NATIONAL LABS ARE CRITICAL DURING A CRISIS AND BEYOND…

Dr JT Janssen is Chief Scientist at the National Physical Laboratory, the UK's National Metrology Institute that specialises in measurement science. JT is responsible for the quality of science and engineering research undertaken at the laboratory as well as strategic engagement with external scientific research institutions, universities and government. He heads the National Graphene Metrology Centre (NGMC), whose role it is to develop metrology and standardisation for the nascent graphene industry. JT is also a Scientific Co-Director of the Quantum Metrology Institute (QMI), which covers all of NPL's leading-edge quantum science and metrology research and provides the expertise and facilities needed for academia and industry to test, validate and ultimately commercialise new quantum research and technologies.

We are here to say "**if there is more we can do, we are here and we want to help**".
Our focus now is to help industry restart. NPL will continue to offer direct support to businesses, we will be developing the digital metrology, virtual testing and validation to reduce the time it takes to get products to market and offer the data quality infrastructure to help businesses make good decisions, based on reliable data.

NPL National Physical Laboratory

The National Physical Laboratory (NPL) is 120 years young this year – providing science and engineering expertise for the UK for over a century and as such we have weathered our fair share of crises. From wars to recession and now through a pandemic, the science and engineering community have always risen to the challenge and supported society to get back on its feet.

NPL is the UK's National Metrology Institute, we look after the measurement standards and measurement infrastructure for the UK. It may not be immediately apparent why this is important but having confidence in your measurements really is crucial during a crisis.

NPL never closed, we have remained open throughout the pandemic, but of course have had to operate under different conditions. Certain services that we provide must keep going no matter the circumstances, this includes:

- **Healthcare services –** calibrations allowing for the delivery of cancer treatments, sterilisation of medical equipment, and assurance of radio-pharmaceuticals.
- **Timing –** we maintain UK's National Time Scale (UTC)NPL. Our atomic clock is accurate to within 1 second in 158 million years and contributes to Coordinated Universal Time (UTC) the global timescale. Accurate timing is essential for navigation, telecommunications, data transfer, fair financial trading
- **Environmental monitoring –** running air quality networks in England and Wales and calibrating the networks in Scotland, to ensure that we continue to meet clean air regulations
- **Nuclear safety –** calibrations of neutron detectors to allow continued safe operations in nuclear power stations.

Then of course we wanted to offer our expertise where we could in response to COVID-19. We asked our scientists and engineers to engage with industry and healthcare contacts to identify where we could offer the most benefit.

SUPPORTING THE IMMEDIATE HEALTH CRISIS

We offered free access to our engineering expertise for organisations working on development of new ventilators, offering testing and validation to quality assure the products and ensure that they met safety and quality standards as well as additional measurement support to enable them to scale up production.

Alongside this, our own engineers have been working on designing new prototype ventilators for use in developing economies. A project conceived by one of our engineers, Jean Morris, who as part of a multidisciplinary team from across NPL - rapidly iterated several concepts to develop an affordable ventilator design. One of the final designs, the PocketVent, costs approximately £1k, a factor of 10 less than a commercial ventilator unit and has been designed by a team of engineers including Jean, and her colleagues Joshua Schofield, Joshua Bayfield, Chris Bull and Arthur Vie – three of whom are early in their career having completed their training through the NPL apprenticeship.

The ventilators were designed to be simple-to use, portable and lightweight and maintain key functionality as well a control panel and detailed data display. All the parts for the ventilator are either made with common machine tools, are easily-sourced off the shelf components, or can be shipped by multiple global suppliers. Design decisions were driven by consultation with several clinicians, with a focus on patient safety and indispensable functionality. We tested our prototypes on a lung emulator which mimics the response of different types of patient's lungs and produces detailed information about the

performance of the devices tested, allowing them to be comprehensively evaluated. We are now actively looking at the further development of this ventilator with partners to make sure it meets the needs of developing economies and their health care systems.

We have been supporting the testing and validation of personal protective equipment for use in NHS and care home settings and have been working closely with a community project, Protecting Heroes. The Protecting Heroes team specialise in industrial engineering and design, they have worked to develop face shields for deployment to the NHS front line. NPL have been delighted to support them throughout the process from initial evaluation, revisions to designs, to ensuring that the face shields passed quality and safety standards, receiving CE certification. NPL have also assisted by delivering advice on the supply chain and safe assembly of the face shields, ensuring confidence in the quality of the product at all stages of the process. We have set up a temporary hub at the NPL sports club where volunteers from NPL put together and pack the face shields ready for distribution. Protecting Heroes are now making 1800 face shields a day and produced over 30,000 so far.

We have a great data science team at NPL and during the pandemic they have been supporting the Royal College of GPs to boost their team's resilience and ensure that health data reports for Public Health England can continue to be delivered.

Our socially distanced engineering team who worked on the PocketVent- from Left to Right: Jean Morris, Chris Bull, top right screen – Joshua Bayfield, bottom right screen – Arthur Vie, Joshua Schofield

Now as lockdown is lifted, UK companies need to operate differently, to accommodate social distancing, to adjust to disruptions in their supply chains and to deal with the demand shocks of the pandemic.

We have asked UK businesses to #TellNPL what they need from us, as the science and engineering community needs to pull together to **make sure that businesses can access our support, expertise and facilities to enable economic recovery.**

INCREASING PRODUCTIVITY

The UK's measurement infrastructure provides vital support for business, enabling access to the research, tools and techniques, standards and facilities to test products in the lab and within real world environments. This means customers can be confident in the performance, safety and security of what they are purchasing. Better measurement can help improve the technical performance of instruments and process control equipment, which in turn enables the creation of appropriate protocols for testing safety and performance, and the **faster commercialisation and adoption of new technologies.**

We will keep offering **direct support to business to help industry restart.**

DIGITAL TRANSFORMATION

Discussions with the manufacturing sector suggest we can expect a change in attitude and behaviour towards research and development activity. Instead of research moving forward in incremental steps, manufacturers are expecting to go for major step changes – in other words, moving straight to the next generation of technology. We are seeing more companies looking at how they can automate processes and benefit from AI and Machine Learning to boost their productivity. COVID-19 is going to be a catalyst for an even faster move to industry 4.0.

We will be **working directly with industry** enabling the development of data quality standards and frameworks so they can have **confidence in the data** they are collecting and **confidence in the decisions** that they are making based upon it.

GETTING PRODUCTS TO MARKET SOONER

The Coronavirus crisis has shown how difficult it can be to get products to market quickly, having tested and certified that they meet the required standards.

NPL are experts in physical testing but to make processes across all industrial and manufacturing sectors more agile in the recovery phase and beyond, we also need to **develop the UK's virtual testing capabilities**, making use of digital technologies to **get novel products to new markets faster.**

Instead of having to send people to test items in situ or send products to NPL, we will work through the National Measurement System programme to develop a combined digital and physical test programme. Virtual testing can take place at both the design and production stage, reducing potential errors earlier on in the process.

Protecting Heroes face shield in use!

CONCLUSION

NPL and other Public Sector Research Establishments are often called upon in times of crisis. As National Laboratories we work all year round for the benefit of society. However, in the Government Office for Science 2019 report "Realising our ambition through science"[1] it states our PSREs are underutilised and more can be done to exploit them.

Reference

1 Government Office for Science (2019) Realising our ambition through science: Government Science Capability Review https://www.gov.uk/government/publications/government-science-capability-review