UK Measurement Strategy consultation – RSC response – December 2015

The Royal Society of Chemistry welcomes the opportunity to contribute to this consultation which will help to frame the UK National Measurement Strategy for the next 5 years.

The Royal Society of Chemistry is the UK's professional body for chemical scientists. We promote, support and celebrate chemistry. With over 51,000 members, we're the world's leading chemistry community (www.rsc.org). A not-for-profit organisation with a heritage that spans 170 years, we have an ambitious international vision for the future. Around the world, we invest in educating future generations of scientists. We raise and maintain standards. We partner with industry and academia, promoting collaboration and innovation. We advise governments on policy. And we promote the talent, information and ideas that lead to great advances in science.

Please contact Michael Smith (smithm@rsc.org), RSC Programme Manager – Analytical Sciences, if you have any questions with regard to this consultation response. We would welcome an opportunity to discuss our responses more fully in a meeting.

We welcome the opportunity to comment on the Executive Summary of the UK Measurement Strategy and support the arguments made about the key role of measurement in increasing productivity, accelerating innovation, addressing grand challenges and giving confidence in new technologies and products. We have the following concerns and suggestions:

a) It is not clear from the Executive Summary what parts of UK measurement capability are encompassed by the strategy. Notably there is no reference to NIBSC, NGML, NMRO or to universities. Of the six case studies given, four are from NPL, one is from NEL and one is from LGC and we suggest that this should be more balanced. From this point of view, it is also not clear who "we" is on the last page of the Executive Summary.
b) The Executive Summary highlights what investment in measurement will deliver for the UK. It is important that the UK Measurement Strategy also provides a clear vision for what the elements of national measurement capability are or should be. This includes
    - knowledge and discovery across many disciplines in science, technology and engineering
    - skilled people
    - facilities and other infrastructure
c) In the Executive Summary it is not completely clear what is meant by the word *measurement,* which is broad and complex. Our focus in this response is primarily on skills and research, but important elements of a UK Measurement Strategy are provision of services for business and industry, and the need for metrology to underpin regulation, law enforcement and industrial claims.
d) The reference to skills is excellent and mirrors concerns from our members. In light of its importance we would suggest making this more prominent, perhaps by highlighting the gaps, making a more compelling case for the needs and/or giving specific examples of what will change.
e) We are particularly concerned that there is no reference at all to universities, which are part of measurement infrastructure at a local or regional level, and are key elements of national research and training capability
f) In our view there should be more explicit reference to research as well as to innovation and skills, because of
    - UK strength in areas of measurement/analytical sciences research and the need to have a long-term view on underpinning research capability
    - the wider national effort to improve translation of research outputs from universities to innovation and associated economic impact.

g) There is an opportunity to make a stronger link with some of the work of the Research Councils, especially the recent *Review of Analytical Sciences* by the Engineering and Physical Sciences Research Council.
h) The commitment to joining up the long-term investment in measurement science is also excellent. In this respect it is important to be clear that this is at the level of investments across infrastructure, training and resource, which must all be joined up with one another to maximise the return on these investments.
i) The UK Measurement Strategy should connect with other developments in national strategy related to research, innovation and skills, in particular as the recommendations of the *Nurse Review of the UK Research Councils* are implemented. It will be important to clarify the connection between the proposed cross-governmental Ministerial Committee and the ongoing development of UK Measurement Strategy, as well the eventual role of Research UK in delivering elements of the UK Measurement Strategy.

Responses to Specific Questions

4. What are the key technology trends in your sector?

Our members work in a wide variety of roles across academia, education and industry. In industry our members work in chemical and chemistry-using sectors including energy, water, environmental services, food, engineering, construction, petrochemicals, pharmaceuticals and biotechnology.

Within the measurement sector itself key technology advances include:

- technologies enabling automated and simultaneous measurement of multiple analytes e.g. enabling a shift from single protein assays to proteomic analyses
- advances in the measurement of single molecules enabling the elucidation of molecular and cellular processes associated with disease
- a growing need for *point of care/point of use analyses* which promise savings in time and cost and more reliable, accurate and individualised data. This is particularly relevant to the health and security sectors
- advances in miniaturisation, leading to more portable analytical instruments
- significant trends in removing the need for sample preparation in the development of analytical technology

7. The UK government has a vision to raise productivity. Which areas of measurement should be a priority for investment in order to improve productivity in your sector?

Overarching developments which promise wide impact across several sectors include:

- miniaturisation of analytical technologies for advanced manufacturing and point-of-use applications (e.g. see Q16 below)
- high throughput screening for disease detection and personalized medicine
- real time monitoring for water, environmental and clinical/medical applications
- data analysis and statistical methods
- advanced materials for sensing applications
- implementation of innovative sampling strategies to save time and cost

Imaging and Personalised Therapies: There have been spectacular advances in the biomedical field in the past ten years in spectroscopy, imaging and other analytical techniques, including DNA sequencing, real time PCR and single molecule studies. Such advances will continue to develop and impact on the –omics fields including emerging areas such as metagenomics in agriculture or in the elucidation of an individual's microbiome. These all hold promise for more personalised therapies in the future. There is an ever growing demand for new chemical probes and highly site-specific, low cost contrast agents which will facilitate higher resolution and more selective imaging of, for example, tumours, ischaemia and neurodegeneration.

Antimicrobial resistance (AMR), or more generally Drug Resistant Infections (DRI), is a major challenge in the UK and globally, highlighted in the recent Spending Review. In terms of costs to productivity, it is estimated that Antimicrobial Resistance could kill an extra 10 million people across the world every year by 2050 and cost the world's economy around $100 trillion, reducing global GDP by 2.24%.[1] In Europe alone, approximately 25,000 people die each year from drug resistant infections, roughly equivalent to the numbers that die in road traffic accidents, and leading to extra healthcare costs and productivity losses of at least 1.5Bn Euro.[2]

Inappropriate use of antimicrobial drugs contributes to the emergence of resistance. In the UK, it is estimated that over 10 million prescriptions of antibiotics are prescribed unnecessarily by healthcare professionals.[3] New or better diagnostic tools are needed to:

- Enable more rapid, accurate and appropriate prescribing
- Improve surveillance of drug resistant organisms
- Target clinical trials at the patient groups with particular resistance strains

8. Taking new technologies from laboratories to the market depends on measurement science at all stages of the development of innovative products. Based on the 8 Great Technologies, where should measurement activity be prioritized to overcome technical challenges and thereby accelerate commercialisation?

Technology
Advanced materials
Energy storage
Big data
Satelites
Robotics & autonomous systems
Synthetic biology
Regenerative medicine
Agricultural science
Quantum technologies
Internet of things

All of these areas will have a strong dependence on measurement. Chemical measurement is particularly crucial for those we have highlighted.

Measurement is vital to provide the quality and reliability required to bring products to market. It is required at all TRL levels and plays a key role in ensuring that the UK is an innovation leader rather than a follower.

10. What issues or benefits do you see for your sector to receive traceability from foreign NMI's not nationally, but internationally?

Given international developments in measurement infrastructure with regard to calibration traceability most capabilities could in principle by sourced elsewhere. However it is not clear how cutting back on key required traceability provision in the UK would ultimately save money if we were to rely on procuring services from foreign NMIs. For example, to remain competitive where international regulations require the monitoring and reporting of regulatory confirmation, a loss of autonomy could prove a false economy.
Potential drawbacks associated with time scales, logistics and customs issues when crossing borders would all need to be taken into account.

1 From *Antimicrobial Resistance: Tackling a crisis for the health and wealth of nations – The Review of Antimicrobial Resistance Chaired by Jim O'Neill, December 2014 (http://amr-review.org/)*
2 From *ECDC/EMEA JOINT TECHNICAL REPORT The bacterial challenge: time to react (http://www.ema.europa.eu/docs/en_GB/document_library/Report/2009/11/WC500008770.pdf)*
3 From *news item on NICE website (https://www.nice.org.uk/news/article/calls-for-nhs-to-curb-inappropriate-antibiotic-prescribing) (18 August 2015)*

16. The proposed executive summary of the UK Measurement Strategy is available here. In your view, does this capture the essence of what the UK's Measurement Strategy should achieve?

Our comments on the Executive Summary are given at the beginning of this document. The following are some examples which may be useful in the Executive Summary or elsewhere in the Strategy Document in order to support or represent the points made there.

Increased Productivity

Rapid Measurement of salts in blood (Queen's University Belfast)[4]

Based on pioneering research into fluorescent PET (photo induced electron transfer) the OPTI blood analyser is a point of care device which allows measurement of salt levels in the blood of hypertension patients. 10 million devices have been sold in the past 5 years. $50 million worth of disposable diagnostic cassettes were sold between 2008–2013. Blood test results can be available in less than 30 seconds, enabling rapid medical responses such as administering a particular blood type with the correct salt levels to the patient.

Grand Challenges

DNA sequencing for personalised medicine (University of Oxford & Oxford Nanopore Technologies Ltd)[5]

DNA sequencing is central to the development of personalised medicine and has considerable utility in agriculture and crop science, food safety, security, and defence. A cheaper and faster method was developed based on membrane protein pores capable of sensing individual molecules by a change in electrical current passing through the pore. Oxford Nanopore Technologies Ltd, launched to develop this technology was valued at $3billion in 2013 and its products can sequence an entire human genome in 15 minutes at relatively low cost.

Additional examples of analytical technologies addressing grand challenges are:

- improved chemical speciation in clinical analyses leading to new diagnostic capabilities
- maximising efficiency in production processes to minimise waste and under production - reducing energy and resource use
- using real-time measurements in manufacturing to better adapt to changes in feedstock composition
- more accurate gene expression measurements enabling the development of new approaches to treating disease
- measurement of multiple biological analytes in cells, tissues and whole organisms which is increasingly important for understanding the processes associated with biological systems and disease

[4] From *Inspirational Chemistry for a Modern Economy, Royal Society of Chemistry (July 2015)* (http://www.rsc.org/campaigning-outreach/campaigning/government-science-support/)
[5] From *Inspirational Chemistry for a Modern Economy, Royal Society of Chemistry (July 2015)* (http://www.rsc.org/campaigning-outreach/campaigning/government-science-support/)