



Department for  
Business, Energy  
& Industrial Strategy

# NATIONAL MEASUREMENT STRATEGY

Delivery Plan 2017-2020

June 2018



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Investing in a world-leading measurement infrastructure



Ensuring good policy, standards and regulations



**Our vision is for the UK to capitalise on its world-leading National Measurement System to be the best place to live and do business.**

Confidence in the intelligent and effective use of data



Getting better connected to our end-users to deliver impact



Improving the UK's measurement skills



## Executive summary

This delivery plan responds to the UK Measurement Strategy published in March 2017. The Strategy sets out a framework for the UK to capitalise on its world leading National Measurement System (NMS).

The NMS has a critical role in ensuring that the UK meets its international measurement needs, and supporting the UK in critical policy, regulation, legislation and maintains sovereign capability.

It will have a role in delivering and supporting the UK's Industrial Strategy by helping people develop new skills, provide services to businesses developing new technologies and taking part in its Grand Challenges such as Clean Growth and Artificial Intelligence.

The Department for Business, Energy and Industrial Strategy invests £65m annually into the NMS which funds research in the advanced manufacturing, life sciences and health, energy, environment and digital sectors.

We will put in place programmes of work that will deliver the outcomes required in the Strategy. Between 2017 and 2020 the NMS' activities will include:

- investing in the best capabilities by delivering a number of new world-leading measurement centres over the next five years in association with relevant partners to meet future emerging need, such as quantum technology, nucleic acid metrology, multiphase flow research and medical physics
- providing consumer confidence through the application of sound science policy advice across government and related organisations based on trusted measurement science, data and information, enabling more robust evidence-based policy decision-making
- expanding the products and services offered by the NMS, such as good practice guides and direct advice and support, and providing easier access through appropriate channels
- maintaining and developing the NMS' leadership position in measurement skills through working with end users to establish a national training programme to increase the adoption of measurement skills training for students and continued professional development of the UK workforce
- leading and publishing a review of the future measurement expertise needed to establish a new data metrology and standards capability

## Our vision

The NMS has a critical role to ensure that the UK meets its international measurement needs, supporting the UK in critical policy, regulation, legislation and maintains sovereign capability.

Our vision is to deliver programmes of work that directly respond to the themes of the UK Measurement Strategy. This will deliver outcomes that the UK can exploit, to improve both the economy and quality of the lives of our citizens by:

- **investing in a world-leading measurement infrastructure.** We will ensure there is a national approach to the NMS' measurement capabilities that drives effective investment in UK measurement laboratories. We will work in partnership with the UK science base and business to deliver a world-leading measurement infrastructure as part of an integrated global system
- **ensuring good policy, standards and regulation.** We will champion measurement across government to ensure good policy, standards and regulation
- **getting better connected to end-users to deliver impact.** The NMS will work smarter and provide greater connection to end-users to increase awareness, and uptake of best practice measurement
- **improving the UK's measurement skills** across all sectors to accelerate new technology uptake and fully exploit the benefits of a high-tech economy
- **providing confidence in the intelligent and effective use of data.** We will bring together the diverse communities involved in data science to understand the new requirements and develop a framework to deliver confidence in the intelligent and effective use of data based on measurement traceability and uncertainty analysis

Measurement will play a vital role in supporting the Industrial Strategy, which sets out how the government is building a Britain fit for the future, and will help businesses create better, high-paying jobs in every part of the UK with investment in the skills, industries and infrastructure of the future. The NMS will play an important part in meeting the Grand Challenges set out in the Industrial Strategy, and directly supports each of its five foundations of ideas, people, infrastructure, business environment and places, which drive the need for new or innovative measurement techniques and standards.

This document sets out how we will ensure we achieve this.

# Investing in a world-leading measurement infrastructure

Our purpose is to manage a dynamic portfolio of measurement capabilities. These ensure the UK sustains an internationally-leading measurement infrastructure and science base, responds to the national challenges where better measurement will play a central role in delivering successful outcomes and helps translate ideas into products and services in all parts of the UK.

The UK's measurement science provision will be world-leading, delivering capabilities highlighted as being of a very high quality, internationally leading and delivering significant stakeholder impact. Our measurement science will continue to be sufficiently flexible to evolve and respond to future, high priority and challenging national needs that occur over the next 10 years or more.

Between 2017 and 2020 the NMS will:

- invest in the best capabilities by delivering new world-leading measurement centres over the next five years in association with relevant partners to meet future emerging need, such as quantum technology, nucleic acid metrology, multiphase flow research and medical physics
- invest and develop the NMS' science capital by ensuring scientists and engineers have the opportunity to develop into experts through peer networking and review and build the networks that will ensure partnership working across the UK measurement capability
- maintain the core capability of measurement that the UK relies upon, using effective and efficient delivery channels such as access to facilities, test and calibration services, and training
- develop new calibration and test facilities in areas beyond current capabilities in advance of users need, such as DNA measurement and fuel cell diagnostics.
- develop opportunities for joint research funding to leverage the NMS investment and to ensure a joined-up approach in areas of national importance and need

We will assess our performance by evaluating:

- the quality of the NMS' science – for example publications/citations, performance in international comparisons and reviews, external awards and positions
- the use of the capability developed - NMS investment will provide a pool of knowledge and facilities that will be relevant to broader joint research endeavours and lever additional income through collaborative projects

## Ensuring good policy, standards and regulation

Good measurement brings confidence to data and the decisions that are based upon them, enabling fair trade and effective regulation and policy. The purpose of the NMS is to ensure that measurement can enable users to have confidence in their data, reducing risk and allowing valid decisions to be made by businesses and across the policy, standards and regulatory environment.

Standards are at the heart of evidence-based policy and regulation. Good measurement practice will ensure the creation and adoption of effective standards, regulation and policies, responsive to future measurement needs for the UK. Technical standards define markets and underpin the development and maturation of new technologies. Simplification or reduction of the regulatory burden on trade, and improvement in its development and implementation, will position the UK competitively for the benefit of UK business.

The NMS will continue to maintain and provide measurement that meets UK user needs. Our measurement laboratory customers use measurement to ensure that goods from suppliers and final products meet specifications and comply with relevant standards and regulations, and deliver safe and effective public services that meet policy goals.

Between 2017 and 2020 the NMS will:

- provide consumer confidence through the application of sound science policy advice across government and related organisations based on trusted measurement science, data and information, and enabling more robust evidence-based policy decision-making
- bring together the legal and scientific metrology communities to align the measurement infrastructure with the standards and regulatory community for a more business-friendly approach. The NMS will use a risk-based methodology to provide the leadership to positively influence new international regulation to support the UK as it leaves the European Union
- promote the importance of quality, accreditation and technical standards to improve the competitiveness of UK industry and promote the adoption of UK technology by providing leadership of the Quality Infrastructure (QI) initiative in a partnership between the national measurement laboratories, British Standards Institute (BSI) and United Kingdom Accreditation Service (UKAS)
- identify the measurement needs to support development of new technical standards - including biotechnology, liquefied natural gas (LNG) and multiphase flow, graphene and quantum technologies - that will give UK technology a competitive advantage and enhance UK market leadership

We will assess performance by evaluating:

- committee representation - quality (representational position) and relevance – and our contribution to published standards and regulations
- the number of invitations to represent UK measurement on government reviews, workshops and similar events
- resolution of disputes supporting legal cases
- income from measurement services



# Getting better connected to our end-users to deliver impact

The NMS ensures there is access to the knowledge through products and services that best enable innovators and the user community to take the best advantage of the UK's national measurement laboratories and achieve the maximum benefit from their investment. The NMS is driven by understanding the requirements of end-users and ensuring ever-increasing access to our measurement knowledge, products and services. To do this we have created a range of channels for users to engage with the NMS.

Between 2017 and 2020 the NMS will:

- increase the depth and breadth of relationships with end-users to better capture user needs, increasing impact and future-proofing the NMS
- expand the products and services offered by the NMS, such as good practice guides and access to direct advice and support to business, and providing easier access through appropriate channels
- focus on delivery at the user point of need to improve accessibility to measurement services by creating regional measurement hubs, in partnership with local academic, clinical, industrial and enterprise partners. The hubs will act as measurement centres of excellence, and raise awareness of measurement products and services and best measurement practice through workshops and other events targeted at specific local end-user communities
- partner with organisations such as UK Research and Innovation (UKRI) that will broaden the reach of the NMS and also bring measurement knowledge into new schemes and communities

We will assess performance by evaluating:

- joint activities with partners and knowledge exchange achieved
- the increased breadth and depth of users making use of knowledge and facilities
- new product and services developed and launched that address changing user needs

## Improving the UK's measurement skills

The NMS ensures that good measurement skills support the UK workforce in adapting to and benefiting from technical change. This will contribute to improved productivity, better quality jobs and higher earning potential, as prioritised in the UK's Industrial Strategy. It will also play an important part in the creation and adoption of new instrumentation, technologies and processes by UK businesses. A focus on the application of legal metrology will also support businesses to trade successfully.

As processes become more automated, investment in leading-edge equipment is vital, and this is the same with measuring equipment used across a huge range of applications such as enforcement control, medical applications, manufacturing and scientific discovery. However, the appropriate practical measurement skills and a thorough understanding of basic measurement concepts are being lost as the workforce becomes more reliant on automated systems. Large and small companies and organisations are realising that the lack of measurement skills is an issue for their workforce. The skills challenge lies across the spectrum of education from apprentice programmes to PhD level and beyond into lifelong learning.

Between 2017 and 2020 the NMS will:

- maintain and develop NMS leadership position in measurement skills through working with end users to establish a national training programme to increase the adoption of measurement skills training for students and continued professional development of the UK workforce. This will build on existing metrology-based training provision, either directly or by embedding training modules/products in other specialist schemes, for maximum reach and benefit both nationally and through inward investment opportunities
- develop programmes to ensure the transfer of skills such as strategic secondments between other research communities, industries and national measurement laboratories to aid knowledge sharing, and fellowships to promote and aid partnerships working
- maintain and develop the effective and efficient delivery of user driven training programmes

We will assess performance by evaluating:

- the improvement in measurement skills in the workforce through a range of training programmes and levels (apprentices, postgraduates, Continuing Professional Development (CPD))
- the number of courses delivered and students trained

## Providing confidence in the intelligent and effective use of data

The NMS will develop relevant novel capability that can ensure user communities make best use of the data revolution by strengthening confidence in the data provenance, storage, transmission and inter-operability that measurement can bring.

The world is getting ever more interconnected, with networks of sensors and other instruments making more measurements and making them more frequently than ever before. The digital revolution has brought with it the ability to generate, combine and manipulate huge quantities of data, but more data does not necessarily increase their value.

Tackling this challenge will require close working with the many constituents of the community including The Alan Turing Institute, Hartree Centre, academia, industry, other National Measurement Institutes and across government.

Between 2017 and 2020 the NMS will:

- lead and publish a review to identify and understand the measurement needs necessary to establish a new measurement capability for data metrology and standards
- identify opportunities for data management and inter-operability, and standards to enable suitable regulatory structure(s) for the use of data to emerge.
- launch a new Programme in Metrology for Data and Standards

We will assess performance by evaluating:

- the new data programme, including number of publications/citations, external awards and positions
- the use of the knowledge and facilities - NMS investment will provide a pool of knowledge and facilities that will be relevant on broader joint research endeavours and lever additional income through collaborative projects

## Our approach

Our approach to delivering the strategy is simple -



In order to do this the NMS will:

### Work in partnership

By building better connections across measurement users to ensure we formulate programmes of work that understand the users' needs and support the delivery of our aspirations.

- The measurement community is broad, from those who directly rely on critical measurements to those that maintain measurements in line with standards and regulations. This includes those across government where the NMS provides advice for policy
- Research often reaches the very limit of current understanding of measurement knowledge and the NMS partners with the world's best scientists and engineers to bring research excellence to the UK. In sharing this knowledge it is practical to work alongside and with other structures of support such as the formal training and education frameworks, local advice and support in regions, and specialist or representative trade bodies

### Deliver world-leading science

By undertaking excellent measurement science, ensuring its application to address the UK's global challenges.

- The work of the NMS will contribute to the knowledge economy pushing the boundaries with a clear view of the impact that it will create for the measurement community. We expect to demonstrate this through scientific outputs and credibility and the demand for our measurement knowledge in broader research challenges
- The NMS will work with the global network of measurement laboratories, helping to ensure consistency of our measurements, fit for purpose regulation and standards, a level playing field for UK trade, and inward investment opportunities. Where applicable, we will ensure value for money of the UK investment in measurement through the establishment of shared measurement challenges between the global networks of measurement institutes

## Undertake continuous engagement

By focussing on end-user requirements, ensuring ever-increasing access to our measurement knowledge, products and services. This will help new ideas come to fruition faster, ensuring their validity, robustness and utility.

- The extensive user community that rely on NMS advice, services and knowledge, also act as its eyes and ears for market needs. This will ensure opportunities for both informal anecdotal and formal structured user insight to be collated and inform our work programmes
- The NMS will work with existing and future market and innovation leaders to anticipate the long-term market needs. We will undertake an extensive foresight exercise with this community that will help inform future strategies and needs

## Act with integrity and independence

By providing confidence in the working of the system and its application such that right first-time accuracy and fit for purpose becomes best practice.

- The NMS will provide impartial advice on measurement requirements and technologies to those that need it, most notably responding to government policy decisions, procurement of services, legal or regulatory issues

## Ensure value for money

By continuing to seek efficiency savings in its delivery mechanisms.

- The NMS will continue to evaluate our measurement capabilities, seeking to balance prioritisation of investment in the national challenges with the need to maintain existing (more mature) measurement capability that industry values highly
- The NMS will identify alternative models of delivery of our work programmes, where appropriate in partnership, leveraging measurement capability associated with complementary funding activities and additional co-funding for the NMS
- The NMS will provide the appropriate information to sponsor and advisory groups to facilitate challenge in this area

## Measuring success

An Evaluation Framework has been developed for the NMS covering the period 2017-2021. The framework is based on the themes of the NMS strategy to ensure accountability for the public investment and to enable future funding to be allocated based on evidence of what worked well. The purpose of the framework is to provide evidence that NMS activities are generating the expected outputs and on course to deliver the intended impacts.

The framework is based upon a set of indicators that capture NMS activities and outputs on an annual basis plus a range of methods to assess the broad range of longer-term outcomes and impact. The framework is summarised below.

Themes	Activities	Outputs	Outcomes	Impact
<b>Investing in a world-leading measurement infrastructure. (Research)</b>	Measurement research	New measurement knowledge	Adoption of measurement knowledge	Increased R&D capital
<b>Ensuring good policy, standards, and regulation (Trade and Regulation)</b>	Maintenance of standards Comparisons Input to documentary standards	Standards Measurement services Reference materials	Increased confidence in measurement data Efficient delivery of public services Enforcement of regulation	Fair trade Better quality of life
<b>Getting better connected to our end-users to deliver impact (Innovation)</b>	Collaboration with end users Knowledge exchange	Adoption of new measurement techniques Customer innovation	Increased sales Better processes	Increased competitiveness New markets More exports
<b>Improving the UK's measurement skills (Skills)</b>	Number of training courses delivered Number of PhDs Outreach events	Increased pool of measurement skills	Users' measurement costs reduced Reduced skills shortage	Higher productivity Higher wages

All science programmes, including cross sector activities, directly support each of the above themes of this Strategy, and their effectiveness is assessed using the evaluation framework detailed above. The 'Providing confidence in the intelligent and effective use of data' theme will be evaluated alongside the sector science programmes. Additionally, our Programme Expert Groups provide oversight and challenge on the effectiveness and relevance of the programmes (more detail on this can be found in the [Governance section](#) on page 16).

## Delivery partners

The UK NMS is comprised of a core infrastructure of measurement laboratories that are connected with the wider measurement community that includes international, legal, quality science and innovation bodies, to deliver the benefits of measurement to the UK end-users.

NPL, NEL (including NGML) and LGC are contracted separately for their portion of work directly by the Department for Business, Energy and Industrial Strategy. NIBSC contribute under their own funding mechanisms.

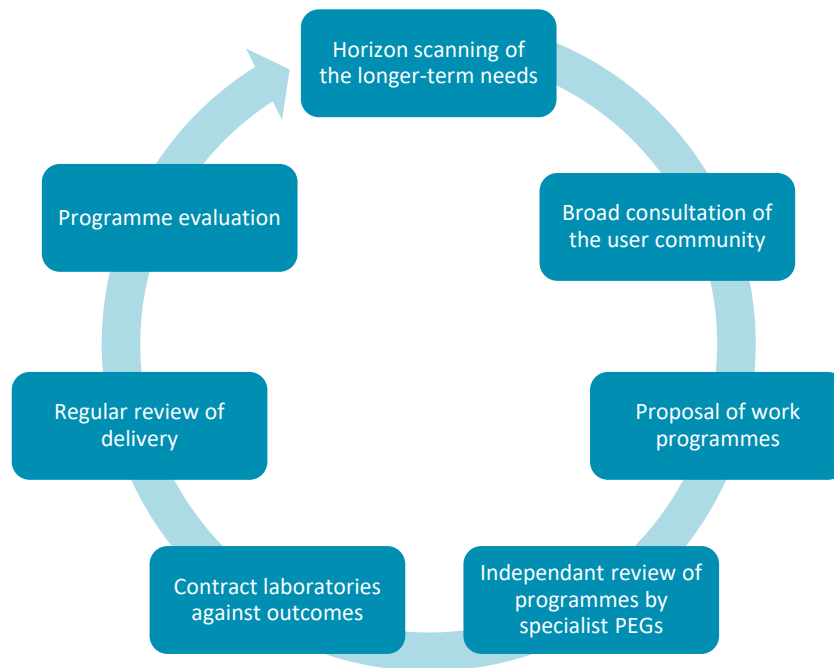
The Office for Product Safety and Standards within BEIS delivers the legal metrology programme. The legal metrology infrastructure underpins trade measurement and confidence in the market.

<b>NPL</b>	National Physical Laboratory	the UK's National Measurement Institute
<b>LGC</b>	formerly Laboratory of the Government Chemist	designated for chemical and biometrology
<b>NEL</b>	National Engineering Laboratory	designated for fluid flow metrology
<b>BEIS</b>	Office for Product Safety and Standards	designated for legal metrology
<b>NGML</b>	National Gear Metrology Laboratory	designated for gears metrology
<b>NIBSC</b>	National Institute for Biological Standards and Control	designated for bioactivity metrology

## Governance

The Programmes of work delivered for the NMS are subject to a continuous cycle of review and scrutiny,

Each measurement laboratory undertakes a formulation exercise every three years with annual reviews and quarterly reporting.



## Programme Expert Groups

Each sector has a Programme Expert Group (PEG). PEG members are representatives from industry, academia, public organisations and government including international representatives, and serve two year terms. They support BEIS in acting as an intelligent customer to procure the NMS programmes.

They provide independent advice based upon their professional judgement by:

- providing assurance on the direction of the overarching sector strategies
- ensuring that the metrology challenges are appropriate and relevant
- challenging project outcomes and impact
- advising on whether the programmes provide value for money
- regularly reviewing progress through quarterly reports, performance indicators and the NMS Annual Review



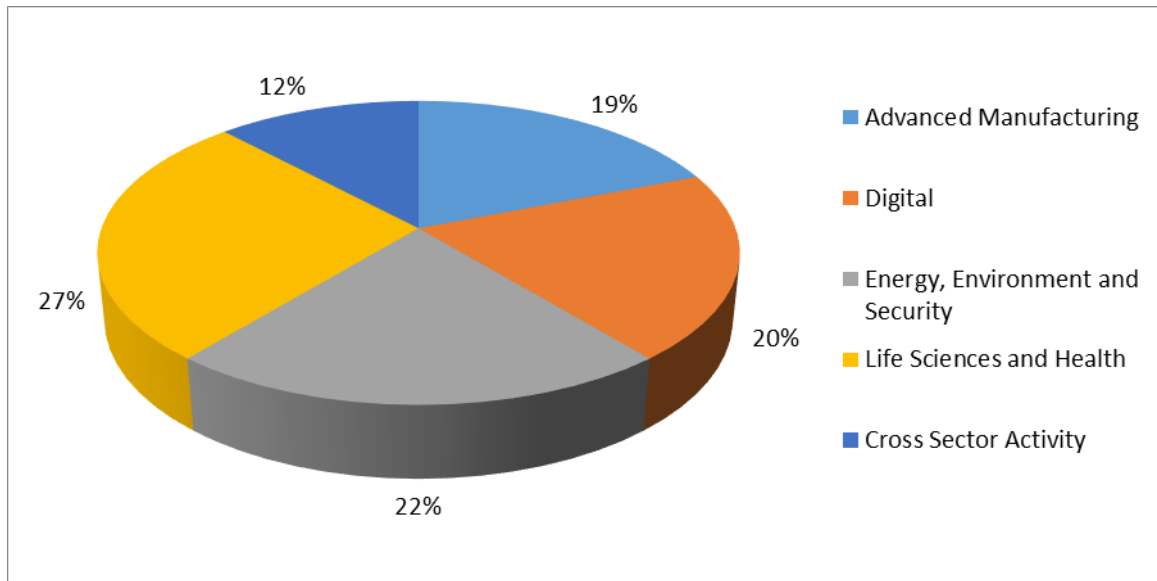
## Programme Expert Group membership

Airbus Defence and Space | Ascendant | Association for Clinical Biochemistry and Laboratory Medicine | AstraZeneca | Atout Process Ltd. | AvroBio | Berryman Food Science Ltd | BIPM | BOC | BT Research and Technology | Buckinghamshire and Surrey Trading Standards | Cameron | Campden BRI | Centrica | Centre for Process Innovation City of Edinburgh Council Public Analyst | Coventry University | The Christie NHS Foundation Trust | Defra | Dstl | Durham University | Environment Agency | Emerson European Space Agency | Exova | FSA | Gambica | GE Healthcare | GnosTek UK | High Value Manufacturing Catapult | Impeller Ventures | Imperial College London | Kent County Council Public Analyst | King's College London | Kingston University Manufacturing Technology Centre | Met Office | Merck | National Graphene Institute National Metrology Institute, Denmark (DFM) | NHS England | Norwegian Petroleum Directorate (NPD) | Nuclear Decommissioning Authority | National Metrology Institute, Germany (PTB) | Oil and Gas Authority (OGA) | Orla | Petrofac | Protein Technologies Public Health England | Renishaw | RHM Technology | Rolls-Royce | Royal Marsden Hospital - Institute of Cancer Research | Science and Technology Facilities Council Smith and Nephew | Stevenage Bioscience Catalyst | Suffolk Coastal Port Health Authority | Taqa | Uniper Technologies Schlumberger University College London | University of Bristol | University of Cambridge | University of East Anglia | University of Leeds | University of Leicester | University of Manchester University of Oxford | University of Southampton | University of Strathclyde | University of Surrey | UKAS | Waters Corporation

## Balance of investment

The Department for Business, Energy and Industrial Strategy (BEIS) is responsible for the UK government's annual £65M investment in the NMS. The balance of this investment is reviewed annually, and the investment by sector for 2017/18 is outlined below to illustrate how this would typically be split:

### NMS Investment by Sector 2017/18



Science themes within the sectors include:

<p><b>Advanced Manufacturing</b></p>	<p>Dimensional Flow metrology Mass Metrology Thermometry, Humidity and Moisture Materials Metrology in Support of Advanced Manufacturing Metrology for Electronic and Magnetic Materials and Sensors Metrology for Advanced Coatings and Formulated Products</p>
<p><b>Digital</b></p>	<p>Data Science Electromagnetic Measurement and Technology Quantum Metrology Time and Quantum Frequency Standards</p>
<p><b>Energy, Environment and Security</b></p>	<p>Earth Observation, Climate &amp; Optical Radiation Metrology Gas and Particle Metrology Emissions and Atmospheric Metrology Underwater Acoustics Nuclear Metrology and Radiochemistry Transportable Mass Spectrometry Chemical Environment Metrology</p>
<p><b>Life Science and Health</b></p>	<p>Mass Spectrometry Imaging Ultrasound Medical Radiation Physics Nuclear Metrology and Radiochemistry Metrology for Disease Diagnostics and Bio-pharmaceuticals Metrology for Advanced Therapeutics Food Safety and Authenticity Metrology for High Accuracy Chemical Analysis</p>
<p><b>Cross Sector Activity</b></p>	<p>Analysis for Innovators programme (in partnership with Innovate UK) Knowledge transfer activities Product Verification Programme (PVP)</p>



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