Executive Summary:

- Metrology training and skills have been identified as one of five key priority areas in a recent consultation of over 400 leading industries that will be informing the up and coming UK Measurement Strategy. Metrology and the associated STEM skills that support its effective use provide a fundamental basis for increasing the efficiency and productivity of the UK economy. As the UK’s National Measurement Institute, NPL plays a significant role in supporting the development of metrology skills to implement the National Measurement Strategy.
- NPL provides a lifelong programme of measurement training, from primary school to professional development. Skills development should be offered and encouraged at all levels so that we can upskill our existing workforce rather than replace it.
- Our interaction with industry, providing them with bespoke training packages to upskill their workforce, has brought recognition to the added value that metrology offers, however it has also revealed a desire for someone to take a leadership position in integrating measurement skills and knowledge into the manufacturing sector. There is a strong desire for a professional recognition such as chartered status.
- Through extensive outreach NPL has concluded that too many students or parents don’t know that there are multiple routes into science, and believe that they have to choose between university and apprenticeships, unaware that they can do both. Government institutes like NPL can assist in challenging this false dichotomy and encourage the public to consider their options fully.

Introduction

“When you can measure what you are speaking about and express it in numbers you know something about it; but when you cannot express it in numbers your knowledge is of a meagre and unsatisfactory kind” – Lord Kelvin

1. The National Physical Laboratory (NPL) is the UK’s National Measurement Institute and is a world-leading centre of excellence in developing and applying the most accurate measurement standards, science and technology available. For more than a century, NPL has developed and maintained the nation’s primary measurement standards. These standards underpin an infrastructure of traceability throughout the UK and the world that ensures accuracy and consistency of measurement.

2. NPL uses cutting-edge measurement science and technology to provide positive impacts in the real world. NPL delivers world-leading measurement solutions that are critical to commercial research and development, supporting business success across the UK, and improving quality of life.

3. NPL recognises that the measures necessary to supply the skills required by businesses cannot be met at one educational level or at one age group. NPL interacts with teachers and students from primary school all the way through to professional development. Filling the STEM skills gap in businesses, academia, and industry does not have to only mean increasing the supply of PhDs
in science. NPL also works to put the necessary knowledge and skills in the hands of the people who need it and who have the experience to use it effectively and become more capable in their existing roles.

4. Skills in metrology and measurement are applicable to a vast variety of situations. It’s not confined to being able to calibrate machinery, but more generally becoming aware of when your perception of a system may be wrong, providing guidance for better decision making in day to day processes, and understanding what your professional and personal actions are dependent on. The ability to understand and apply measurement knowledge across the major growth sectors of the UK economy is vital, and has a direct impact on global competitiveness and productivity. Nevertheless, organisations have been reporting a decline in measurement skills caused by a variety of factors from low training uptake to demographics.

Outreach

5. The outreach programme at NPL involves engaging students, teachers, and the public as a whole to support STEM education in the UK. We also see this as an opportunity for NPL staff to engage with the public and ‘give something back’, which is found to be a personally rewarding activity for many individuals whilst also supporting NPL’s commitment to corporate social responsibility. Outreach at NPL is a timecoded activity, permitting those in the company to participate in it as part of their contracted hours. Due to this we have been able to support 700 people-days each year of 150 separate NPL employees interacting with over 50,000 people in through 230 separate interventions. The people reached consist of approximately 70% students (from Primary school to Masters), 10% teachers and 20% general public.

6. Simply enabling our staff to engage with the public has led to some fantastic achievements. In 2009, for example, one of our first Science Ambassadors, Michael de Podesta, was awarded an MBE for services to science through his outstanding commitment and passion for science communication. There are now over 40 NPL Science Ambassadors following in Michael’s footsteps, delivering hundreds of events each year.

7. These events include activities like the NPL Water Rocket Challenge, where schools from across the UK (and even internationally) come to NPL to attempt to land their pre-constructed rockets exactly 70 (± 5) m away by self-built technology and adjusting launch parameters. Our staff are also involved in mentorships, including local school mentoring, and deliver teacher/trainee continuing professional development courses. The mentoring includes working with the Young Engineer for Britain Award, for which the Head of Engineering UK stated that “the best part of the Young Engineers Award is the value provided by the [NPL] mentoring process”. Many of our staff take time to exhibit at fairs and festivals such as the Royal Society Summer Exhibition, Green Man Festival, Cheltenham Science Festival, and Big Bang Science Fairs.

8. Sometimes the easiest way to engage with people about science is to invite them to come to us. NPL holds an Open House every two years when thousands of members of the public (3,500 in 2016) tour our facilities – choosing from over 50 labs on show, taking part in activities and listening to talks from our scientists. In addition to large events like this we also host many schools, colleges, and institutions, in 2016 we provided 32 lab tours to areas in which groups had expressed a particular interest. During February half term we host a science camp called Labtastic in which 30 students from years 8 and 9 spend three days taking part in experiments and activities led by scientists and apprentices. To see a scientist talk about their studies while surrounded by the equipment they use conveys the practicalities of their work really effectively.
9. Every July we offer something a bit more serious where 40 GCSE and A-Level students attend the NPL Academy. This is one week of hands on work experience within a laboratory. This raises STEM skills and confidence as well as increasing links with schools. It also gives students a better idea of whether working in science is something that would interest and engage them. Many who attend the NPL academy decide that this is the case and come back to NPL as apprentices. It is this engagement and then retention of interested minds that is so important in increasing STEM skills in the UK.

10. To widen coverage and impact of our educational work, John Nunn at NPL created (and continues to grow) the Virtual Physical Laboratory (VPLab). This is now a collection of over 300 interactive simulations and experiments for teachers and individual learners. It is used in over 15 countries covering 5 continents. With support from the Institute of Physics, this resource is provided free of charge to teachers in the UK who attend a demonstration.

11. We also give away or lend products and equipment. Our most popular loan is a liquid nitrogen demonstration kit which is only permitted after a safety training session for school staff. We also lend much more, including infra-red cameras, oscilloscopes, rigs to measure the speed of sound, and a laser height gauge. If all of the aforementioned activities do not provide enough help for teachers, we give out books on physics and measurement such as our ‘The Little Big Book Of Metrology’ and we annually ship 40,000 NPL posters on measurement that describe the fundamental S.I. units (kg, second, metre etc.) and measurement terminology like the difference between precision and accuracy.

12. All of these events and engagements focus on increasing an appreciation and understanding of science in general, physics in particular, and metrology specifically. Because of its universal applicability, the science of measurement is easily related to a host of inspiring activities from sport to robotics. We can therefore work to improve skills and understanding of measurement while talking about a range of exciting and interesting topics.

13. Funding for NPL outreach comes from our overheads. The average annual budget is around £450,000, of which at least 75% is spent on staff time. This enables as many staff as possible to engage in outreach related to something they are passionate about. It is important in raising staff morale to enable them to take personal actions to benefit society, and for society to put faces and personalities to scientists. We showcase a number of excellent role models for future scientists, particularly women.

Apprenticeships

14. NPL has been employing junior science apprentices since 2013 and business administration apprentices since 2015. In 2016 we started an engineering apprenticeship and we will be running apprenticeships in procurement, digital marketing, and finance & accounting starting in 2017. Over the course of these apprenticeships we have had 29 junior science apprentices (14 female, 15 male), 7 business administration apprentices (1 female, 6 male), and 7 engineering apprentices (1 female, 6 male).

15. At NPL we see value in recruiting scientists and engineers from a variety of educational backgrounds. This means that although we are proud of joining us with HEI qualifications, we also encourage people to develop skills by other means. To this end we have been taking on apprentices direct from school. One of this year’s (2016) apprentice cohort first came to NPL
Written evidence submitted by the National Physical Laboratory (NPL) (GAP0034)

along with 30 others at our summer work placement activity (NPL Academy), and enjoyed herself so much that she negotiated with her school to join NPL as an apprentice while sitting A levels as an external candidate. As with most staff working at NPL, if she continues working at NPL on completion of her apprenticeship, we would likely fund half the costs of University tuition fees.

16. There is a shortage of skills in many metrology areas in the UK, but especially in engineering where NPL has an aging workforce of people with appropriate training. In 2016, for the first time in twenty years we offered an engineering apprenticeship with seven in our first cohort. Engineering apprenticeships will be longer and more expensive to run than our science apprenticeships due to the types of equipment they use daily. They spend a year at Kingston College obtaining general training of how to handle different types of machinery, and for subsequent years will spend four days a week at NPL with the fifth at Kingston College.

17. All our apprentices spend 20% of their time on formal training leading to professional qualifications. In addition to this, they receive specialist knowledge/skills related to two areas of metrology. However, we know that we are not training them to stay at NPL forever, therefore, even though their enhanced understanding of measurement will serve them well in any profession and in their day to day lives, we also enrol them in our soft skills programme. They are taught skills and are exposed to situations setting them up for any job/career path they may choose, such as how to effectively use software like Microsoft Office, and how to make a professional phone calls and emails (which many are not taught at school). They also receive training in business skills and confidence building as well as presentation, teamwork, and communication. NPL is also the first organisation in the UK to teach their apprentices how to meditate as a way to deal with stress and improve mental health.

18. The involvement of apprentices in outreach is especially important as we have found that none of our apprentices come across apprenticeships during school careers advice sessions. We have found it hard to recruit junior scientist apprentices as most consider science to be a career entered into after university. It is not only students but also their parents that discount apprenticeships, perceiving a disconnect between apprenticeships and advanced, further and higher education, and who do not realise that an apprenticeship provides a real taste of what it is like to work in science or engineering, enabling a more informed choice about future career and education.

19. We are very proud of our apprentices, in this year alone (2016) we have had two win awards, with one winning the CSR Group Advanced Apprentice of the Year award, and another being named a finalist in the National Apprenticeship Awards. Many of them engage with our outreach programme, encouraging and enabling other students to consider science as a career path with their own stories which are easy for their peers to relate to. Most of our apprentices, even if they leave NPL, go on to careers in science, from veterinary medicine to aeronautics.

The Postgraduate Institute for Measurement Science (PGI)

20. The PGI, established following a strategic partnership between the Department for Business, Energy and Industrial Strategy (BEIS), the Universities of Strathclyde and Surrey, and NPL, aims to be the leading UK and international centre for doctoral training and skills development in metrology and its applications. It provides a measurement science training programme for students from a number of universities undertaking postgraduate studies related to NPL
Written evidence submitted by the National Physical Laboratory (NPL) (GAP0034)

projects. This is delivered at NPL by the Postgraduate Institute where co-supervision is provided by NPL staff.

21. The PGI aims to enhance a student’s ability to have a positive impact in both their social and academic lives. It aims to amplify their skills by providing a fundamental basis for them in measurement science and by exposing them to industry facing projects so as to deliver industrially-primed STEM postgraduates. This tackles two main skills gaps in UK science. The first being a lack of understanding of the metrology that underpins all research, and the second being a disconnect between academia and industry resulting in the UK falling behind in profiting from our world class science.

22. These skills are delivered through three parts: research, training, and the cohort experience. All students will have their own research programme for which different PGI courses will be applicable, advice on which of these will be useful is given by the students’ supervisors and by the PGI so that each student can build up a portfolio of skills to aid in their research and further career. The training itself is delivered via both e-learning and through classroom/laboratory teaching. The cohort experience includes showcasing the students to the world and the world to the students, whether that means industry, government, or NGOs, it is important that our postgraduates are prepared to be society-ready, not just science-ready.

23. The PGI currently has 184 students from 36 universities. Since the start of the PGI in 2015, 28 students have completed their PhDs.

24. Funding for PGI studentships come from a variety of sources. Studentships are arranged from the research side by the universities via funding they have received from any of the seven RCUK bodies for academic studentships. There is also the opportunity for industry to propose studentship projects, for example via the CASE programme which is run by the relevant RCUK body. In most cases PG studentships are partially co-funded by industry (and in the case of NPL by the NMS) which provides the necessary top-up funding in developing an aligned PG studentship project.

NPL Training

25. Filling the STEM and metrology skills gap in the UK does not have to only mean increasing the supply of young people, whether at apprentice or degree level, with science or metrology training. NPL also works to put the necessary knowledge and skills in the hands of people who are already working in areas where an understanding of metrology would make them more capable in their current role.

26. NPL Training aims to deliver world-leading measurement knowledge and skills which are critical to the success of industry research and development as well as the success of UK businesses. We do this through several mechanisms: the Framework of National Qualification in Metrology, which is delivered through classroom training courses and through blended learning courses which allows for information to be supplied to the learner in the most convenient way; the e-learning Training Programme which offers a series of online CPD courses; the Measurement Explained Series which is a set of free online CPD units; and a Bespoke Training Course, which is delivered through the provision of tailored training courses.
27. NPL Training metrology courses are delivered to over 1,500 people each year and supports over 500 companies in sectors ranging from aerospace to healthcare. 92% of the organisations that attend these courses report that they have seen an improvement related to productivity or efficiency in their organisation following the course.

28. In most cases funding for NPL Training is shared between the NMS and the organisation it is being delivered to. The NMS pays for the creation of the course content on the basis that it can be re-used in future to benefit a wider range of learners throughout industry, with further organisations paying only for its delivery.

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