POWERING TECHNOLOGIES FOR TOMORROW'S SOCIETY

Professor Charlotte Deane is Executive Chair of the Engineering and Physical Sciences Research Council (EPSRC) within UK Research and Innovation (UKRI)

Innovations in engineering and physical sciences created the world we know today. Continued strategic investment in research will ensure we're ready to tackle the challenges of tomorrow, too.

Take a look around and much of what you see is the result of engineering and physical sciences (EPS) research. Take the mobile phone in your pocket as an example. It is connected through communications networks that build on research into infrared lasers in the 1980s. It's powered by rechargeable lithium-ion batteries developed through ground-breaking discoveries in chemistry. The LED screen was made possible by advanced materials scientists, and its functions are ever evolving thanks to the progress of semiconductors research.

It's not just your phone. The roads you travel on are designed by civil engineers; their traffic flow optimised with algorithms created by computational engineers. Each year, millions of Magnetic Resonance Imaging (MRI) scans, based on work by physicists going back to the 1970s, enable medics to better diagnose and treat illnesses, and the NHS is increasingly informed by healthcare data made possible by computer scientists. EPS research is even making your clothes cleaner, through chemical engineers working with companies like Procter and Gamble to devise new laundry detergents that boost cleaning at lower temperatures and with less water.

From communications to transport, manufacturing to healthcare, decades of EPS research underpins every aspect of our lives. And it is not just solving today's problems. EPS research is also laying foundations for the future.

Advances in emerging technologies, such as AI, engineering biology, semiconductors and advanced communications, will continue to create transformational change. The UK is a world leader in quantum technology research, for example. The potential of quantum technologies to handle incredibly complex tasks will impact major aspects of our society, from drug discovery to weather prediction, financial services to cyber security.

The Engineering and Physical Sciences Research Council (EPSRC) helps drive the UK's world-leading EPS research. Our investments support the people, systems and ideas that will

power these technologies of tomorrow; unlocking new jobs and economic opportunity, tackling major challenges and transforming society.

CREATING A STEM WORKFORCE FOR THE FUTURE

Brilliant research is driven by brilliant people, so training the next generation of thought leaders and innovators is key. Investing in people is at the core of EPSRC, from training PhD students through to fellowships and grants for those advanced in their research careers.

For the economy and society to be competitive and thrive, we need a pipeline of skills: the quantitative decision makers that underpin so many industries; those who understand how to harness AI for public good; the robotics engineers transitioning manufacturing to 'smart' factories. EPSRC recently announced a £1 billion investment in our Centres for Doctoral Training (CDTs) to train this future workforce, working across myriad sectors from pharmaceuticals to finance, national security to the NHS.

CDTs have supported people such as Jana Skirnewskaja, University of Cambridge, who has developed new in-car technology with holographic projections that could help drivers see hazards and reduce traffic accidents.

Then there's Melanie Whitfield, who is developing an 'electronic nose' that can detect food spoilage before it can spread, cutting food waste and carbon footprint. She is now working with a food distribution company to put her research into practice.

Working with industry in this way is also a crucial part of our Industrial Cooperative Awards in Science & Engineering (ICASE). Students are tackling real-world industry-led problems. Like ICASE student Stuart Colville, who is working with Airbus to develop fuel tanks for aircraft powered by more environmentally friendly liquid hydrogen.

BUILDING OUR NATIONAL CAPABILITIES

In the UK, we are fortunate to have a powerful research and innovation system – a world-class asset. One of the roles of EPSRC is to keep us in this top tier by ensuring we continue to fund areas where the UK leads, as well as expanding into areas important to our future national capabilities.

Investment in infrastructure is vital. There's physical infrastructure, where we have funded state-of-the-art facilities, such as the National Wind Tunnel Facility+ (NWTF+). This network of 22 world-leading wind tunnels keeps the UK at the forefront of aerodynamic and fluid mechanics research by replicating real-life conditions in aviation, aerospace, rail, defence, civil engineering and environmental science.

Then there's our increasingly important digital research infrastructure. This provides researchers with computer facilities tuned to their needs, unlocking advances in simulations, modelling and calculations critical for addressing global challenges.

For example, the combination of high-capacity processing power, memory, data storage and networks of the Advanced Research Computing High-End Resource (ARCHER) enabled researchers to run computer simulations that helped design COVID-19 vaccines and medicines. It's since been superseded by ARCHER2, which is 11 times more powerful, and available to thousands of academic, business and government users to work on challenges from designing more efficient jet engines to understanding the impacts of climate change on coastal communities.

PARTNERING WITH BUSINESS AND INDUSTRY

EPSRC is catalysing the research and innovation the UK needs to tackle local, national and global problems. For example, our Prosperity Partnerships bring together leading UK-based businesses and universities to develop transformative new technologies, processes and skills to deliver societal impact and economic growth.

These include EPSRC spin-out company Oxford PV, which is working with the University of Oxford to develop a next generation of solar cells that are more efficient and cheaper to produce. A Prosperity Partnership between haptics experts Ultraleap and University College London is developing technology that allows people to 'feel' virtual 3D objects, like 'tactile holograms'. While the Universities of Manchester and Cambridge are working with consumer goods company Unilever to pioneer digital manufacturing techniques that fast-track new products from lab to supermarket shelf.

I believe that good research works equitably across the system. It's not the role of universities to come up with ground-breaking ideas and then throw them out to the world for someone to implement. Similarly, it's not the role of business to demand what academics should research. Our Prosperity Partnerships drive true linkage through co-research and co-investment – with £240 million from businesses alongside £61 million from universities and £182 million by EPSRC since 2017.

They show that connectivity and collaboration are vital to understanding the contexts and challenges of both industry and academia – and are key to unlocking knowledge and innovations that address key industrial challenges of the coming decades.

INVESTING IN IDEAS

Investment in EPS research is great value for money. EPS research has supported more than 900 spin out companies, creating 29,000 jobs and £6 billion in revenue. It also benefits the public sector and wider society through increased productivity and efficiency.

Perhaps more importantly, EPS research helps safeguard our future economy and society. Climate change, future pandemics, the transformation of our digital world – we don't know what we might need to know, and EPS research hasn't yet produced a time machine! However, personal experience has shown me that what we do know is the UK needs a thriving research base to address the challenges of now and the future.

During the pandemic, I worked as UK Research and Innovation's COVID-19 Response Director. There were many, many challenges the research community had to address at pace. We saw the unparalleled speed with which the Oxford AstraZeneca vaccine was developed and rolled out – thanks not only to ground-breaking research in immunology but also EPS research in manufacturing. Then there were practical solutions, such as an innovative system that used gases to speed clean ambulances, which was designed by chemical engineers in less than two weeks.

We were able to rapidly respond to problems thanks to clusters of researchers, working across EPS and with other disciplines, that could draw on decades of research and apply their collective knowledge to address unforeseen challenges.

Public funding plays a unique role in the R&I ecosystem. It is an investment in new ideas and the people who have them. The long-term, strategic approach of public funding enables research that addresses the challenges of the next five to ten years, and decades beyond. It allows the UK's most brilliant minds to creatively and freely explore areas that lay the foundations for future economic and societal change – not to mention the next generation of mobile phone in your pocket. ■