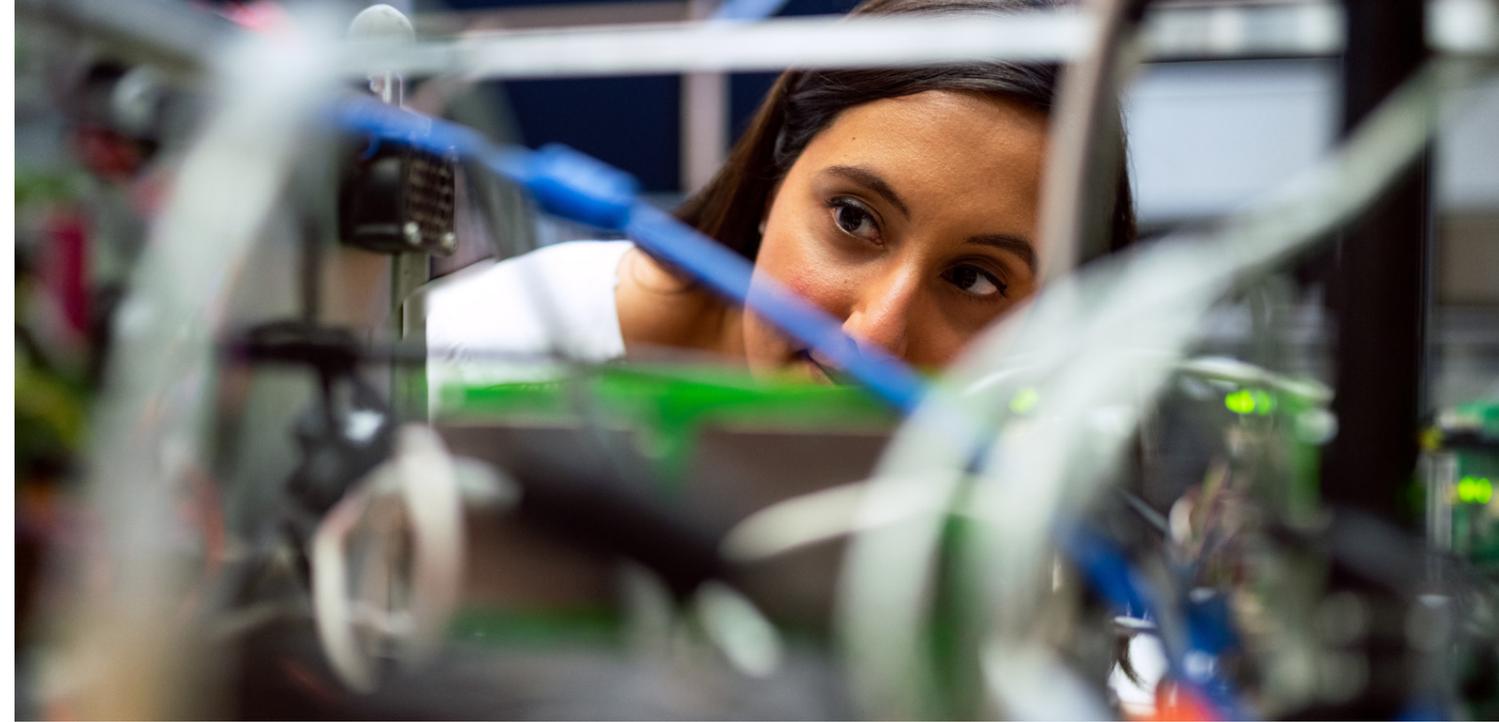
consists of more efficient office software or incredibly advanced digital twinning technology [5]. Sillem also discusses the pertinence of the servitization of engineering, with manufacturers shifting their business models away from product sales, to services based around these products. Whilst this is very much a trend across all industries, Sillem outlines that it is rather significant for the engineering sectors as such changes likely require significant overhauls of existing management processes [5]. It appears that all engineers are gradually becoming digital engineers in some shape or form, with increased digitisation of E&G, and as per Sillem, such moves, like a switch to servitization, have brought various benefits including a more sustainable approach to engineering and construction. Such switches and a focus on efficient use of supplies allows one to manage factors such as ensuring the retention of responsibility for a product, throughout its life cycle, instead of launching a product and relinquishing all worries about what happens to the said product beyond that launch. Thus, it seems that the future of engineering and construction is in the hands of.... well.... the engineers and constructors. It is up to forward thinking individuals to enter these industries, to innovate and to shape our future, with sustainability and inclusivity at the heart of decision making processes, as we strive to make our planet a better place, for everyone.

3 Who is our engineering future?

“Women are severely underrepresented in the industry with just 12% of those working in engineering being female.”

With the current talent shortage in engineering, it begs the question, who is going to build the future of this important industry? Well, if we are indeed to make a concerted effort to build for the future, in the right way, a fantastic start would be to ensure fair representation and the hot topic in engineering is of course the infamous male hegemony across STEM industries. As per *Engineering UK*, women are severely underrepresented in the industry with just 12% of those working in engineering being female, compared with 47% of the overall UK workforce [7]. This of course begs the question, what is the root of this problem? Harvard Business Review discusses how, for decades, in an attempt to tackle this issue and to attract more women to the field, engineering educators have focused on curriculum reform, for example by making a conscious effort to promote girl's interests in STEM subjects. Whilst these efforts have brought in more women to study engineering, the problem is that many leave the field during or after their education. This indicates that a focus purely on education does not address the fact that women tend to leave the profession at a higher rate than men.

Harvard cites that women make up 20% of engineering graduates, but it's been estimated that nearly 40% of women who earn engineering degrees either quit or never enter the profession [8]. Perhaps the problem lies both at a university level and in the field. As we mentioned before, whilst women earn around half of science and engineering degrees, they account for less than 20% of those employed in the field. In addition to this, many women that choose this career path often find that they are the only person of their gender in a room [9]. Looking at this, it is possible that women in engineering may suffer from the lack of female role models in the industry. One McKinsey article discusses the particular importance of workplace sponsors, a role different but not too dissimilar from mentorship. Although one can fill both roles, it appears important that a sponsor understands that their role is to not only offer advice, as a mentor would, but also to advocate for opportunities and shepherd someone in early tenure toward their goals. It seems that a successful sponsorship is all about personal chemistry [9].



This notion of a lack of female engineering role models is somewhat translated into a workplace culture that perhaps is not very inclusive. Harvard Business Review's research indicates that whilst female students do as well or better than male students in school, once in the workplace, they often point to the hegemonic masculine culture of engineering itself as a reason for leaving [8]. When considering that the focus regarding the fixing of these problems, was placed on female's education, when taking into account the male hegemony in the field, perhaps a focus on the education of young males in STEM and the need to foster a culture of inclusivity and collaboration, would go some way to building more modern and representative work spaces in the industry. There has no doubt been genuine efforts to bring more women into STEM, especially in the realm of new hires and conscious focus on greater equality in executive roles but organisations may be lacking in another critical realm, career advancement and promotions [10]. Worryingly, the gender gap for women in technical roles seems to be more pronounced, with only 52 women being promoted to manager for every 100 men as indicated by McKinsey research. Diversity and representation is particularly important in STEM roles as to help “debias the technologies that make up an ever-present and evolving component of modern life” [10]. As we have discussed throughout this report, it is up to those entering E&G and other STEM industries to shape our future as these people will be the ones who literally build and engineer our world and its new possibilities.

Beyond moral reasoning for fair hiring and career progression, McKinsey research has shown that, unsurprisingly, there is a strong relationship between diversity on leadership teams and the likelihood of financial outperformance for companies against their less inclusive rivals, with the most gender-diverse companies being 48 percent more likely to outperform the least gender-diverse companies fiscally [10]. Tech and engineering firms simply cannot thrive under a more archaic management style and must adopt governing principles suitable for our time. Firms must provide the routes to success for all of their talent, including the provision of valuable training and exposure to high growth projects. Even if an organisation has good intentions, if the firm is entrenched in a male dominated hegemony with existing sponsorship and mentorship arrangements, it is easy for women to have their career progress stalled, without leadership even realising. This is why leading companies can expand skill development beyond technical training, by offering resources such as sessions on how to prioritise career development and running programs that pair women with sponsors who can offer seniority, power, and influence to help those they are sponsoring meet their goals. In addition to this, effective networking groups and a formalised professional development process can build a culture of fair career progression and inclusion within STEM firms [10]. Again, whilst it is of course important that women have fair career progression in any sector, it is especially important in the likes of tech and engineering, as they are building the infrastructure of our increasingly digitised world. If women are not included in the building process here, then our planet's entire digital infrastructure will likely be inherently biased against them.



4 Engineering a fair future

As we develop this brave new world for engineering, construction and other STEM fields, it is the responsibility of business leaders to foster inclusive and collaborative workspaces that promote fair career progression for all. In our increasingly digitised world, it is vital that those who develop our infrastructure are selected from a representative talent pool as said infrastructure has major implications on most of our personal and working lives. Thus, we must ensure that our future infrastructures, and thus our future possibilities, are inherently unbiased. Harvard's research indicates that the reasons men and women enrol in engineering were extremely similar. Both groups cite being good in mathematics and science disciplines in secondary education and seeking interesting and well paid professional opportunities. However, interestingly, the research indicated that more often than their male counterparts, women added that they want to become socially responsible engineers, working to solve major problems and making a difference in people's lives, which is consistent with other research showing that women are significantly more likely than their male counterparts to be interested in engineering work that is "socially conscious" [8]. Therefore, whilst we should never pigeonhole a person to a role because of their gender, if business leaders provide infrastructure to allow women to thrive in tandem with their male counterparts, it is abundantly clear that organisations will flourish. The aforementioned research indicates that organisations with greater gender equality consistently outperform their competition that rank lower in such inclusivity, fiscally.

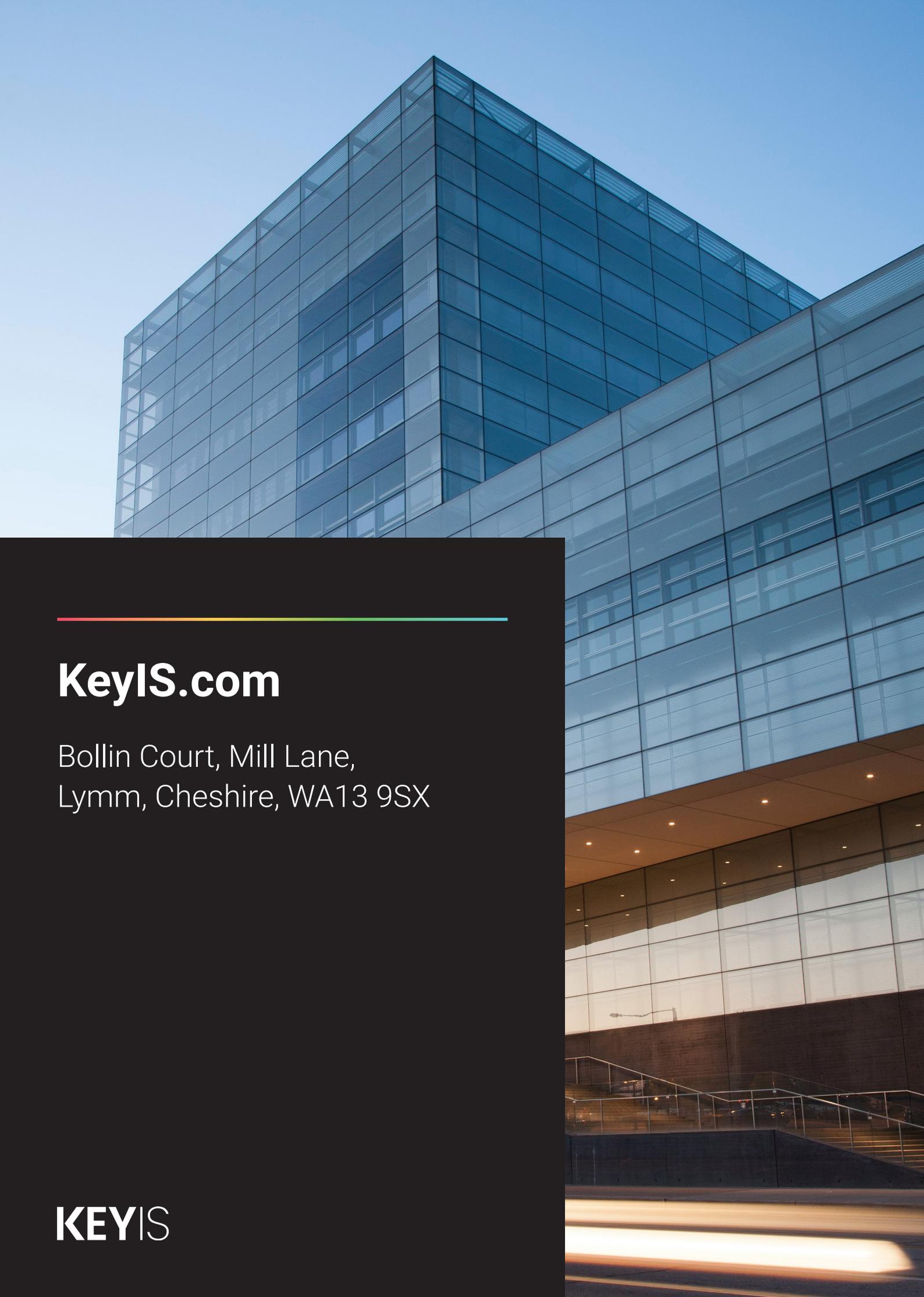
It is also incredibly important that business leaders do not unwittingly create uneven experiences for entrants into a business. Speaking to McKinsey, a new manager at a tech company, who had just received her second promotion, spoke about the stress of having to promote people for the first time. However, since her company provided extensive training and documentation to aid the creation of a strong case for the advancement of her team's members, she had the tools to help her to act as a successful sponsor for her own team [10]. This is why education and training in management is so important, as ill informed decisions can lead to erosion of a fair and inclusive meritocracy. Harvard's research also highlighted that women in engineering were much more likely to look to others to affirm, and reaffirm, their confidence as opposed to their male counterparts. However, whilst the men in the sample did talk about doubting themselves, they did not necessarily seek reassurance from others [8]. This indicates that building a more diverse and representative working environment also means fostering a more collaborative and supportive culture, which again can only benefit an organisation and represents one of the many reasons that businesses that rank highly in diversity and inclusivity within their workspaces consistently win against their rivals. Thus, as engineers, constructors and general STEM professionals, we must assume responsibility to carve out a fair and inclusive future. We must ensure that everyone across our organisations has equal footing and the equal opportunity to flourish. We must ensure that we build infrastructure both physical and digital that is inherently unbiased and finally, we must take collective ownership of our future possibilities and engineer a fair future for generations to come.



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