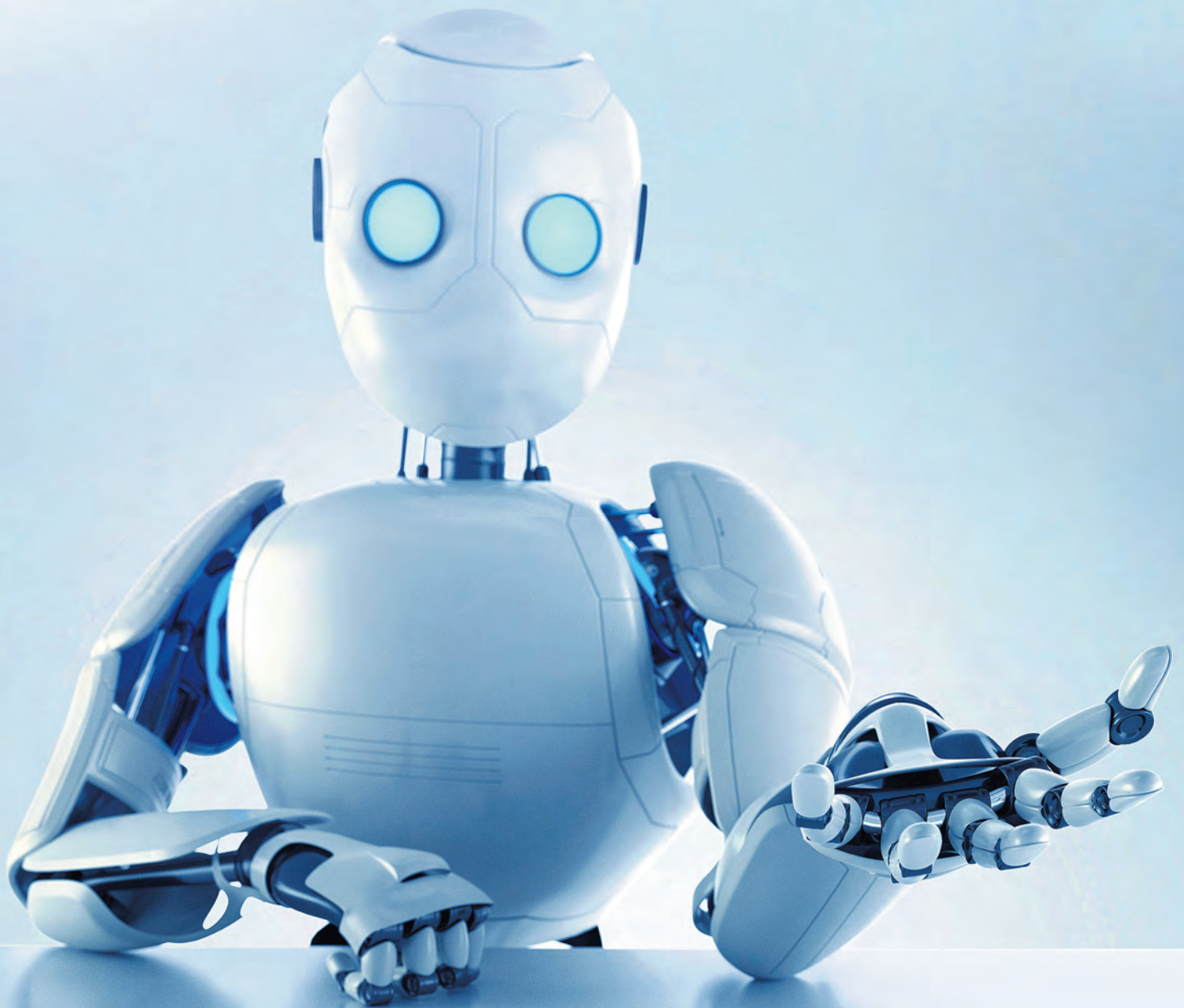


# Innovation in engineering

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Making the future move



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# A profession for the future

Engineers work on complex and fascinating projects for a huge range of companies across many sectors - and the already high demand for their skills will only grow, says **David Benady**

**M**echanical engineers keep the world moving. Their skills power the new generation of autonomous vehicles and the latest innovations in aviation. They are the brains behind transport networks, wind turbines and power generators.

No wonder demand for their skills is soaring. Engineering enterprises in the UK will need 265,000 skilled engineers and technicians each year until 2024, according to the Engineering UK 2017 report. Demand is exceeding supply - there is a shortfall of some 20,000 engineering graduates annually.

This is pushing up salaries. The average starting salary for a mechanical engineering graduate is between £21,800 and £28,100, according to graduate recruitment firm targetjobs.

Mechanical engineers work in the car industry designing and building car chassis, engines and transmission systems. They work in aerospace on jet engines and rockets, in computers

**Mechanical engineers are in high demand in the aerospace and automotive sectors**  
Getty

on hardware and in automation they design robotic systems. Biomedical engineers work on that most complex machine of all, the human body - taking on everything from prosthetic limbs to robotic surgery and surgical equipment.

A mechanical engineering degree opens the doors to working at a huge range of companies. Some of the UK's top mechanical engineering employers include Rolls-Royce, Jaguar Land Rover, Airbus, Dyson and Transport for London. The NHS employs many clinical and biomedical engineers.

Mechanical engineering degrees can be studied for three years leading to a B.Eng, or for four years, leading to a masters. Apprenticeship routes are also available, and can lead to higher qualifications or professional technician roles with the employer, or to achieving professional registration as an engineering technician (EngTech).

But employers are concerned that many young people are put off studying mechanical engineering by its reputation for being male and

associated with heavy industry. The industry is trying to attract more diverse candidates and increase the participation of women, who account for less than 10% of engineers.

Those working in the field speak highly of the variety, development, rewards and satisfaction that come with a career in the sector. Sean Brennan, a mechanical development engineer, says in an interview with the Royal Academy of Engineering: "Every day is different - engineering can be as simple as manufacturing the chairs you sit on or as complicated as building a space station."

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# How I got 'totally hooked' on robotics

**David Benady** meets a young engineer who has discovered her passion in a futuristic field

**K**atie Winkle is studying for a PhD in assistive robotics, designing robotic systems for caring roles, such as looking after older people. She graduated from a four-year mechanical engineering degree at Bristol University with a master's in engineering, an M.Eng.

"Growing up, I was interested in cars, in how machines work, stuff we can build using science in an applied way. My dad was a car mechanic and he encouraged my curiosity," she says.

She thinks a mechanical engineering degree is the key to a wide range of careers and experiences in engineering and beyond. Some students who graduated alongside Winkle got jobs in the finance industry, which is looking for problem-solving and

**Winkle hopes her research will help people achieve a better quality of life**

numerical skills. Others have gone on to engineering roles in the automotive and aeronautical industries.

Winkle took science A-levels plus maths, and originally wanted to study chemical engineering, as she thought it would be about inventing new materials. But she later found out that it is about building factories and chemical processes. "I switched to mechanical engineering because the more I read about it, the more I saw it really is one of the broadest types of engineering. All the fundamentals of engineering are there, so you could go into civil engineering afterwards or chemical engineering. It really is the broadest and oldest type of engineering."

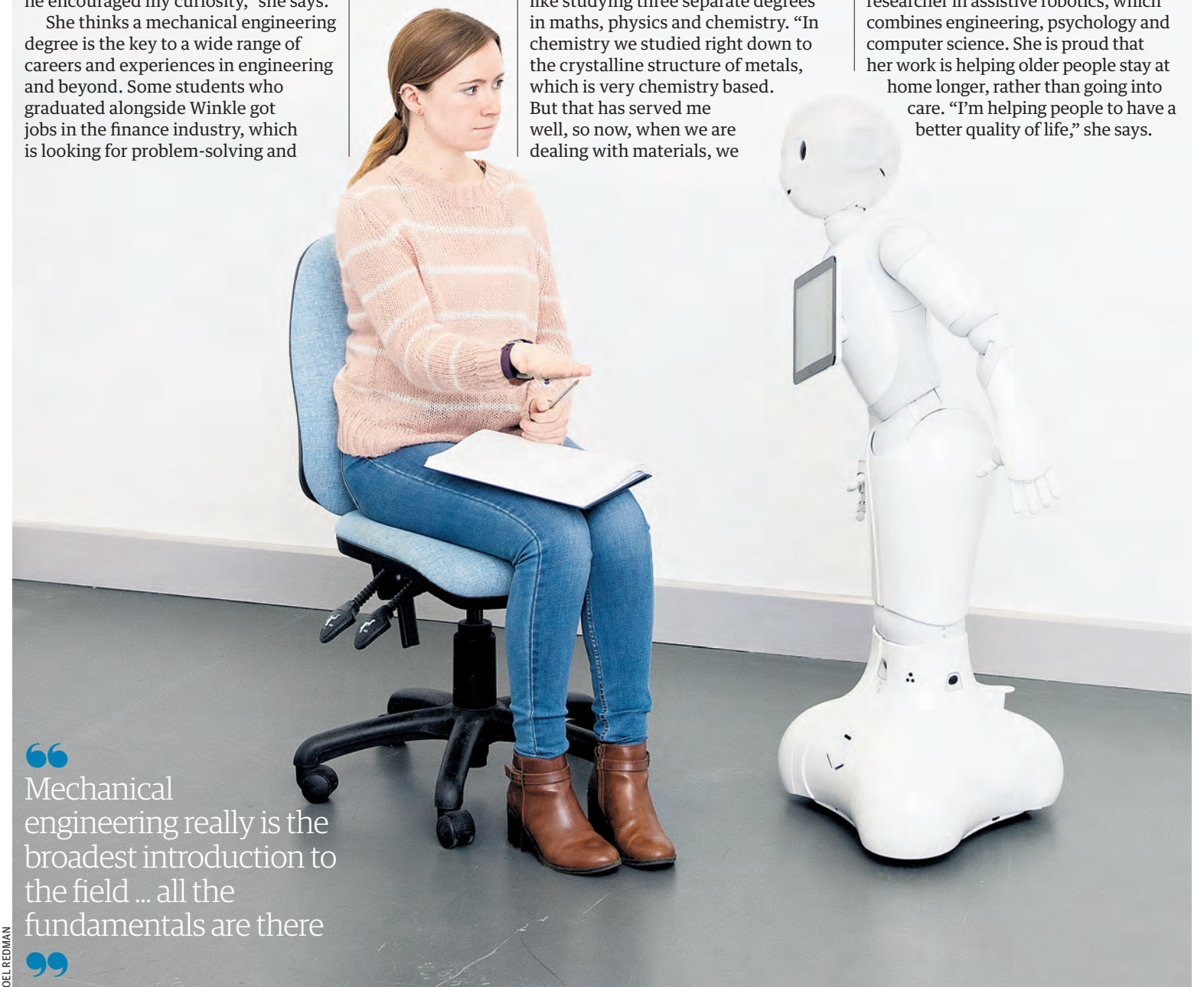
She says the course was intense, like studying three separate degrees in maths, physics and chemistry. "In chemistry we studied right down to the crystalline structure of metals, which is very chemistry based. But that has served me well, so now, when we are dealing with materials, we

have a deeper understanding of how they react."

During her degree, Katie spent summers as an intern at Jaguar Land Rover. She says internships for engineers are paid and many of them lead to a graduate job, giving you the chance to have hands-on experience.

"The most interesting time I spent was in research, looking at alternative fuels, electric cars, hydrogen fuel cell cars and thinking about what the car industry is going to look like in 50 years' time," she says. During her final year, she took a module on robotics and "got totally hooked", so she applied to stay on and do a PhD in the Bristol Robotics Laboratory.

She wants to continue working as a researcher in assistive robotics, which combines engineering, psychology and computer science. She is proud that her work is helping older people stay at home longer, rather than going into care. "I'm helping people to have a better quality of life," she says.



“Mechanical engineering really is the broadest introduction to the field ... all the fundamentals are there”

# Making the world better

Britain needs more engineers, especially women, to lead it into the 'fourth industrial revolution' – and one way to do this is by changing engineering's image

**E**ngineering knowhow is the driving force behind the technological revolution that is changing our lives by the day. Engineers are involved in everything from designing prosthetic limbs and hospital MRI scanners, to developing autonomous vehicles and building windfarms. Far from being all about greasy overalls and heavy industry, this is a career that demands high-level problem-solving, creative thinking and a hunger for innovation.

“People think it is very hands-on, manual and physical, when, in fact, much engineering is conceptual, intellectual and driven by design,” says Peter Finegold, head of education, Institution of Mechanical Engineers.

Engineering is a dynamic, rapidly changing field, bringing together many disciplines that all bleed into each other. From civil engineering to mechatronics, chemical engineering, electrical engineering and biomedical engineering, it underpins vital economic sectors such as aerospace, metallurgy, communications and healthcare.

The Institution of Mechanical Engineers (IMechE) is working with other UK professional bodies to boost engineering's image and encourage a new generation of students to consider a career in this essential field.

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People think it is very hands-on, manual and physical, when, in fact, much engineering is conceptual, intellectual and driven by design.

**Peter Finegold, head of education,  
Institution of Mechanical Engineers**

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Engineering contributes £486bn to the UK economy each year and the sector accounts for a fifth of the UK's jobs, some 5.7 million people, according to research by IMechE. Britain needs to recruit 182,000 engineers a year to boost its position as an innovation powerhouse, some 2 million over the coming decade.

To encourage young people into the profession, engineering is shedding its male, socially conservative image and opening its doors to diverse talents. It needs to attract greater numbers of women – and people from different backgrounds. Institutions such as the University of Bath are dropping strict requirements for physics A-level to get on an engineering BSc course. Opening up engineering degrees to people with broader arts A-levels should encourage more women and people with greater creative ambitions into the profession.

IMechE is supporting several initiatives to shift perceptions among school students. One successful scheme is STEM Insight, which encourages school and college teachers from science, technology and maths subjects to spend a week or two at an engineering company or university department. They take this experience back into the classroom and inspire students to consider an engineering career. Students can follow the university path or take apprenticeships to become technicians.

To reinforce the vital role that engineering plays in innovation, IMechE has created the Stephenson Fund. This £2m investment fund aims to help companies bring innovations to market. One such investment has been in Tokamak Energy, which is working on technology to develop nuclear fusion.

The inventiveness of engineers drove the industrial revolution of the 19th century. Today, their ingenuity is creating a “fourth industrial revolution” that is blurring physical, digital and biological spheres, and could help us live longer in a cleaner, safer, more prosperous world. For anyone looking to make the planet a better place, a career in engineering is a great starting point.

For more information on the Institution of Mechanical Engineers please go to [imeche.org/careers-education](https://imeche.org/careers-education)

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## Reham Badawy 'Working on Parkinson's is demanding, but it's also extremely rewarding'

Reham Badawy is a postdoctoral researcher at the School of Engineering and Applied Sciences at Aston University, Birmingham, investigating the use of smartphones in detecting and monitoring the symptoms of Parkinson's disease.

"The symptoms of Parkinson's have to be really apparent before doctors can diagnose it," says Badawy, who holds a dual honours BSc in smart systems and neuroscience from Keele University and a PhD in applied mathematics from Aston University.

"Research shows that patients can have very subtle movement problems before diagnosis, but they're not really aware of them. We think that the sensors in your phone can detect these subtle movement problems.

For example, your walking pattern can help detect if you have the disease. You could download our app, start it, put the phone in your pocket and walk in a straight line for about 30 seconds, then turn around. Using that data, we could try to detect very subtle movement problems in your walking pattern that would help us distinguish it from someone who does have Parkinson's and someone who doesn't."

There's still a lot of work to be done on the app, says Badawy, but she relishes the challenge. "This is an extremely exciting field that allows you to work at the forefront of human knowledge. Yes, it is demanding but it's extremely rewarding. With engineering, you have that opportunity to make a positive impact on the world around you. That is really special." **LJ**



# Machine medicine

Working alongside clinicians, biomedical engineers are on the frontline of major advances in healthcare. **Lucy Jolin** reports

From hip replacements to genetic engineering, engineering principles have long been applied to medical challenges. Now, the work of biomedical engineers is more important than ever, as they use problem-solving techniques plus innovative technology to find new solutions for new challenges.

The NHS in England treats one million people every 36 hours, says Helen Meese, head of healthcare at the Institution of Mechanical Engineers, and this is only set to increase.

"Healthcare is increasingly dependent on technology, and the safe, effective advancement of this technology depends on the work of biomedical engineers," she says. "Today, doctors are not only addressing the acute needs of patients, but trying to find solutions to preventable illnesses."

Biomedical engineering is all about collaboration. Engineers work with doctors, therapists and researchers to develop systems, equipment and devices to solve clinical problems. And it's a discipline that stretches across many different areas of unmet need within healthcare - from remote diagnostics to precision therapy. According to the UK government, the fastest-growing areas in the medical technology field are medical imaging, in-vitro diagnostics and drug delivery.

**Biomedical engineers work with doctors to develop equipment and devices for clinical treatment**  
*Getty*

“You can make a difference in a way you can't in any other engineering sector”

Customised healthcare is a big growth area. "Research in this area has touched on altering drug doses to patients based on their weight, body fat, age and the severity of their condition," says Ed Littlewood, marketing manager at global engineering company Renishaw. "There is also ongoing research and development into using patient-specific implants that are designed and manufactured to fit an individual perfectly, rather than using generic parts that can lead to future complications. With the role of medical devices becoming more important, there is a high level of development going on. Innovating in this area can help to develop technologies that have a lasting and visible impact on people's lives - it's tremendously rewarding."

It's an exciting field, and one which is only going to get bigger in the years to come. "There are growing numbers of engineering roles in many medtech, biotechnology and medical devices companies," says Littlewood.

"Healthcare professionals are not engineers and vice versa, so there is a big opportunity for adaptable engineers who can bridge this gap. Engineering in the healthcare sector gives people a chance to see their engineering expertise realised in a very positive way - you can really see it making a difference to patients in a way you can't see in any other engineering sector."

# Making all the right moves

From self-driving cars to zero-emissions vehicles, engineers are at the forefront of a revolution in mobility and transport, with manufacturers providing vast opportunities. **Lucy Jolin** reports

Transport and engineering are big news right now. The UK government wants nearly all cars to be ultra-low emission by 2050. Manufacturers are racing to produce more efficient electric cars and vehicles that drive themselves. At the same time, smart technology is enabling a new era of mobility, thanks to the evolution of the Internet of Things and big data. All these advances require the ingenuity of engineers.

"It is difficult to think of an area of modern life that doesn't benefit from the work of transport engineers," says Dr Lucy Rackliff, lecturer in transport and logistics at the School of Engineering & Applied Science at Aston University, Birmingham. "Increasingly, it's a multidisciplinary field, where an understanding of what is technically possible has to be accompanied by an appreciation of the possible societal impacts. This may not have been so true in the past, where the focus was on predicting future transport needs and designing ways of meeting them. Now it's necessary to look not only at how we might meet those future needs, but what the implications of doing so are for the global and local environment, the economy, and also for society."

The processing power of smart tech, for example, has the potential to make a big difference to how we get to where we're going, and the impact our journey has. "Processing power can analyse traffic flow on all modes, addressing congestion, spotting bottlenecks at particular times or



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“This is rewarding work that is making a direct impact on society”

providing individuals with alternative travel routes on alternate modes," says Philippa Oldham, head of transport and manufacturing at the Institution of Mechanical Engineers. "All this can happen in real time, leading to a reduction in emissions, congestion and cost to individuals."

Autonomous vehicles also present a huge opportunity. "Engineers have the opportunity to design solutions that take into account that individuals have diminished senses, such as sight, hearing, touch and event smell," Oldham says. "Many older people feel

uncertain when using technology, so we must make sure that the designers are not making assumptions."

And these changes are helping provide new jobs and opportunities, says Ryan Maughan, founder and managing director of AVID Technology: "This is challenging and rewarding work that is making a direct and tangible impact on society. Strong analytical skills, maths and science are essential, as well as a desire to learn and change things. These abilities will allow anyone to have a fantastic career in one of the most exciting fields of engineering."

## Nike Folayan 'Engineers work on the most exciting and the most beautiful things'

**Nike Folayan was first inspired to become an engineer by watching TV. "From an early age, I was fascinated by how you got those images on the box!" she says.**

She's now technical discipline leader in communications and control (rail) at

global engineering giant WSP, enabling technology, both old and new, on major transport projects, including Crossrail, the Victoria station upgrade and Edinburgh Gateway station.

"I focus on design and infrastructure that allows people to communicate," she says. "That could be getting information to the customer, such as public address announcements, or working out ways we can identify threats using CCTV systems. The other day, I was in the Mersey Tunnel in Liverpool, looking at the radio equipment needed to allow the emergency services to operate in the tunnel. No day is the same. My job as a consultant is to understand what the clients' needs are and how we

can put them into action to make sure the client is satisfied."

Engineering, Folayan says, is a wide area with vast opportunities. "Engineers do the most exciting, the most entertaining and the most beautiful things. I love to design and I'd really like my future to be about growing with innovation, leading innovation and coming up with new technologies and new ways of doing things, which will revolutionise the industry.

If you're creative, if you like maths, and if you like solving real problems, then engineering is definitely something you should consider." **LJ**

