

THE FUTURE MANUFACTURING ENGINEER: READY TO EMBRACE MAJOR CHANGE?

Institution of
**MECHANICAL
ENGINEERS**

IET The Institution of
Engineering and Technology

Predictions on the future of the
manufacturing engineer as foretold
in a joint IMechE/IET survey



Improving the world through engineering

“““

Manufacturers must continually enhance their digital and complementary soft skills to thrive in the sustainable design, production, operation, and maintenance of their products.

Dr Martin Cross CEng FIMechE

Chair

Manufacturing Industries Division
Institution of Mechanical Engineers

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Engineering has a pivotal role to play in delivering net zero within the manufacturing sector. There has never been a more exciting time for engineers to make it so.

Jeremy Hadall CEng FIET

Chair

Design and Production Sector Executive Committee
Institution of Engineering and Technology

This report presents the findings of the IMechE and the IET 'Future Manufacturing Engineer' survey created and peer reviewed by the IMechE's Manufacturing Industries Division and the IET's Design and Production Sector.

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Executive Summary

This report presents the results of a survey, jointly commissioned by the IMechE and the IET, exploring the views and thoughts on the future manufacturing engineer.

The headline results reveal that skills in automation, robotics, and mechatronics are thought to be the most important for manufacturing engineers (84%) in the next ten years. These skills were followed by artificial intelligence (69%) and sustainable, lean, resource efficient, manufacturing (65%).

67% of respondents feel that the anticipated rate of major change will occur in the next 5–10 years. Barely 32% feel major change will occur in the next 5 years.

Communication skills, creativity and design thinking ranked as the top three softer skills of 'highest importance' for future manufacturing engineers.

Energy, transport, and the circular economy were perceived as the top three challenge areas where manufacturing engineers can make the most significant contribution.

Education remains a sticking point: There was no shortage of ideas from respondents on ways to better align manufacturing engineering college and degree-level courses with the needs of industry employers.

In response to these results, the IMechE and the IET recommend:

For those seeking to start or continue a career in manufacturing engineering: Ensure you have the complementary training and support as well as your technical skills to develop your career and secure the success you seek.

For those seeking to recruit, train and retain manufacturing talent at all levels: Recruit flexibly and then invest in your people to bring out their ideas, agility, and contributions.

For those providing education and training to the next generation of manufacturing engineers: Seek to develop a pipeline of versatile and digitally-literate problem solvers who are prepared to be lifelong learners in a rapidly changing environment. Multi-disciplinary skills and knowledge, including in sustainability, energy systems, and behavioural science – alongside traditional engineering and science disciplines – should be a central part of the skills pathway for next generation manufacturing engineers.

For the IMechE, the IET and other relevant professional engineering institutions: Collaborate widely with others, especially non-engineers, to detect change coming more quickly than you expect. Support the UK sector embracing and exchanging new ideas with others across the world to ensure productive manufacturing for all.



Introduction

In late 2020, the IMechE and the IET came together to discuss what the future manufacturing engineer might possibly look like. What are the key skills that engineers will need to survive and thrive?

Expert volunteers from the respective IMechE and IET manufacturing panels worked together to produce a survey with relevant questions targeted to gauge an understanding of what engineers in the sector think.

The topics in the survey questionnaire included how manufacturing engineering roles may change in the future, which competencies will be most important, and where manufacturing engineers can make the most significant contribution to finding answers to some of humanity's greatest global challenges.

A compelling narrative based around those future challenges, written by David Wright, Director of Strategic Relationships at Coventry University, was published to engage hearts and minds. This can be found on the IET and IMechE websites alongside this report, together with the survey results.

Five global challenges – where engineers can make things happen

1. **Transport:** How do we move people and goods?
2. **Energy:** How do we generate and distribute enough energy to sustain cities and their communities?
3. **Food:** How do we feed 10 billion people?
4. **Health:** How do we meet peoples' health and well-being needs?
5. **Circular Economy:** How do we ensure that we make best use of resources?

The survey was promoted widely to IMechE and IET members and contacts and via social media and mailing lists, generating 346 responses^[1]. These came from a cross section of age groups, ranging from 18 to over 75 years old, and from different levels of seniority, with the most common job descriptions being Senior Engineer and Consultant.

This report presents a snapshot as to what engineers are thinking and feeling about where manufacturing engineering is currently and how it will evolve in the future years.



Key Findings – In Summary



84%

Automation, robotics, and mechatronics top the poll (84% of those responding) when it comes to perceptions as to what **the most important knowledge and skills** will be for manufacturing engineers in the next ten years.



69%

Artificial intelligence polls second highest (69%).



65%

Lean principles/sustainable manufacturing polls third highest (65%) with many respondents **most interested in working in the energy and circular economy sectors** in the future.



67%

67% of respondents feel that the anticipated rate of **major change will occur in the next 5–10 years**, with almost 75% anticipating continuity of major change in 10–20 years' time. Barely 32% feel major change will occur in the next 5 years.



54%



54%



47%

Future manufacturing engineers will need strong soft skills to survive and thrive, with **communication skills (54%), creativity (54%), and design thinking (47%)** ranked as the top three competencies of 'highest importance'.



Energy, transport, and the circular economy are the top challenge areas where manufacturing engineers can make **the most significant contribution**.



Education remains a sticking point: There was no shortage of ideas from respondents on ways to better align manufacturing engineering college and degree-level courses with the needs of industry employers.

Key Findings – In Detail

Automation, robotics, and mechatronics top the poll (84% 289/346) when it comes to perceptions as to what the most important knowledge and skills will be for manufacturing engineers in the next ten years.

Comment: This finding is significant not least given the backing given to the on-going digital transformation of the UK manufacturing sector. This aligns with the emphasis placed on digitalisation by industry leaders and commentators, and as reflected in the strong support provided through initiatives such as the Government-backed 'Made Smarter' programme^[2] and by organisations such as the High Value Manufacturing Catapult^[3].

This finding may also help to allay some fears that mass automation of manufacturing processes will reduce the number of jobs in the sector. Given the rapid pace of change in technology, engineers will have to upskill/retrain multiple times throughout their careers. Creating a diverse education market to deliver such upskilling and retraining will be required, at scale.

Artificial intelligence polls second highest (69% of those responding, 240/346).

Comment: Something of a surprise perhaps, when one considers the relatively low yet rising incidence of applied AI in UK manufacturing^[4], at the present time. This is, nonetheless, an important message. Clearly, future manufacturing engineers will want to harness the massive increase in data availability and analytics being enabled through increased investment in digital. As AI in manufacturing could be pivotal in the future of manufacturing engineering, alongside robotics and automation, more can be done to encourage UK manufacturers to utilise this technology and implement it in their factories.

Sustainable manufacturing polls third highest (65% 226/346) with many respondents most interested in working in the energy and circular economy sectors in the future.

Comment: Complementing emphasis on digital futures, the impact of net zero targets, now enshrined in law, carries massive implications for manufacturers and something which future manufacturing engineers want to embrace.

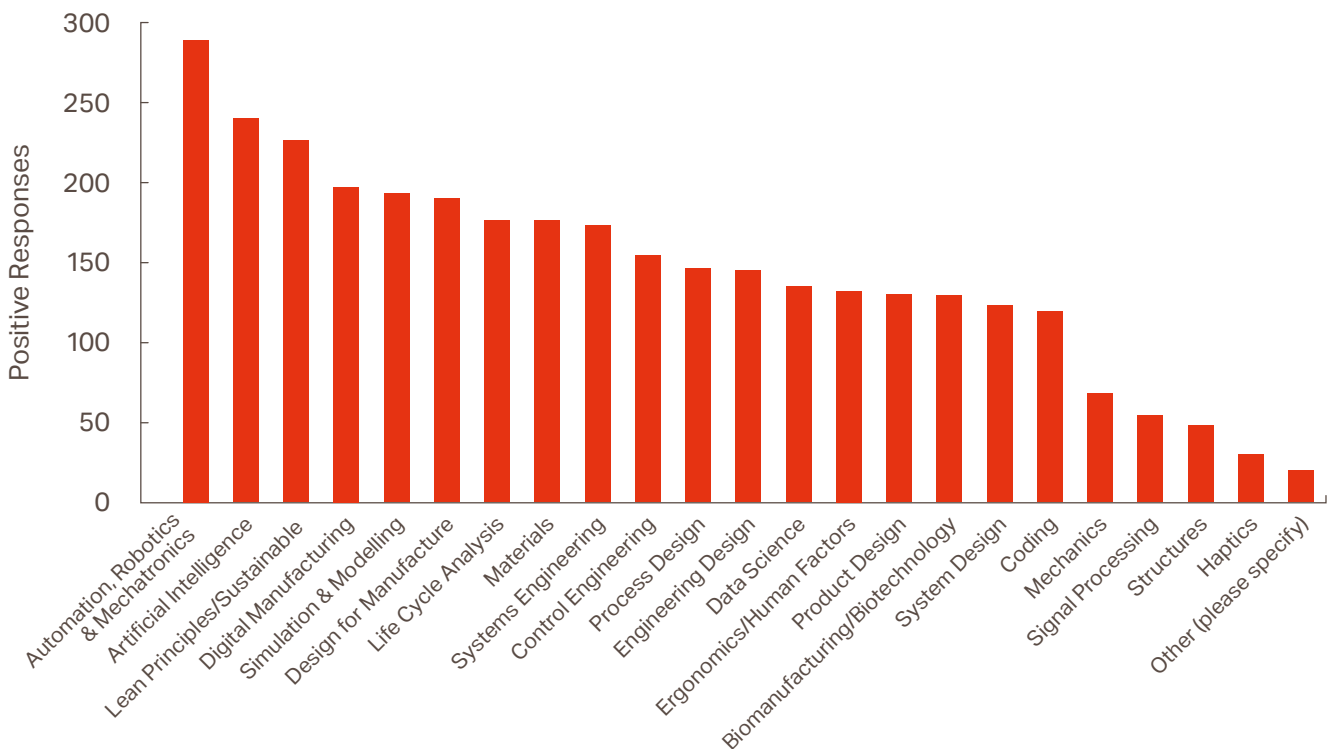
On sustainability and climate change, future manufacturing engineers will be at the forefront of securing improved non-labour, resource productivity, and with that, increased productivity too, making more with less.

As manufacturers come to terms with the impacts of Brexit, the COVID pandemic and future shocks and disruptions on their liquidity, their workers, customers and suppliers, sustainable resource efficient manufacturing will be a prerequisite to building a resilient business.

The largest group of our respondents were currently working in the transport sector (105/315) followed by energy (86/315). However, when asked which areas would interest them in the future, working in energy polled top (130/474 NB. Multiple answers permitted) followed by the circular economy (98/474).

These results reflect public awareness of the need for cleaner air and energy and the influence that transport has on this, as these topics have been widely discussed in the media and general society in recent times.

Figure 1: Important knowledge and skills for manufacturing engineers in the next 10 years



When it comes to the anticipated rate of major change, over 67% of respondents (232/346) feel that this will occur in the next 5–10 years, with almost 75% (257/346) anticipating continuity of major change in 10–20 years' time. Barely 32% (109/346) feel major change will occur in the next 5 years.

Comment: Manufacturing engineering and the way we do things is changing and there are certain factors that are influencing this. The pandemic has, of course, had an impact on our lives and engineering has shown us the way in which we can adapt and work differently yet efficiently. Yet the relatively low level (32%) of those anticipating major change in the first five years is surprising.

Action and investment would seem to be required now, as the UK economy returns post-COVID, to enable firms to keep up with their overseas competitors. Greater alignment of education (supply) and industry (demand) timescales is equally challenging. Even if major change does not happen until 2026–2031, this is a relatively short space of time for schools and colleges to respond to.



Future manufacturing engineers will need strong soft skills to survive and thrive, with communication skills, creativity and design thinking ranked as the top three competencies of 'highest importance'.

Comment: Many respondents felt that future engineers will need to have multi-disciplinary skills to be effective. Of the many anecdotes received, this comment was typical...

'Future engineers will be part of a cohesive team where interpersonal skills will be paramount to ensure an efficient outcome'

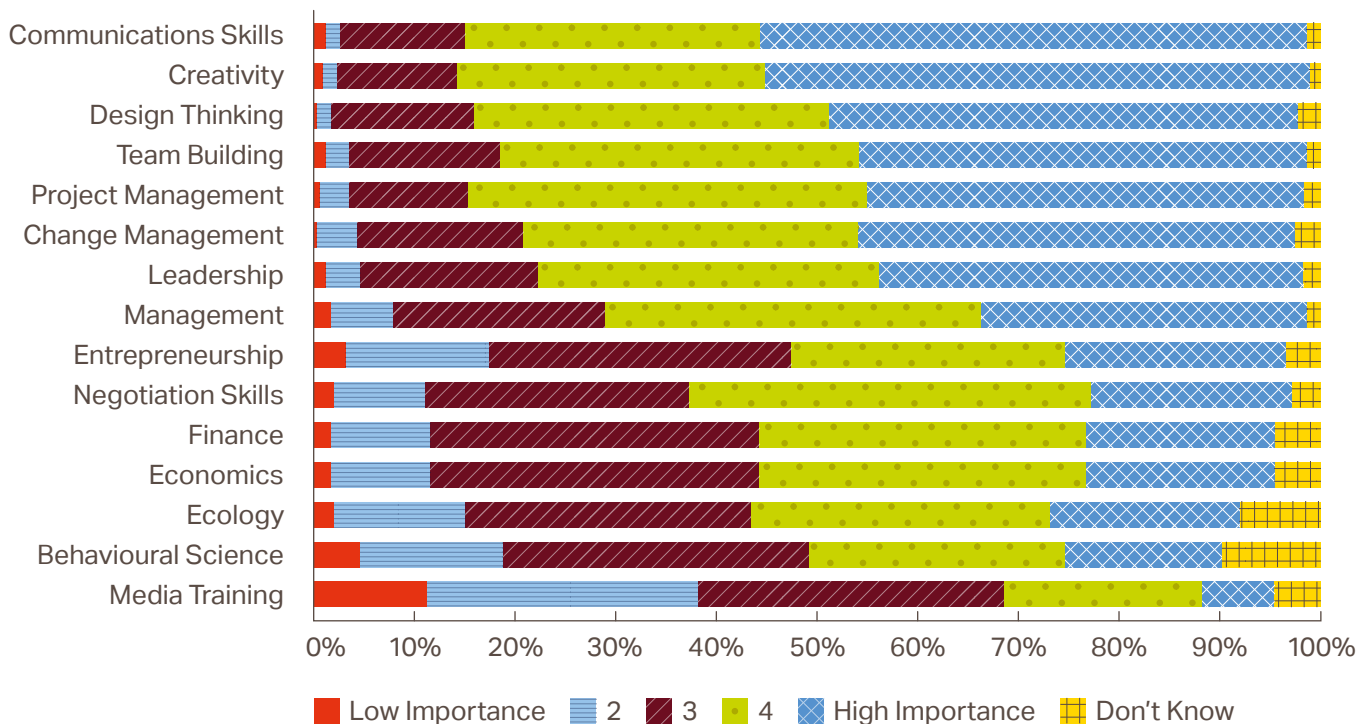
The thought of multi-skilled engineers being important was mirrored in answers to another question. Where comments included...

'Soft skills keep coming up. The thought is that anyone can do anything with the correct technical attitude, but so often we are rejected because of irrelevant technical skills'.

There were many comments alluding to a similar feeling of the emphasis on soft skills. This would also be relevant to engineers becoming both multi-skilled and well-rounded.

As can be seen in the chart below, of the competencies listed, communication skills, creativity and design thinking polled as the top three competencies of 'highest importance'.

Figure 2: Important competencies to the role of manufacturing engineers in the future

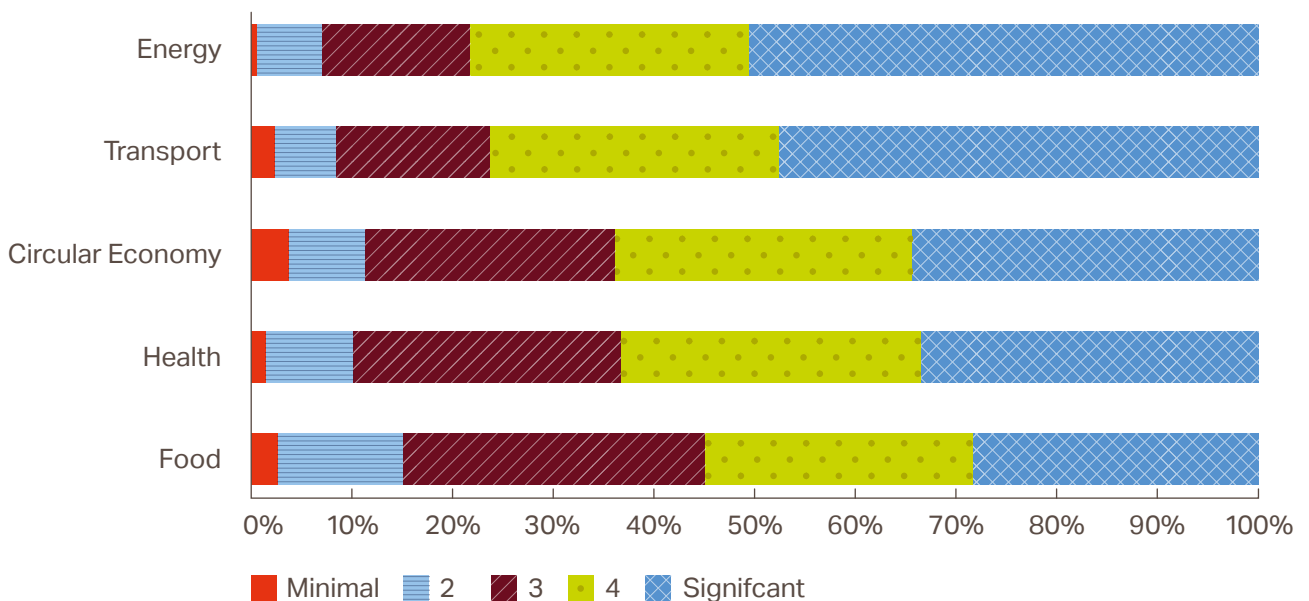


Energy, transport and the circular economy are the top challenge areas where manufacturing engineers can make the most significant contribution.

Comment: Massive demand and opportunities for energy and transport manufacturing engineers underlines the importance of net zero and digital futures. These leading sectors will generate an increased demand for manufacturing engineers as the UK rolls out production of electric vehicles, battery storage technologies, and the charging infrastructure to support them. Electrification of other modes of transport will heap further pressure on employers and colleges to recruit, retain and train manufacturing engineers with the necessary skills.

There will be a likely increased requirement in the number of manufacturing engineers with electrical and digital skills. This poses some very interesting opportunities and challenges for the manufacturing engineers concerned, whether those just coming into the sector or those already working in it, yet with requirements to upskill or retrain.

Figure 3: The impact of manufacturing engineers on different sectors over the next 10 years



Education remains a sticking point: There was no shortage of ideas from respondents on ways to better align manufacturing engineering college and degree-level courses with the needs of industry employers.

Comment: The Government's most-welcome White Paper (January 2021)^[5] on 'Skills for Jobs: Lifelong Learning for Opportunity and Growth' with its promise of putting employers at the heart of the system, investing in higher-level technical qualifications and the Prime Minister's Lifetime Skills Guarantee provide huge potential for the future.

We asked respondents for their general thoughts as to how we can best help the next generation of manufacturing engineers to forge a successful career and have a positive impact on industry. Many written responses to this question were received relating to education, knowledge sharing and skills flexibility. Comments such as...

'Less theory and more practical experience while at college/university'.

As professional engineering institutions, the IMechE and IET play an important role in engaging with schools, introducing engineering to students from a younger age and from across wider society to drive diversity, and in working with employers (through programmes such as Corporate and Enterprise Partnerships).

'Ensure there is no knowledge lost from the previous generation. There's a big shift towards qualifications which while important doesn't teach the skills and experience gained through working with one's peers'

Knowledge sharing can be difficult to achieve by the institutions alone. Close engagement with apprenticeship and graduate programmes will be required. The institutions encourage members to influence younger generations with this, as many members have a wealth of experience that can be shared and valuable to prospective engineers at an early age.

Both institutions continue to promote manufacturing engineering careers, to champion continuous professional development (CPD) towards professional registration (Chartership) and to celebrate engineering excellence through good practice standards, codes, and guidance.

Recommendations

Based on the results of this survey, we have highlighted the following key action areas.

For those seeking to start or continue a career in manufacturing engineering: Ensure you have the non-engineering training and support as well as your technical skills to develop your career and secure the success you seek.

Manufacturing offers an exciting future with good prospects, an opportunity to learn and apply valuable technology-based skills such as automation, robotics, mechatronics, AI and lean, green, resource efficient, sustainable manufacturing. Transferable soft-based skills such as communication skills, creativity, and design thinking will become increasingly important.

Engineers will play a pivotal role in meeting society's biggest challenges such as sustainability and climate change, digital futures, and healthy lives. Explore the opportunities and benefits of being a member of a professional engineering institution, your professional home for life.

For those seeking to recruit, train and retain manufacturing talent at all levels: Recruit flexibly and then invest in your people to bring out their ideas, agility, and contributions.

A thriving UK manufacturing sector, one which can add new overseas markets, and build the confidence needed to unlock sustainable jobs and prosperity, is possible^[6]. Invest in new digital technologies, net zero measures, and above all, invest in your people.

Consider the importance which many of today's young people place on issues such as climate change, sustainability, and other great challenges^[7] facing the world. Their passion and ambitions in respect of these issues may well help to inform their education and employment choices, inspiring some to become manufacturing engineers.

Understand what net zero means for your business and invite your young engineers to get involved in shaping and creating a company-wide net zero plan.

It is only by building a sustainable operation that you can become a resilient business. After a long period of stability and relative calm, impacts caused by Brexit and COVID disruption created varying levels of distress and changes in direction, across UK manufacturing, and particularly for SME manufacturers. You should prepare for future shocks.

Collaborate with local schools and colleges to generate interest in STEM subjects and careers and improve the work-readiness of new recruits^[8]. Provide meaningful and valuable work experience. Commit to thorough life learning for all. Ensure all workers have personal development plans in place, together with the opportunity to embrace top-up and new skill courses, on a regular basis.

Employers should also recognise that new recruits to the profession bring with them digital skills which could find a natural home in many manufacturing engineering environments. This could be of a significant advantage to a manufacturing firm looking to implement digital technologies. Equally, this talent pool can play a positive role in helping upskill the rest of the workforce.

Take advantage of Government-backed training schemes, where appropriate, such as the present-day proposals for Lifelong Learning. Remember you are not alone. Talk to your customers, your suppliers and neighbouring businesses in your area and gain further inspiration by encouraging your managers to go out and have similar conversations. Where appropriate, seek knowledge transfer partnerships working with your local KTN adviser, local colleges, universities, and research centres.

For those providing education and training to the next generation of manufacturing engineers:

seek to develop a pipeline of versatile and digitally literate problem solvers who are prepared to be lifelong learners in a rapidly changing environment. Multi-disciplinary skills and knowledge, including in sustainability, energy systems, and behavioural science – alongside traditional engineering and science disciplines – should be a central part of the skills pathway for next generation manufacturing engineers.

All those involved in training, retraining, and upskilling engineers need to recognise the rapidly evolving nature of the field. Universities and technical colleges should work with the IMechE and IET to actively manage and regularly refresh their syllabi for future manufacturing engineering apprenticeships, undergraduate and post graduate courses. There will be a crucial role for agile CPD training providers to provide emergent skills support to enable engineers to maintain fresh and relevant capabilities.

COVID reduced the number of apprenticeships commencing in Autumn 2020 with knock-on impacts for FE colleges. Moving forward, the number of young people coming into the manufacturing engineering workforce will need a sizable boost as the country reopens from lockdown. Improving the links between schools and manufacturing firms in their local area may yet prove to be a significant source and access point for young people seeking paid employment and a career within manufacturing engineering which offers good prospects for the future.

For the IMechE, the IET and other relevant professional engineering institutions:

Collaborate widely with others, especially non-engineers, to detect change coming more quickly than you expect. Support the UK sector embracing and exchanging new ideas with others across the world to ensure productive manufacturing for all.

Continue to celebrate the role which engineers and engineering play in taking the UK manufacturing sector forward. Detail the public good which the manufacturing engineering community contributes to society to help attract new entrants to engineering and the manufacturing sector.

Membership of a PEI can be a constant throughout working life, a vital counterpoint to what are likely to be multiple changes in job roles, technical focus, and employers. The IET, the IMechE and other institutions can form part of an important eco-system which supports members during their careers, helping them to learn new skills (eg agility, flexibility etc) and deal with challenging scenarios (eg shocks, disruptions).

As the survey reveals, increasingly the impacts of greater inter and multi-disciplinary approaches will require manufacturing engineers to have a good command of the soft, non-engineering skills.

Manufacturing engineering expertise and skills are needed to address climate change and the passage to net zero. The PEIs can help improve the understanding of the manufacturing net zero challenge by sharing and disseminating information, including member case studies showcasing current good practice.

Working with industry and business to highlight engineering and technology adoption within manufacturing, the PEIs must champion the manufacturing sector, providing evidence and input to governments, policy makers and politicians on the prosperity and public good it contributes to society.

Next Steps

The IMechE and the IET will now review the survey results and distil the outputs. The feedback received will help to inform the forward programming and manufacturing priorities of both institutions and create opportunities for further IMechE/IET collaboration.

In respect of the recommendations, the IMechE and the IET will explore possible workstreams to take these forward including respective and collective plans for further research and engagement with manufacturing members and contacts.

Please get in touch if you would like to know more about this survey and or the manufacturing activities and interests of both institutions.

For the IMechE visit <https://www.imeche.org/industry-sectors/manufacturing>

For the IET visit <https://www.theiet.org/impact-society/sectors/design-and-manufacturing/>

With thanks to all those who completed the survey and all those involved in the production of this report.

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