A report by Tata on the future of UK engineering in collaboration with the Institution of Mechanical Engineers

March 2017
Contents

Foreword 2
Executive Summary 5
About this paper 5
Opportunities for future growth 8
Solving the skills crisis 11
International comparisons 19
Building the future 21

Appendix

Contributors 23
About the survey respondents 24
The Tata group in the UK operates 19 companies producing everything from cars, to salt, to steel – and much else besides, including cutting edge IT services for blue chip clients around the world, Tetley Tea and even Michelin-starred food at our 5-star Taj hotel in central London.

Beyond a commitment to improving the quality of life of the communities we serve which stretches back nearly 150 years, our UK companies’ activities may appear very diverse. What unites them, however, is a reliance on innovation and in most cases engineering. Tata in Europe has over 60,000 employees, many of whom are engineers, technicians and apprentices, working on everything from cloud connectivity to Artificial Intelligence to a new generation of driverless cars. Around the world, if you can think of an engineering discipline, there’s almost certainly a Tata person doing it.

Engineering matters to us. It is also vitally important for the UK, never more so than now, as we chart a new future for ourselves outside the European Union. More than 1.8m additional engineers and qualified technicians will be needed by 2025 to meet existing and growing demand for skills across Britain, according to Engineering UK. The engineering sector as a whole currently accounts for 26% of GDP and more than 5.7m jobs.

Our survey, undertaken in collaboration with the Institution of Mechanical Engineers, comes at a critical time for UK engineering. The UK is experiencing a routine shortfall of more than 20,000 engineers every year. The country still does not train enough of our young people to enter the profession – especially women and minorities. This survey captures the collective wisdom of more than a thousand members of the Institution on the key questions: what skills our engineers need, how best to inculcate those skills, the challenges that lie ahead for UK engineering, and which countries we can look to for examples of good practice. Above all the report shows us the opportunities that are out there for the taking.

We would like to thank all those who took part in the survey, as well as our three engineering leaders – Jose Lopes (Jaguar Land Rover), Julie Woods-Moss (Tata Communications), and Nick Sale (Tata Technologies) – who provided their insights for this paper. We would also like to thank the Institution of Mechanical Engineers for making the project possible.

We hope the findings and analysis of the survey can contribute to the important debate about the future of UK engineering at a vital time for our economic future.

Dr David Landsman OBE
Executive Director, Tata Limited
The Institution of Mechanical Engineers represents over 115,000 members, working at the heart of the most important and dynamic sectors such as the automotive, rail, aerospace, medical, power, process and construction industries.

We are passionate about our vision of improving the world through engineering and promoting the value of engineering to wider society. Without engineers, not only would we not have cars or trains, but many of the medical procedures that we take for granted would not be possible. We would be unable to power our homes or even contact our loved ones via our smartphones. In our increasingly technological age engineering is more important now than ever.

Furthermore, as the UK gears up to leave the European Union, we urgently need to raise our game in developing the highly-skilled, technically-trained workforce to underpin our industrial strategy, build new infrastructure and secure our future economy.

However the reality is that despite having some of the best University engineering courses in the world, we don’t have enough people pursuing technical training. There is an annual shortage of supply of engineers at all levels and efforts to attract women into engineering are falling short: today less than 1 in 8 of the engineering workforce is female.

Despite many well-intentioned efforts over the years, the lack of meaningful progress in narrowing the engineering skills gap has been striking. Part of the problem has been a lack of dialogue between industry, teachers, Governments and professional institutions like ours. It is surely time to try something different.

This report offers an interesting perspective from the 1,158 engineers that were surveyed, but if we want fundamental changes to the way we address the UK’s skills shortage, it is just part of the picture.

We have therefore been working with educationalists, teachers and children to find ways to engage them to solve the engineering skills shortage. We also need to ensure that all schoolchildren, not just those who choose to specialise in engineering subjects, are better able to understand the world they live in and are better equipped to make the right choices.

As part of our work we have found strong consensus that engineering should be explicitly taught as part of existing lessons, from primary level upwards. In addition, many leading educationalists, politicians and learned bodies concur that specialisation is routing young people into either arts or sciences too soon. This prevents them from considering options before they have even truly grasped what employment is.

Tackling the engineering skills crisis is complicated and one that cannot be done by engineers alone. This report forms part of the dialogue, not the answer. We clearly need engagement and input from parents, teachers, companies and Government. It is vital we do this not just to ensure students are able to make informed choices, but to make sure we have enough people with the right skills to allow the UK to prosper.

Dr Colin Brown
Director of Engineering at the Institution of Mechanical Engineers

“Engineers don’t have all the answers. We need to get parents, teachers, employers and education specialists on board with solving the problem. Engineering is not a stand-alone profession that ‘other people’ do, it is a people focused, creative and socially beneficial activity that engages us all.”
The following is a summary of the responses of 1158 members of the Institution of Mechanical Engineering, surveyed in December 2016 and January 2017.

Almost two-thirds (63%) of engineers believe that the UK education system will not meet the needs of the engineering sector by the middle of the next decade unless reforms are made, while only one in ten (13%) think it will.

According to the Tata group’s survey of more than 1150 members of the Institution of Mechanical Engineering, 70% said that ‘understanding of an engineer’s job’, together with ‘the image of engineering’ (68%) were the two biggest barriers to young people choosing an engineering career.

When asked how the UK education system should change to boost the supply of new engineers, 57% said ‘focus on Maths, Physics and Theory’ was the most crucial factor, followed by ‘more hands on work’ and ‘greater emphasis on industry and vocation’. Amongst 18-24 year olds, however, the order was reversed: 74% saw ‘more hands on work’ as the number one priority; ‘maths, physics and theory’ was prioritised by just under half.

When it came to lifelong learning, digital skills were highly valued, with almost half (48%) of existing engineers saying ‘Data Analytics’, 47% saying ‘Connectivity’ and one-third saying ‘Artificial Intelligence’ would be the most important digital skillsets of the next decade. At present, more than one third (35%) of engineers said their companies have to source ‘CAD design and product development skills’ from the EU, while 25% of respondents said ‘software development’ skills were necessary to source from Europe.

Energy (64%), Biomedical (42%) and Aerospace (34%) emerged as the top three sectors that engineers believed held the most opportunities for future growth – with ICT and software a close fourth (35%). Power and energy (42%) came top in a list of sectors that engineers thought should be a focus for UK R&D, as well as the type of infrastructure investment most likely to drive value for the UK (73%). Other infrastructure priorities included Rail (52%), Road (34%) ICT (32%) and Airports (31%).

When it came to countries the UK should emulate, four-fifths (81%) of engineers thought Germany had the best Industrial Strategy, while China (40%), Japan (36%) and South Korea (29%) also scored strongly.
Tata supports further work on the wider use of applied maths and physics in education, as well as enhancements to the quality of careers advice (particularly in engineering). Tata recognises that industry has a significant role to play in these areas and this is why the Tata group is partnering with Nesta to develop a new maths intervention for secondary school students.

Amongst 18-24 year olds, 74% saw ‘more hands-on work’ as the number one priority; ‘Maths, Physics and Theory’ was prioritised by just under half.

64% 42% 38%

Energy, Biomedical (42%) and Aerospace (38%) emerged as the top three sectors that engineers believed held the most opportunities for future growth.

Almost two-thirds (63%) of engineers believe that the UK education system will not meet the needs of the engineering sector by the middle of the next decade unless reforms are made.

63%

70% said that ‘understanding of an engineer’s job’, together with ‘the image of engineering’ (68%) were the two biggest barriers to young people choosing an engineering career.

Tata welcomes the Government’s intention to prioritise infrastructure investment, particularly transport improvements, which are a key enabler of economic growth. Clear commitments to infrastructure development offer potential for productivity gains, provide opportunities for private sector investment and contribute to stronger business confidence.

Tata supports the development of a long-term Industrial Strategy for the UK. The policy framework must recognise and support the crucial role for engineering in our future economy.

Tata is encouraged by efforts to reform aspects of our education and skills system. Improving the UK’s STEM skill base and developing a system of technical qualifications that bring about parity of esteem between academia and technical qualifications are key areas for reform.

Tata believes that in any developed economy developing the skills of the domestic workforce must be coupled with ensuring access to the finest global talent. A flexible and business-led approach to the temporary movement of people in and out of our country will remain important to many engineering projects and companies.

When it came to countries the UK should emulate, 81% of engineers thought Germany had the best industrial strategy.
ENGINEERING:
Building the right skills
Tata welcomes the commitment to affordable energy and clean growth as part of its Industrial Strategy green paper. Setting out clear plans for investment alongside long-term regulatory and financial frameworks will play a key role in attracting industry investment and co-operation.

Engineering: opportunities for future growth

Tata supports the development of a long-term Industrial Strategy for the UK. The policy framework must recognise and support the crucial role for engineering in our future economy.

Energy (64%), Biomedical (42%) and Aerospace (38%) emerged as the top three UK sectors that engineers believed held the most opportunities for future growth in the UK – with ICT and software a close fourth (35%). Power and energy also topped the list of sectors that engineers thought should be a focus for UK R&D (42%) as well as infrastructure investment driving value for the UK (73%). Though almost a quarter of respondents worked in the power or energy sectors, the strength of consensus went beyond this.

The results didn’t surprise Julie Woods-Moss, President and Chief Innovation and Marketing Officer at Tata Communications. “We all need energy – it’s not just about powering heavy industry anymore. The digitisation of our lives still has a long way to go – our computers, our connectivity, our digitalised manufacturing industries will all rely on more and better use of energy to function. That will involve a lot of work and focused problem solving from engineers over the next 20 years – and it will facilitate the expansion of more of energy intensive digital infrastructure that we need, such as data centres.”

Woods-Moss welcomed the Government’s commitment to invest an additional £4.7 billion by 2020–21 in research and development funding in the Industrial Strategy green paper. “I hope this funding helps to successfully commercialise our R&D.”

One surprise was that the biomedical sector ranked so highly as a UK opportunity sector, ahead of aerospace, manufacturing and IT. Nick Sale, Chief Operating Officer at Tata Technologies in Europe, offered an explanation.
“We’re on the cusp of an unprecedented era of personalised medicine, and even more exciting than that – certainly from an engineering perspective – are the possibilities on the horizon for human augmentation. Biomedical is a sector I can really see explode in the next ten years,” he said. “Look at the current generation of hearing aids, how small and practical they are and yet they can make a massive difference. It is not a huge leap to see them connecting to our mobile phones and other forms of technology.”

“As someone with a humanities background, the emphasis on biomedical surprised me,” said David Landsman, Executive Director of Tata Limited. “I wouldn’t necessarily assume that biomedical was a major engineering sector, but clearly that’s a matter of perception, not reality. We need to make sure that the breadth of engineering types are better understood, as well as the wide variety of careers there can be for a talented engineer.”

Landsman also believed the breadth of opportunities in the aerospace sector also represented the reasoning behind the sector’s high ranking on the survey. He added “The UK has become a global manufacturing hub in aviation but there are also exciting opportunities further afield in the commercial space flight sector which is worth 25 billion in the next 20 years.”

Automotive came in only fifth. David Landsman suggested an explanation: “Britain has a world-leading automotive sector, so we are already starting from a high base. The National Automotive Innovation Centre, which is being developed following support from a number of Tata companies, WMG (Warwick Manufacturing Group) and the government, will also help us to develop breakthrough designs and technologies that offer real growth opportunities for the sector.”

“We’re optimistic about the future of car-making in the UK,” said Lopes. “Yes, Jaguar Land Rover produce premium marques, but this is an attractive sector, and one capable of supporting thousands of engineering jobs now and in the future.”

“The size and scale of the automotive supply chain in the UK is often underestimated, too,” added Sale. “It’s not just about car parts, important though those are. There’s also opportunity in the marketplace for applied engineering expertise and outsourced problem-solving – which is what we do for some of the world’s largest car makers. That kind of work is a major growth area, not just for Tata Technologies but for UK plc.”

CASE STUDY
The National Automotive Innovation Centre

The National Automotive Innovation Centre (NAIC) will be a unique, state-of-the-art centre of excellence and innovation for the UK’s automotive sector when it opens in early 2018, and the largest of its kind in Europe.

Located outside Coventry, NAIC is a £150m joint collaboration between WMG, the University of Warwick, Jaguar Land Rover, Tata Motors European Technical Centre and HM Government. R&D teams will drive forward new discoveries in autonomous vehicle technology, low carbon propulsion, emissions reduction, sustainable power trains, and battery efficiency.

When fully operational, NAIC will host more than 1,000 academics, scientists, and industrial engineers in more than 33,000 sq m of research space. The Centre will house next-gen R&D facilities, an engineering hall, a VR lab, advanced driving simulators, design workshops, teaching facilities, a library, outdoor car viewing garden, and a publicly accessible showroom and café.

NAIC will help to propel a renaissance in the UK automotive industry and build bright opportunities for the next generation of engineers.
Tata welcomes the Government’s intention to prioritise infrastructure investment, particularly transport improvements, which are a key enabler of economic growth. Clear commitments to infrastructure development offer potential for productivity gains, provide opportunities for private sector investment and contribute to stronger business confidence.

**Facilitating future growth**

Tata and the Institution asked engineers what national infrastructure projects would add the most economic value for the UK over the years to 2025.

The most popular responses were Energy (73%), Rail (52%), Road (34%) and ICT (32%).

“The results reflect where the engineers expect to see Government investment in infrastructure,” believes Landsman.

“Energy is the great enabler,” added José Lopes, Head of Technical Excellence at Jaguar Land Rover. “So the emphasis on energy makes sense. Next-gen technologies will make more demands of our energy infrastructure but it’s undeniable that we don’t yet have the energy infrastructure to cope with that. Jaguar Land Rover, for example, is investing huge resources to become a leader in electric and connected cars. But to achieve a critical mass of mass electric-car use across Britain, we will need to radically overhaul our infrastructure.”

Sale, however, was not so sure. “Of course we all need energy,” he said, “but securing a competitive advantage in energy infrastructure will be extremely difficult, given that emerging markets in Asia are streets ahead of us already. We need to focus on being a leading global player by differentiating ourselves. We need to be smarter, not just bigger.”

New rail, road and airports infrastructure also scored highly – though only half of respondents said they saw renewed transport infrastructure as an important way to make cities and engineering hubs attractive and prosperous outside London.

They identified raising the profile of leading companies outside London (56%), improving weighting of non-London salaries (44%) and spreading government spending and funding opportunities more evenly across the country (41%) as just as important.

Interestingly, only 16% thought that ‘better international air links’ would attract talent and investment – despite double that number (31%) identifying Airports as a key infrastructure priority.

Landsman thinks the findings are instructive for government as it looks to refine and implement its Industrial Strategy. “We all know breathing life and vitality into regional economies beyond London is critically important, especially as we exit the EU – but this survey provides useful insights into what our priorities need to be.”

In particular, he saw raising the profile of leading companies outside London as vital. “So much groundbreaking engineering work goes on in this country, much of it totally unnoticed,” he said.

Woods-Moss emphasised the importance of broadband and telecommunications as enabling infrastructure. “Roads and rail and energy are of course important, but these are all ‘big box’ public infrastructure projects. Of course these will be very good for certain kinds of engineers! However, we absolutely must not forget that small and medium sized businesses are the backbone of the UK economy, and they need fast broadband and global connectivity to flourish. We also need the kind of society that rewards experimentation and entrepreneurialism.”

Lopes, however, thought something was missing from the survey. “Skills devolution,” he explained. Giving local people the right skills to thrive in high value local jobs – whether that’s automotive engineering in Coventry, or software development in Cambridge, or the life sciences in Cheshire - could really help to address the ‘London brain drain’ issue. This is an area where industry and local authorities can really work together to deliver the right skills for their communities,” he added.
The skills squeeze in British engineering is well documented. According to the 2017 Engineering UK report, *The State of Engineering*, more than 1.8m more staff with engineering skills will be needed across the UK by 2025; there is an annual shortfall of 20,000 engineers; and the UK needs to double the number of engineering graduates it produces if it is to meet the growing demand for skills. More than half of engineering firms report finding it difficult to fill advertised roles, and in the automotive sector alone, up to 5,000 roles nationwide could currently be vacant due to a skills shortage, according to the Automotive Industrial Partnership.

“We have been talking about a skills crisis in engineering for years,” said David Landsman, “but until now, we’ve been able to plug any gaps with talent from the across the EU. It’s right that the best and brightest should be able to come from anywhere in the world to work in the UK, and that will continue to some extent - but the reality is that, unless we act quickly to boost the numbers of young people choosing engineering careers, a shortage of skilled workers will act as a drag on economic growth. Decisive action is needed now.”

Survey respondents agreed. Almost two thirds (63%) of engineers surveyed thought that the UK’s engineering system would not fulfil the needs of the British engineering sector by 2025; only 13% thought it would.

Tata is encouraged by efforts to reform aspects of our education and skills system. Improving the UK’s STEM skill base and developing a system of technical qualifications that bring about parity of esteem between academia and technical qualifications are key areas for reform.

"We’ve talked for too long about the challenges facing us as an industry in the UK, but we’re engineers. When we see a problem, we prefer trying to fix it.”

José Lopes  
*Head of Technical Excellence, Jaguar Land Rover*
When asked why, 70% said ‘understanding of an engineer’s job’ and 68% said ‘the image of the industry and engineering’ were the two biggest barriers to young people choosing a career in engineering. Tata’s experts agreed that engineering is hobbled by a pervasive image problem.

“Engineering is exciting, it’s creative and it has a true value to society. If you’re an engineer, you’re a creator - inventing new things and solving real world problems. When I tell young people that the inventors of Google, Instagram and Skype are all engineers, it really blows their minds. The opportunities opening up in digital, IT and software engineering could really transform the image of engineering and entice more people into it.”

Julie Woods-Moss, President, Chief Innovation and Marketing Officer, Tata Communications
Wrong perceptions are damaging the diversity of the sector,” said Lopes. “The extent of opportunities that engineering can open up clearly isn’t getting through to enough people – but especially women and girls.” Just 1 in 8 engineers in the UK are women.

Julie Woods-Moss agreed. “Out of my year, I was the only girl who applied to study engineering. There were more girls who went to study the sciences, and medicine, but for a long time I was pretty much the only female engineer I knew.

Nick Sale said he and his colleagues were constantly having to battle misconceptions. “People think it’s dirty, it’s mucky, it’s a job just for men, it just involves mending things, it’s un-creative, dull – more or less the opposite of my own experience. And if we could triple the number of young women taking maths and physics at A Level, that would go a very long way towards closing the skills gap entirely.

Social worth was not the only area where respondents felt undervalued. Forty four percent had considered leaving engineering, with the number one reason for doing so being pay; ‘prospects in another profession’ came second.

Tata believes that further work by government and industry is necessary to enhance the status of engineers in our society.
Reforming education: is ‘Maths, Physics and Theory’ top priority?

Though Lopes, Woods-Moss and Sale come from very different engineering backgrounds, they did have one thing in common: all three had parents or close family members who were also engineers, and informed their decision to pursue an engineering career.

Not everyone has that advantage, however, making the education system of paramount importance. When asked about how the secondary education should change to boost the supply of engineers, 57% of survey respondents said focus on ‘Maths, physics and theory’ was the most important factor, while almost half said focus on ‘Hands-on work’ and ‘Industry and vocation.” were also important.

Interestingly, amongst 18-24 year olds this order was reversed: 74% of this age group prioritised ‘hands on work’, with ‘industry and vocation’ coming in second place: ‘maths, physics and theory’ was prioritised by under half.

Julie Woods-Moss and Jose Lopes sympathised with the younger age group.

“Certainly in my area, median pay for engineers is commensurate with what you can earn as a solicitor, chartered accountant or an architect.”

Nick Sale
Chief Operating Officer,
Tata Technologies
Woods-Moss said the Tata Communications approach is no less aware of the need to identify ‘non-conventional’ talent. The issue, she believes, comes from the way we as a society view intelligence and achievement. “Engineering is all about understanding a problem and then working out how to solve it – in other words, creative, lateral thinking, requiring intuitive, practical smarts. Yet the way we measure academic achievement and intelligence is by seeing how much information people can memorise – the opposite of engineering in many ways. We need our schools to show young people how to think their way around a problem, stick with it, and – yes – apply maths and physics.”

CASE STUDY
Tata Consultancy Services – IT Futures

Tata Consultancy Services (TCS) is a global leader in IT services, digital and business solutions that partners with its clients to simplify, strengthen and transform their businesses.

TCS has a UK workforce of over 11,000 employees based across 30 locations, including London, Edinburgh, Manchester, Leeds, Ipswich, Norwich and Liverpool.

TCS’ IT Futures programme works with numerous secondary schools and universities across the UK and Ireland with the aim of engaging students at critical stages in education (from secondary to university level), while strengthening the ability of educators to deliver effective training and relevant skills.

IT Futures has brought together over 7,100 employees in the UK to help promote digital skills. Since 2013, the company has dedicated over 3,000 hours annually and engaged more than 51,000 students between the ages of 7–25 years old.

“Often young people have difficulty in seeing how maths and physics have real-world value,” said Nick Sale. “If we could really show that, we might boost the number of students choosing to study it at a higher level.”

David added “One of the things that has changed over my working life is that very few people now think they will be in the same job in the same industry in the same way. So it is important that we create a system that allows people further to take on engineering throughout any stage of their career.

Tata supports further work on the wider use of applied maths and physics in education, as well as enhancements to the quality of careers advice (particularly in engineering). Tata recognises that industry has a significant role to play in these areas and this is why the Tata group is partnering with Nesta to develop a new maths intervention for secondary school students.”
The role of industry in catalysing educational change

The Government has developed incentivised employer led apprenticeships with the new Apprenticeship Levy, which Sale hopes will increase the provision and improve the reputation of apprenticeships. He says “with university tuition fees rising, there is an opportunity to make apprenticeships a viable and respected alternative route to higher education.”

According to David Landsman, the industry, in partnership with engineering organisations such as the Institution of Mechanical Engineers, is delivering effective outreach programmes to schools showcasing the excitement of engineering to classrooms. “There are some excellent outreach programmes, but the challenge is to increase their scale to meet the demand and engage in a sustained manner.”

However, Lopes believes that there should be more collaboration between the outreach programmes. “There are over 600 organisations encouraging STEM participation. We need to unite these efforts and groups to implement a considered long term engagement strategy.”

CASE STUDY
Tata Steel

Tata Steel UK is one of Europe’s leading strip steel manufacturers with steelmaking facilities located at both Port Talbot, Wales and Rotherham, South Yorkshire, as well as steel rolling and processing facilities in the Midlands, the North East and Wales.

Over the past decade, £1.5 billion has been invested in the company’s UK operations to upgrade plant and technology. Tata Steel’s products go into a wide range of markets, including automotive, construction, energy and power, aerospace and packaging.

Tata Steel employs more than 11,000 people across the UK, and offers more than 300 UK apprenticeships and 60 graduate trainee places annually. The company offers structured careers opportunities for a wide range of engineering specialisms, from Civil, Chemicals & Process and Mechanical, to Electrical or Design.

Young people joining Tata Steel as school-leavers can choose to pursue apprenticeships in Electrical Engineering or Mechanical Engineering (as well as in other disciplines).

The two-year UK graduate trainee scheme provides on-the-job engineering experience with regular feedback and mentoring, alongside a programme of formal training that builds on academic qualifications.
Tata’s experts agreed, however, that the Government’s proposed new approach to technical education was promising. “Engineering is diverse and the ways people come into engineering must also be diverse – graduates are of course valuable, but better technical education will help move our system away from the over-reliance we have on people choosing to study the subject at university,” said Woods-Moss.

With more hands-on learning identified as a priority for the engineers surveyed, the experts agreed that the educational curriculum could be better supported with more industry involvement, to help expose more young people to applied maths and physics. “There isn’t enough of a connection with studies and in the application of maths and physics; technical education needs to be embedded better into the education system,” Jose Lopes said.

Lopes believes that “much is being done to create an embedded solution between industry, education and the Government”. £170 million of capital funding has been committed as part of the Industrial Strategy to create new Institutes of Technology, which will deliver higher technical education in STEM subjects. However, Lopes states that “the industry recognises it must work hand in hand with the government in providing investment, resource and feedback into the skills agenda.”

“The growth of University Technical Colleges are good examples of industry working with education to provide students equipment, expertise and importantly some context for what they’re learning. It means the students receive the training they’ll need to take them directly into an engineering role”, Lopes believes.
**Upskilling and lifelong learning**

A majority of the engineers surveyed believed that keeping their skill sets up to date was important in preserving their employability, especially since only a third believed that ‘all of their current skill set’ would still be of use in 2025. The pace of technological change will mean that new engineering skills, and new ways of working, will need to be learned and mastered.

David Landsman sees this as a positive. “It is really important that we are aware of the speed of change, as recognising it is the first step to being able to adapt it. One of the things that has changed over my working life is that very few people now think they will be in the same job in the same industry in the same way. The sooner we grasp this, and this poll suggests the sector is grabbing it, the better we can focus on skills for the future.”

When asked about which skills engineers would most wish to upskill in today, the top response was ‘Project and Team Management’ (at 34%), followed by ‘Software Tools and Simulation’ (also at 34%) and ‘Computer Programming’ (also at 34%).

Nick Sale said, “because of the evolution to Industry 4.0 it isn’t surprising to see software tools and simulation as popular areas for upskilling as they are the heart of the digitalisation of manufacturing.”

Lopes adds, “the courses on these skillsets are very popular on our Technical Accreditation Scheme.”

**Are there skills particularly lacking from the resident UK population that you currently source from the EU?**

![Pie chart showing demand for skills](chart.png)

<table>
<thead>
<tr>
<th>Skill Set</th>
<th>Demand Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAD Design and product development</td>
<td>48%</td>
</tr>
<tr>
<td>Management skills</td>
<td>47%</td>
</tr>
<tr>
<td>Software development skills</td>
<td>46%</td>
</tr>
<tr>
<td>Technical skills such as machining etc</td>
<td>45%</td>
</tr>
<tr>
<td>Test, measurement and validation skills</td>
<td>44%</td>
</tr>
</tbody>
</table>

Sale also agrees about the importance of project and team management. "Everything in engineering today is collaborative", says Sale. “Tata Technologies’ graduate scheme is called the ‘Ready Engineer’ and this is because although well qualified, the graduates still need to learn about how to work on a project across the supply chain”.

Woods-Moss adds that "the education system and universities, with a focus on exams, are too formulaic; business isn’t like that. It’s collaborative, iterative – social. At Tata Communications, for example, we encourage our employees to enter team competitions and other programmes to improve these softer interpersonal and project management skills – they’re no less vital".

When asked about the digital skillsets they thought would be most important over the next 10 years, 48% said ‘Data Analytics’, 47% said ‘Connectivity’, and 34% said ‘Artificial Intelligence’.

For individual engineers, the survey pointed to a number of skills currently in short supply, where engineering companies currently need to source from the EU. IT and digital skills were amongst the most in demand – with 25% citing ‘software development’ and 35% citing ‘CAD design and product development’ as the most demanded skills.

“IT and digital competencies are now central to the engineering skillset,” explains Woods-Moss. "Even in manufacturing sectors, such as automotive, the industry moving trends, like the connected car, are centred on digital manufacturing. Connecting big data reliably, and in real time, has immense potential to drive innovation and enhance UK productivity.

**CASE STUDY**

**Tata Technologies – Ready Engineer**

Tata Technologies is a global leader in engineering services outsourcing and product development IT services to the global manufacturing industry; enabling ambitious manufacturing companies to design and build better products.

The company operates in 14 countries and has a combined global workforce of more than 8,500 worldwide.

In 2016 Tata Technologies took on 50 interns and graduates into its ‘Ready Engineer’ training programme. All graduates were placed in the Institution of Mechanical Engineers’s Monitored Professional Development Scheme and will have the opportunity to apply for professional registration on completion for the industry renowned Incorporated or Chartered Engineer recognition from the Institution.

The company participates in a schools outreach programme across Warwick and supports the Arkwright Scholarship Trust, which provides scholarships to students who pursue science or engineering as a degree course. Tata Technologies also has close ties with Coventry University where the company sponsors the Ada Lovelace degree course. Tata Technologies also has close ties with Coventry University where the company sponsors the Ada Lovelace degree course.

The importance of upskilling and lifelong learning is emphasised in the Industrial Strategy, which explores new approaches such as introducing maintenance loans for higher technical education, new signposting of online training opportunities and opportunities for students to transfer between courses and institutions.

It’s also a key consideration for Jaguar Land Rover. “It’s a priority for our employees. To make sure their skills stay current, we’ve developed the Technical Accreditation Scheme with bespoke MSc programmes delivered by 10 universities including Cambridge, Bradford, Warwick and UCL. We offer more than 80 technical modules, designed and delivered in conjunction with these leading educational institutions. The initiative allows us to upskill our workforce to fill new gaps,” said Lopes.
Almost two thirds of survey respondents said that Germany produced the best engineers (followed by Japan and the USA, at just 7% each, and South Korea on 4%).

The reasons for this overwhelming preference for Germany are well known: a strong vocational and technical educational system, greater respect for and understanding of the role of the engineer (or Ingenieur, from the same root as ‘ingenious’), protected status for the engineering profession, and a diversified industrial strategy that has focused for several decades on building the industrial and advanced engineering capacities of several key German cities.

When it came to countries with the best industrial strategies, Germany again came top (81%), but China (40%), Japan (36%) and South Korea (29%) also scored well. When asked about the contributing factors to a strong industrial strategy in these countries, our engineering respondents gave a variety of answers; from ‘taking a long term view, not just what returns can be achieved within two years’, to a ‘focus on technical education’, ‘a better work ethic’, ‘better appreciation of the value of engineering to the economy’ and ‘cheaper and more technically proficient labour’ as key reasons for these countries’ engineering strengths.

Landsman saw a clear correlation between the highest ranked countries and established global brands. “Iconic brands, such as Jaguar Land Rover, create and sustain a wider ecosystem that generates jobs; they are also a magnet for talent. Countries that are able to grow and support these engineering flagbearers are able to help empower the industry.”

Woods-Moss believes that the UK can learn a lot from Singapore’s approach to their industrial strategy. She explains, “Singapore looks at emerging technologies, such as 3D printing, and provides incentives and government support to select regions to support the growth of these sectors or niches. In the UK we could look at growing nascent technologies and industries through business led Local Enterprise Partnerships and Enterprise Zones. MediaCity in Salford is a good example of this working in the UK.”

What country, apart from the UK, do you believe develops the best engineers?

What countries do you think have the most effective industrial strategies?
One surprise was that only 18% of the engineers believed that the US had one of the best Industrial Strategies. Sale commented, "the US is a fascinating enigma. They can create the world’s greatest jet planes, they can create space shuttles but yet in areas, like the automotive sector, they are struggling."

He adds "America has been the exemplar of embracing people and giving anyone the opportunity to be successful. Elon Musk of Tesla is from South Africa; Satya Nadella, CEO of Microsoft, is from India; and Sergei Brin, Co-founder of Google, is from Russia. They are testament to the success of America’s melting pot culture. Anything that could compromise this culture would be detrimental to US engineering."
Tata is encouraged by efforts to reform aspects of our education and skills system. Improving the UK’s STEM skill base and developing a system of technical qualifications that bring about parity of esteem between academia and technical qualifications are key areas for reform.

Tata supports the development of a long-term Industrial Strategy for the UK. The policy framework must recognise and support the crucial role for engineering in our future economy.

Tata believes that further work by government and industry is necessary to enhance the status of engineers in our society.

Tata believes that in any developed economy developing the skills of the domestic workforce must be coupled with ensuring access to the finest global talent. A flexible and business-led approach to the temporary movement of people in and out of our country will remain important to many engineering projects and companies.

Tata welcomes the Government’s intention to prioritise infrastructure investment, particularly transport improvements, which are a key enabler of economic growth. Clear commitments to infrastructure development offer potential for productivity gains, provide opportunities for private sector investment and contribute to stronger business confidence.

Tata supports further work on the wider use of applied maths and physics in education, as well as enhancements to the quality of careers advice (particularly in engineering). Tata recognises that industry has a significant role to play in these areas and this is why the Tata group is partnering with Nesta to develop a new maths intervention for secondary school students.

Tata welcomes the commitment to affordable energy and clean growth as part of its Industrial Strategy green paper. Setting out clear plans for investment alongside long-term regulatory and financial frameworks will play a key role in attracting industry investment and co-operation.

Tata welcomes the Government’s intention to prioritise infrastructure investment, particularly transport improvements, which are a key enabler of economic growth. Clear commitments to infrastructure development offer potential for productivity gains, provide opportunities for private sector investment and contribute to stronger business confidence.

Tata welcomes the Government’s intention to prioritise infrastructure investment, particularly transport improvements, which are a key enabler of economic growth. Clear commitments to infrastructure development offer potential for productivity gains, provide opportunities for private sector investment and contribute to stronger business confidence.

Tata supports the growth of more than 50 University Technical Colleges so far in the UK and welcome the Government’s investment of £170 million of capital funding to develop Institutes of Technology to provide higher-level technical education. It will be important to devote effort to promoting these educational routes to potential students.

Tata supports the growth of more than 50 University Technical Colleges so far in the UK and welcome the Government’s investment of £170 million of capital funding to develop Institutes of Technology to provide higher-level technical education. It will be important to devote effort to promoting these educational routes to potential students.
Tata recognises the key role that many business-led Local Enterprise Partnerships are playing in efforts to attract new investment, supporting regional economic growth and rebalancing the UK economy. Through measures such as Enterprise Zones and Catapults there is much that can be done to boost growth outside London and South East of England. We will remain actively involved in this work in the areas in which we operate.

Tata is committed to engaging with the Government and partners to help the UK develop and implement an effective long-term Industrial Strategy that promotes engineering as an integral part of the country’s economic future.
APPENDIX
Contributors

Dr David Landsman OBE

David Landsman is Executive Director at Tata Limited, the promoter company for Tata enterprises in Europe – a group of 19 companies producing everything from tea to IT, and from cars, to salt, to steel.

Many Tata companies operating in the UK are engineering and innovation leaders in a wide range of fields, from driverless cars to artificial intelligence to advanced manufacturing. Tata companies employ more than 60,000 people in the UK, including thousands of engineers, and collectively are one of the country’s largest investors in R&D.

Before joining Tata, David spent his career with the UK’s Foreign and Commonwealth Office, latterly as Ambassador to Greece, and where he spent two years’ secondment to manufacturing firm, De La Rue plc.

He holds a doctorate in linguistics from the University of Cambridge.

About Tata

Tata Group is one of the world’s oldest and largest business organisations. Founded in 1868 and with a presence in London since 1907, there are 19 Tata companies operating across Europe, with well over 60,000 employees in the UK and a presence in almost every European country. Around the world, the family of more than 100 Tata companies operates on six continents, generating more than $103bn in global revenues annually.

In the UK, Tata is among the largest employers, operating in more than 40 towns and cities. It is the company behind such well-loved brands as Jaguar Land Rover, Tetley Tea, and Taj Hotels, as well as cutting edge research and technological innovation driven by other companies within the group such as Tata Communications, Tata Consultancy Services, Tata Technologies and Tata Elxsi.

It is also engaged in UK industrials via the activities of companies including Tata Chemicals and Tata Steel.

For more information, visit www.europe.tata.com.

José Lopes CEng FIET FI Mech E

José Lopes is Head of Technical Excellence at Jaguar Land Rover, responsible for nurturing and developing engineering skills and competencies across the business. This includes developing the skills needed to support the company’s advanced low-carbon vehicle development and research, and ensuring that new engineering graduates and higher apprentices are given the necessary skills to support their future growth.

José joined Jaguar Land Rover as a graduate trainee in the R&D division in 1985, and has previously held roles as Group Leader of Jaguar Vehicle Dynamics and Group Leader of Stability Control Systems.

In addition to his role with Jaguar Land Rover, Jose is Chair of the Skills group of the UK Automotive Council, trustee of SEMTA and chair of governors of the WMG Academy for Young Engineers in Coventry.

He is a Chartered Engineer, Fellow of the Institution of Mechanical Engineers and Institution of Engineering and Technology and Companion of the Chartered Management Institute. He graduated from the University of Wolverhampton with a degree in Applied Physics and a MPhil in the Analysis of Steel.

About Jaguar Land Rover

Jaguar Land Rover is the UK’s largest automotive manufacturer, built around two iconic British car brands: Land Rover, the world’s leading manufacturer of premium all-wheel drive vehicles, and Jaguar, one of the world’s premier luxury sports saloon and sports car marques. The company was acquired by the Tata group in 2008.

The company employs 26,000 people in the UK, 38,000 globally and supports around 275,000 more through its dealerships, suppliers and local businesses. Manufacturing is centred in the UK, with additional plants in China, Brazil and India.

The largest investor in R&D in the UK manufacturing sector, Jaguar Land Rover has invested £12 billion in the last five years and in the current year alone will spend over £3 billion on new product creation and capital expenditure.

For further information, visit www.jaguarlandrover.com.

Julie Woods-Moss

Julie Woods-Moss is Tata Communications’ President, Chief Innovation and Marketing Officer. She is responsible for all company-wide marketing and communications, as well as Tata Communications’ innovation mandate, working closely with innovation ecosystems and leading the company’s internal entrepreneurship programmes.

Julie is passionate about the role of women in STEM. She is the founder of Tata Communications’ “Winning Mix” group, established to promote the professional development of women at Tata Communications.

Following a degree in Telecommunications Engineering at Plymouth Polytechnic, she began her career as an encryptor within the satellite industry. She remains proud to be a qualified engineer, which has proven a substantial asset in building her business career.

Julie has more than 20 years’ experience in senior executive roles with leading international corporations including IBM, UPC and BT. At IBM, she was Director of Global Sales and Distribution for Mobile Solutions and Chief Operating Officer for IBM’s Emerging Markets.

She is on the list of Global Telecoms Business ‘50 Women to Watch in 2016’ and in the Economic Times Telecoms ‘Top Ten Women Across The Globe 2016’.

About Tata Communications

Tata Communications works with multinational enterprises and service providers, leading from the front to create an open infrastructure, partner ecosystem and platforms for businesses to stay competitive in this digital age. With a strong presence in both developed and emerging markets, the company is an enabler of information and communication technology globally with a broad range of services including network services; voice, data and mobility solutions; unified communications and collaboration tools; managed security; content management; media and entertainment services; and cloud and data centre solutions. Tata Communications owns and operates one of the most advanced and largest subsea cable networks, including the only wholly-owned fibre ring around the world. This network enables customers and partners to reach 99.7% of the world’s GDP, with connectivity to 240 countries and territories.

For further information, visit www.tatacommunications.com.
The Institution of Mechanical Engineers, in collaboration with the Tata group, conducted an online survey of 1158 members of the Institution over December 2016 and January 2017. Respondents were all current members of the Institution, and therefore qualified engineers. Of the respondents:

- 6% were aged between 18-24
- 42% were aged between 25-44
- 22% were aged between 45-54
- 17% were aged between 55-64
- 14% were aged over 65

The most common sectors for engineers to work in were:

- Automotive (16%)
- Manufacturing (14%)
- Power (including Nuclear) (13%)
- Oil and gas (11%)
- Aerospace (10%)
- Defence (7%)

The least common sectors included Biomedical (2%), Computers and IT (1%), Shipping (1%) and Mining and Quarrying (less than 1%).

The majority of respondents were based in:

- The Midlands (East and West) (23%)
- South East England (excluding London) (17%)
- South West England (14%)
- Scotland (11%)
- North West (11%)

The regions with the fewest numbers of respondents were Wales (3%), North East England (3%), and Northern Ireland (1%). Two per cent of respondents came from outside the UK.

Survey percentages are rounded to the nearest whole number throughout this document. Percentages may add up to more than 100% due to the nature of the questions asked, and rounding of figures.

About the Institution of Mechanical Engineers

The Institution of Mechanical Engineers was established in 1847 and has some of the world’s greatest engineers in its history books. It is one of the fastest growing professional engineering institutions. Headquartered in London, we have operations around the world and over 115,000 members in more than 140 countries working at the heart of the most important and dynamic industries such as the automotive, rail, aerospace, medical, power and construction industries.

www.imeche.org
If you would like any further information or discussions on any of the contents or topics included in this paper, please contact:

**Adam Barriball**
Director of Corporate Communications, Tata Limited
Adam.Barriball@tata.co.uk (+44 020 7235 8281)

**Alexander Ehmann**
Head of UK Public Affairs, Tata Limited
Alexander.Ehmann@tata.co.uk (+44 020 7235 8281)
About Tata

Tata is one of the largest investors in manufacturing in the UK and a major UK employer and investor in people.

600,000

EMPLOYEES GLOBALLY
Tata is supported by over 600,000 employees globally

£8 billion

UK GDP CONTRIBUTION
The Group’s contribution to UK GDP is over £8 billion

£65 billion

GLOBAL REVENUES
Global revenues have reached approximately £65 billion across Tata companies*

Jaguar Land Rover, the largest manufacturer of premium vehicles in Britain, is headquartered in the UK.

Tata Consultancy Services serves more than 350 clients in Europe, including British Airways, BT, Marks & Spencer and the Home Office.

The Shard, currently the tallest building in the European Union, contains nearly 1,000 tonnes of steel produced by Tata Steel.

66% of the equity of Tata Sons, the promoter holding company, is held by philanthropic trusts.

Jaguar Land Rover and Tata Motors are collaborating with the University of Warwick and the UK government to build the £150m National Automotive Innovation Centre in Coventry, the largest facility of its kind in Europe.

Tetley is the second largest tea brand globally and is the most bought tea brand in the UK.

Over 24% of the world’s internet routes are on the Tata Communications’ network.

Tata Technologies will be opening a new £20m European Innovation & Development Centre (EIDC) in Leamington Spa in the Spring 2017.

£25 billion

COMBINED UK REVENUES
The Tata group’s combined UK revenues are over £25 billion

40

TOWNS AND CITIES
Tata companies operate in more than 40 towns and cities across the UK

19

COMPANIES
Tata operates 19 companies based in the UK

60,000

TATA UK EMPLOYEES
Tata companies employ over 60,000 people across the UK

DILIGENTA | JAGUAR LAND ROVER | TAJ GROUP | TATA CAPITAL | TATA CHEMICALS | TATA COMMUNICATIONS | TATA CONSULTANCY SERVICES | TATA ELXSI
TATA GLOBAL BEVERAGES | TATA INTERACTIVE SYSTEMS | TATA LIMITED | TATA MOTORS | TATA STEEL EUROPE | TATA TECHNOLOGIES | TKM GLOBAL LOGISTICS