THE IMPORTANCE OF THE MEASUREMENT INFRASTRUCTURE IN ECONOMIC RECOVERY FROM COVID-19

Dr Richard Brown
Head of Metrology, National Physical Laboratory

Richard Brown has worked at the National Physical Laboratory, the UK's National Metrology Institute, for 20 years having joined following his PhD at Imperial College London. He is currently NPL's Head of Metrology, with accountability for ensuring the quality of NPL's scientific output and for overseeing the accuracy of the UK's national standards of measurement, ensuring their comparability internationally, and enabling their dissemination through the UK's measurement quality infrastructure.

MEASUREMENT TODAY

Measurement is a fundamental activity which is invisible day-to-day, but supports the economy by underpinning science, technology, medicine, trade and industry. We actively use the products and services which are enabled by measurement science every day, because we have trust in their standards. This confidence does not happen by accident but is a result of a well-established infra-technology – our measurement infrastructure, which is based on a globally agreed system and implemented locally. It is an invisible glue that binds together science and technology and enables all progress. Metrology, the science of measurement, oversees the maintenance and improvement of the measurement infrastructure, continually responding to evolving societal needs.

The National Physical Laboratory (NPL) is the UK's National Metrology Institute (NMI). It holds the UK's measurement standards and is one of the six laboratories who make up the National Measurement System (NMS). This system provides the underpinning measurement infrastructure and technologies that are essential for enabling science, innovation, research and development, as well as facilitating trade. The measurement infrastructure is vital to the UK economy, for example due to its role in maintaining standards which enable trade, as well as by supporting industry to innovate. As a result, measurement science has a key role to play in accelerating the economic recovery from COVID-19, including in emerging sectors such as the digital economy.

MEASUREMENT SCIENCE CREATES THE FOLLOWING BENEFITS:

Measurement improves the effectiveness of science and R&D	The efficiency with which generic knowledge is converted into proprietary knowledge depends on access to research tools, techniques, and standards (Tassey, 2004). These core tools are public goods, known as infra-technologies, and determine the productivity of private R&D. NPL economists make the case that for the UK to achieve its target of investing 2.4% GDP into R&D, designed to boost productivity, businesses need to invest more in R&D (King & Renedo, 2020). It proposes that, to encourage this investment from industry, policy makers should invest in the infra-technologies which support R&D. Investment into measurement infrastructure technologies can support innovation and productivity by reducing the risks for businesses investing in R&D and optimising the process [1].
Measurement creates trust in the outcomes of R&D and innovation	Accessing reputable measurement services provides businesses and academics with greater confidence in their R&D. This confidence is then extended to others, who have greater assurance that the research or product is reliable, by virtue of its inventor's association with the reputation of the NMS labs. These factors enable private sector organisations to continue their innovation drive, and academics to continue research with confidence and trust from others. *"… by pinning NMS's reputation to our measurements, we are able to back up the claims we are making."* – NMS lab user

NPL National Physical Laboratory

Measurement improves efficiency of businesses by reducing waste, increasing productivity and value for money	Around 75% of all errors that occur in production are pre-determined in the earliest phases of manufacturing (Kunzmann et al., 2005). However, 80% of these failures are not detected until either the manufacturing process or after sale. Advanced metrology allows manufacturers to reduce their scrap-rates, by creating tighter production processes with better control of parameters that influence the quality of a final product (Orji et al., 2009). Secondly, between 2009 and 2017, there was a 5.5% increase in employment among businesses receiving regular support from the NMS (Belmana, 2020). Around 80% of this growth was additional, not seen in a matched control group, and employees moving to these NMS supported businesses received an annual wage premium of £2,600. This indicates measurement creates significant productivity benefits for industry.
Measurement accelerates innovation, getting products to market faster	To maximise productivity, the products of R&D need to be commercialised and brought to market as quickly as possible (Hawkins, 2017). A key driver in accelerating this process is giving potential customers or regulators confidence that a new technology works as well as its owner claims it does. Standards and accreditation are delivered through established methods for testing the performance of a product or process, which are rooted in measurement certainty. A survey of NMS users between 2014 and 2017 displayed the role of measurement in accelerating products to market. 80% of the NMS labs' business customers made a change to their products or processes, with 1 in 5 saying the change would not have happened without the support they received from the NMS labs. Similarly, the previous Measurement for Innovators programme, run by the NMS labs to provide free support to innovative businesses, found that businesses who completed the programme were around 11% more likely to file for a patent compared to comparative similar firms (Nwaigbo & King 2020).
Enables change to happen quickly, adding value	The efficiency or speed with which one type of knowledge is converted into another type of knowledge depends on having good access to appropriate research tools, techniques, and standards (King et al., 2017). These elements form the infra-technology needed for the reproducibility of experiments. Where supporting infra-technologies are not available, industry has a low success rate for knowledge transfer and commercialisation, as seen by biotech firms across the 1980s and 1990s (Tassey, 2004). For example, in 2005, only 12 of the 50 largest biotech companies were profitable and the industry was losing money, 25 years after the formation of the first company, Genetech.
Essential for the development and assessment of evidence-based policy	Measurement science provides vital evidence which underpins many policies. In 2015, a team aimed to fingerprint emissions from six municipal waste incinerators, and test for traces of these in ambient air samples. The analysis used metrology to detect of this, and found no evidence of incinerator emissions in ambient metal concentrations around four UK waste incinerators (Font et al., 2015). The conclusions of this paper were used in Parliamentary briefing notes on waste incineration facilities, as well as for the incineration of industrial and commercial waste.

MEASUREMENT FOR RECOVERY (M4R)

Increasing the adoption of better measurement will provide significant competitive advantage for the UK, as all nations now begin their recovery from COVID-19. It can help to accelerate the UK's recovery, making up for lost time and ensure resiliency for any future or further disruption. Running until the end of 2020, the BEIS funded Measurement for Recovery (M4R) programme [1] delivered by NPL and NMS partners [2] will provide 300 – 400 businesses with access to world-leading experts in testing and measurement, providing them with advice or short consultancies to support their response and recovery activities, free of charge. Within the first two months of the programme there have been nearly 150 applications from businesses across the UK with representation in England, Scotland and Wales.

MEASUREMENT FOR THE FUTURE

Whilst the measurement infrastructure supports all aspects of the physical world, there are several emerging sectors which go beyond the physical and have unique infra-technology needs. These topics include big data and the digital world, clean growth and achieving net zero carbon emissions by 2050, artificial intelligence, industry 4.0 and future communications, personal medicine and the ageing population.

As a result of their data intensive nature, these topics are not covered by the traditional measurement infrastructure, whose history evolved from the physical world of weights and measures. However, they require the stability and control that the application of measurement science brings, in order to advance rapidly. As a result, NPL has identified the need for the implementation of a new measurement infrastructure to unleash the potential of these emerging technologies and sectors which will revolutionise the society and economy. This new framework would build on the traditional measurement infrastructure to create a novel approach, not involving physical measurement standards.

THE INFRASTRUCTURE FOR THE FUTURE WILL CREATE THE FOLLOWING BENEFITS:

- Provide the focus for national and **global leadership in the development, validation and agreed standardisation of measurement methods**, making the UK a world leading superpower in these areas with a competitive advantage over other economies.
- The underpinning and flexible nature of this new measurement infrastructure

would be agile and universal, able to apply its principles to support, at short notice, new demands on the economy and UK government, providing **resilience to cope with any future national requirements or crises**. This would future proof the UK to flexibly develop and support yet-to-be-conceived technologies.

- The system will enable faster, more productive and efficient transfer of science into innovation to disseminate best practice for data assessment, interpretation, curation and reuse. It will form a new national infra-technology that supports technologies and challenges equally.
- It will place innovation at the heart of economic recovery and future growth and accelerate progress towards the government's 2.4 % R&D target.
- Lastly, a digital infrastructure will provide equal support across the regions and nations of the UK, supporting the levelling up agenda, as well as a progressive approach that ensures the UK attracts and retains a highly skilled, diverse workforce.

This proposed world leading measurement infrastructure is essential to the rapid, harmonious and widespread adoption of the digital economy, made even more crucial now as the UK seeks to recover from COVID-19. Read further evidence in Richard Brown's 2020 paper.

Footnotes

1 https://www.npl.co.uk/measurement-for-recovery

2 https://www.npl.co.uk/measurement-for-recovery/partners

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COVID-19: LESSONS TO BE LEARNED FROM PARLIAMENTARY SCRUTINY

The Right Honourable Greg Clark MP

Chair of the House of Commons Science and Technology Committee

Throughout the course of civilisation, great changes—societal shifts, wars, revolutions—have engendered great innovation in medicine, technology and automation. It is a privilege to Chair the House of Commons' Science and Technology Committee. Our country has a rich tradition of scientific discovery and is recognised around the globe as a world leader in scientific advancement. Perhaps now more than ever, the world appreciates the true importance of science and technology in our society, be it the video platforms connecting us with our loved ones, the software allowing some of us to continue to work from the safety of our homes, or the tireless work of medical researchers around the world racing to develop vaccines to help in our fight against COVID-19.

The times we are living through are unprecedented in our lifetimes. During the last six months the whole country witnessed the tireless work of NHS staff, civil servants, researchers and indeed all key workers. I speak not only for myself but for all of my colleagues when I say that their work is truly recognised by the Committee.

Yet much as crises spark innovation, they also deliver valuable lessons. In early March,