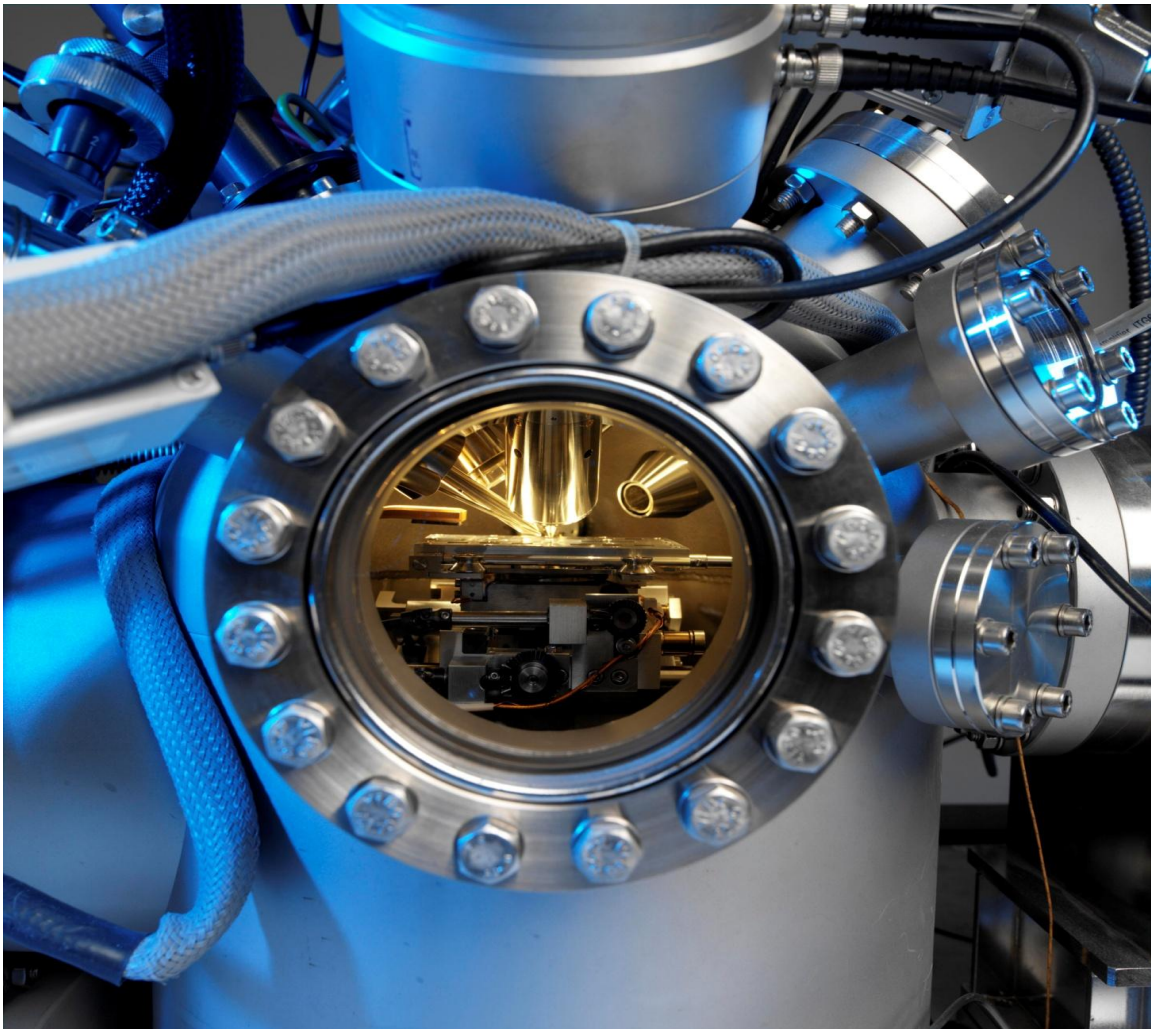


**Consultation on a Strategy for the National Measurement
System: May – September 2009**

Analysis and Government Response

Published March 2010



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Introduction

1. On 20 May 2009 the National Measurement Office (NMO) launched a consultation to determine the future direction of the National Measurement System (NMS). A proposed strategy was published and views on it were invited from anyone who had an interest in the outputs and impact of the NMS. The consultation ran for 17 weeks and closed on 18 September 2009.
2. The NMO's proposed strategy for the NMS set out the priorities for supporting leading edge research to advance the measurement technologies that would underpin the UK's economic growth and an innovative response to national challenges. It also described how NMO planned to achieve impact through investing in measurement assets, working in partnership with the measurement community and sharing knowledge in order to support business to innovate. The Strategy aimed to form a framework for the future scope of the NMS by setting out the rationale for funding and the ambitions for impact.
3. The Strategy was accompanied by several supporting studies and analyses. Technology roadmaps were produced for each of the main measurement research programmes which showed the potential impact of the research and the timeline and milestones for delivering the impact. The proposed priorities for measurement research were derived from an analysis of Government policy objectives and the contribution that new and improved measurement technologies could make to their fulfilment. As part of an evidence base to support the rationale for Government funding, an econometric analysis and case studies of economic impact were produced.
4. The proposed strategy was divided into the following sections, which shaped the consultation.

Priorities	Delivering world-class science
	Responding to national challenges
	Leading UK measurement
Delivery	Investing in our measurement assets
	Working with the measurement community
	Achieving impact through sharing knowledge
	Measuring impact
	Operating efficiently

Respondents were invited to answer eleven questions structured around the above framework. Contributions could be made to either a private email address or posted on a public web-based facility.

The response

5. There were 91 responses to the consultation. 37 were received via the interactive web interface through which a total of 195 comments were recorded. A further 54 responses were made privately. A broad range of stakeholders responded, including businesses and business

associations, academics, professional institutions, public agencies and national measurement institutions, both UK and overseas.

6. A number of consultation meetings were held for communities connected with NMO, such as the Measurement Board and other advisers. There were also opportunities for groups associated with the Technology Strategy Board and Regional Development Agencies to provide comments collectively. In addition, an event was held by the Research and Development Society to enable its members and other members of the R&D community to contribute to the consultation.

Summary of the consultation

7. Almost all respondents welcomed the proposed NMS strategy and supported its ethos that publically funded measurement research should have a sound rationale and be needs-driven and demand-led. A recurrent theme of a number of the responses was that the strategy was ambitious in scope and scale, which was praised, but that Government should be realistic about what could be achieved, especially at the level of excellence that was aimed for and the amount of money available. Many respondents advised that it would be necessary for NMO to choose priorities carefully in implementing the strategy and that the views of business and other stakeholders should inform the selection.

8. Many respondents commented that NMO's strategy for the NMS and for measurement science and research in particular, should be cross Governmental, explicitly informed by, and serving, the priorities of Government as articulated in current strategies such as the Low Carbon Industrial Strategy and Digital Britain and the policies of the Technology Strategy Board. In addition, the strategy should say more about the place of the NMS within the UK's science and research base and state an intention to link better with other Government-sponsored assets.

9. There was a widespread view that the prime role of the NMS was to support business innovation and competitiveness, particularly by maintaining and developing the core infrastructure of measurement standards and techniques. NMO's prime role in promoting competitiveness and innovation was seen by many as providing the underpinning measurement science infrastructure and regulatory framework to allow innovation to flourish and where appropriate to be regulated. Several respondents wished to see specific mention of the NMS role in supporting the manufacturing industry.

10. Most respondents agreed with the five sectors (energy, sustainability, healthcare, digital economy and security) identified as priority national challenges for NMS focus. There was approval of the commonality of the challenges with those identified by other Government innovation and science agencies such as the Technology Strategy Board and the Research Councils. There was widespread support for the proposed Centre for Carbon Metrology.

11. A number of respondents commented that the importance of legal metrology and the impact of regulation were understated in the strategy. Many aspects of regulation were underpinned by measurement technologies and techniques and the production of good quality scientific evidence. The strategy should state this and commit to maintaining this infrastructure. There

was also concern that the needs of the citizen and consumer for good measurement regulation and enforcement had not been sufficiently recognised.

12. A strong leadership and influencing role was advocated for NMO and the NMS laboratories, both nationally and internationally. The UK should continue to exert strong influence in international scientific and legal metrology committees and in the European Metrology Research Programme.

13. There was support for the NMS to continue to strive to be world class and world leading in selected areas of science where the UK would benefit economically. The science priorities were supported but should be justified. Nanoscience should be mentioned explicitly. There was support for the construction of the proposed advanced metrology facilities. Virtually all who supported the construction also supported locating the facility close to NPL on the Teddington site.

14. Many respondents advocated a leadership role for NMO and the NMS laboratories in promoting and providing measurement training, education and skills. There was support for the NMS to pump-prime basic and intermediate levels of vocational training in measurement methods and use in order to remedy existing skills deficits and be responsive to emerging skills needs. Some respondents advocated that the NMS strategy should include a role to promote measurement science and technology as part of the education system and as a career choice.

15. There was widespread support for the NMS, the Technology Strategy Board and the Research Councils to work much closer together on common agendas and to exploit synergies and to look for opportunities for joint-funded activities and knowledge transfer. Respondents advised that the NMS should engage better with national and regional innovation infrastructure, for example science and innovation parks, and form partnerships to exploit existing measurement resources and facilities not currently classed as part of the NMS. Existing means of knowledge transfer, such as events, guides and networks, were supported, particularly when there was a face-to-face element. NMO and the NMS laboratories should engage better with stakeholders and beneficiaries to determine measurement needs and raise awareness of measurement advances.

Summary of the Government Response

16. NMO will ensure that the final NMS Strategy is realistic in its scale and scope and reflects the available budget. The strategy will describe how the NMS fits within the UK's science and research base. It will set out the contribution that the NMS makes to wider Government strategies and state the intention to form better linkages with future strategies both in their formulation and their implementation.

17. The NMS Strategy will emphasise that support for business competitiveness, with business innovation as a component part, is the prime driver of the NMS. It will state the intention to maintain and develop the core NMS infrastructure of measurement standards and techniques. Specific mention will be made of the NMS role in supporting the manufacturing industry.

18. The five challenge areas of application (the sectors of energy, sustainability, healthcare, digital economy and security) will continue to be the priority focus of the NMS. The importance of the infrastructure of legal metrology and regulation will be emphasised in the NMS Strategy, as well as the needs of the citizen and consumer for good measurement regulation and enforcement.

19. The proposed Centre for Carbon Metrology will be supported in the NMS Strategy if NMO's continued consultation with wider Government and business representatives shows that the investment would be sound and bring benefit to UK businesses.

20. The leadership and influencing role of the NMO and the NMS laboratories will be set out clearly in the NMS Strategy. Emphasis will be placed on the need for strong UK influence in international scientific and legal metrology groups and committees, and the benefits that this brings to UK business. The strategy will also describe a leadership role for NMO and the NMS laboratories in promoting and providing measurement training, education and skills, including the provision of support from the NMS to underpin vocational training in measurement techniques in order to remedy existing skills deficits and be responsive to emerging skills needs.

21. The NMS Strategy will emphasise that the NMS will continue to strive to be world class and world leading in selected areas of science where the UK would benefit economically. The science priorities will be set out, together with a better justification of their selection and clear information about the contribution they would make to business competitiveness, innovation and meeting national challenges. Nanoscience will be included as a cross-cutting technology.

22. The NMS Strategy will support the construction of the proposed advanced metrology facilities if a sound business case is produced. The location of the facility would be determined by the business case, but NMO notes that virtually all respondents who supported the construction also supported locating the facility close to NPL on the Teddington site.

23. NMO will review the partners of the NMS and be more explicit in the NMS Strategy about joint working, particularly with the Technology Strategy Board and the Research Councils. NMO will also work with business associations and professional bodies in the instrumentation, testing, control and trading standards sectors.

Next steps

24. The draft NMS Strategy will be revised to reflect the responses from Government set out in this Response Document.

25. The Response Document, the revised NMS Strategy and the accompanying evidence of NMS impact will form an input to decisions on future Government spending priorities. The final NMS Strategy will take account of the future funding profile for the NMS. Publication of the NMS Strategy is expected in Autumn 2010.

Responses to specific questions

Question 1: Delivering world-class science

What are your views on the science priorities and objectives?

26. There was widespread support for the statement in the strategy that NMO should support the NMS laboratories to retain a leadership position in selected areas of science. Respondents stated that the world-class measurement science within the NMS gave the UK a competitive advantage in business and commerce. Comments were made that performing world class science made valuable international collaborations possible which in turn helped the NMS to achieve its goals and exercise influence and leadership.

27. Some respondents commented that the work of NMO and the NMS laboratories came across as niche, remote or dislocated from that of other Government-funded scientific or R&D organisations that perform or commission measurement science, for example the Engineering and Physical Sciences Research Council, the National Institute for Biological Standards and Control and the Technology Strategy Board. Links and partnerships should be made, or emphasised if they exist.

28. Most respondents liked to see that the science priorities had been clearly declared. However, some questioned the selective nature of the list and wanted more information about how the science areas were chosen, how they fitted together and how their pursuit would translate into applications and impact. The benefits to business, for example to the manufacturing sector, and the impact on meeting the national challenges, such as environmental sustainability, should be evident. Some said that the list was too detailed, esoteric and overly prescriptive. Points were made about the need for flexibility. Also, the science priorities looked aspirational and questions were raised about whether it was realistic for the NMS to aim to pursue all the areas on the list, given likely future pressure on resources.

29. On the list of priorities, at least ten respondents pointed out that measurement science for nanotechnologies seemed to have been ignored. It was considered to be a cross-cutting technology. Suggestions were made to include work on nanoparticles and nanodevices in the science priorities. A number of respondents commented that chemical and biological measurement was given too low prominence and that a more even balance with physical measurement within the NMS portfolio should be strived for. There was approval of the inclusion of quantum technology on the list.

30. There were mixed views on whether the NMS, primarily NPL, should focus on building on existing core scientific strengths as opposed to branching out and investing in new capability. There was also a range of views on whether NPL should be selective in its science areas or retain expertise in a broad field, as may be expected for a measurement laboratory classed as one of the “top three in the world”.

31. Several respondents emphasised that the NMS should play a role in encouraging the study of measurement science in schools, colleges and universities. The headline scientific achievements of the NMS could be used to excite and enthuse future students. A role was seen for the NMS in developing the UK’s measurement skills-base through transfer of scientific know-

how. NMO, through the NMS, should be active in promoting measurement sciences as a career choice through outreach activities in schools, colleges and universities.

32. Several respondents felt that the science section in the strategy should follow on from the sections on national challenges and leadership, as the science priorities are key to achieving objectives in these areas.

Government response to be taken into account in the NMS Strategy

- 1) The NMS Strategy will continue to show science priorities. The aim would be for the NMS to work at high level in the selected disciplines to achieve maximum impact. The Strategy will present a better justification of the chosen science priorities and set out the contribution they make to business competitiveness, innovation and meeting national challenges.
- 2) The NMS Strategy will place the measurement science funded by the NMS in the context of the UK science base, bringing out the totality of measurement science effort in the UK and overseas, and the role of the NMS within it. The Strategy will state the intention to continue to build links and partnerships with other UK Government-funded measurement science.
- 3) The science priorities will be less technically detailed. NMO will bring out the linkages between them and will avoid setting them out as a list. Nanoscience will be given more prominence as a cross-cutting technology.
- 4) The predominance of physical measurement science in the priorities over chemical and biological measurement represents the current balance of capability of the NMS in these areas. The balance may change to meet the needs for new measurement science capability to satisfy the priorities determined in the NMS Strategy.
- 5) NMO will support a role, if cost-effective, for the NMS in promoting measurement science as part of the education system. If so, this will be reflected in the NMS Strategy.
- 6) The positioning of the science section in the strategy will be considered so that there is flow-through from the impact areas to the enabling science.

Question 2: Responding to national challenges: priorities

What are the priorities for measurement research within the following national challenges set out in the Strategy?

- **Business competitiveness**
- **Business innovation**
- **Energy, Sustainability, Healthcare, Digital Economy, Security**

How would you rank the priority of each national challenge?

33. At least ten respondents felt that the distinction between business innovation and business competitiveness was artificial. Some also said that these essential business support elements did not sit well with the text on the national challenges and should not be directly compared, or be in competition with them.

34. Business competitiveness, with business innovation as a component part, was seen by most respondents as the most important ambition as this has undoubted economic benefit and drives output in the five challenge areas of application (the sectors of energy, sustainability, healthcare, digital economy and security).

35. There was widespread support for re-emphasising, in the context of business innovation and competitiveness, the role of the NMS in maintaining and developing the core infrastructure of measurement standards. NMO's principal role in promoting competitiveness and innovation was seen by many as one of providing the underpinning measurement science infrastructure and regulatory framework to allow innovation to flourish and where appropriate to be regulated. The importance of improved accuracy in product inspection, testing, monitoring and control in the manufacturing industry should be highlighted. The impact of past achievements, such as improvements to the accuracy of time standards, should be recorded as evidence of impact.

36. Many respondents advised that the need for continuing investment in the core measurement infrastructure into the long term should be at the heart of the NMS strategy. The NMS role in standardisation, validation and regulation should not be understated. The NMS contribution to ensuring international equivalence of measurement standards through Mutual Recognition Arrangements should be mentioned as an important support mechanism to business.

37. Most respondents agreed with the five sectors identified as challenge areas in the strategy. Most felt that the sectors were equally valid, although those that ranked the challenges tended to place environmental sustainability related to climate change at the top. Efficient energy supply and use, particularly for renewable forms of energy, were seen as key aspects of this. There was most doubt about the digital economy and security sectors, mainly because it was perceived that the relatively small NMS effort in these very broad areas would not make much difference and there could be overlap or duplication elsewhere. It was also felt that many of the proposed work areas would require a large scale international collaborative effort and the NMS strategy should be realistic in what could be achieved.

38. Most respondents welcomed the commonality of the sector challenges with those of other Government agencies, such as the Technology Strategy Board and the Research Councils, which set policy and distributed funds for innovation and science. Several respondents suggested that the NMS strategy should be specifically geared to, and joined up with, other Government strategies such as those for low carbon, healthcare, advanced manufacturing and digital Britain. Points were made that advances in measurement technology would contribute to the objectives of these strategies and that the NMS should be a contributor to similar future strategies and activities. Comments were made about the need for coordination and linkage of research effort across Government in order to achieve maximum impact and avoid duplication.

39. There was some concern that the strategy gave the impression of a significant widening of scope of the NMS but there was no indication as to how this would be resourced, apart from mention of collaborations with universities and Research Councils. In addition, there were comments that the supporting information in the challenge areas, particularly for healthcare and sustainability, read like a catch-all and implied that the NMS would be involved in all the topics. There was comment that the strategy did not explain what the priorities would be and how they

would be determined. However, many of the specific proposals, where focussed, were welcomed.

Government response to be taken into account in the NMS Strategy

- 1) The NMS Strategy will state the intention to make better links with Government policy makers to influence and deliver Government strategies. It will also emphasise the formation of strong links with the Technology Strategy Board and Research Councils in order to coordinate Government funded measurement research.
- 2) We agree that business competitiveness and innovation are prime drivers of the NMS and that they will continue to drive the NMS Strategy. We will consider how best to present the relationship between these two elements.
- 3) The NMS Strategy will reaffirm the commitment to maintain and improve the core measurement infrastructure of national standards and associated traceability, calibration and testing capabilities, which businesses and other users can access.
- 4) The five national challenge areas will continue to be the priority areas of NMS focus but the NMS Strategy will be clearer on scope and priorities within the five areas.
- 5) NMO will consider suggestions made by respondents on specific proposals for NMS work, which would be at too detailed a level to feature in the high level NMS Strategy. In some cases NMO will instigate a dialogue with the respondent to find out more about the suggested work area.

Question 3: Responding to national challenges: omissions

Have you identified any challenges that are missing from the Strategy?

Are there other areas of measurement research that should be stated in the Strategy?

40. At least five respondents commented that the importance of legal metrology and the impact of regulation were understated in the strategy. Many aspects of regulation were underpinned by measurement sciences and the strategy should explore this relationship further. The strategy should acknowledge that such regulations are supported by good quality scientific evidence.

41. At least five respondents commented that the safety and security of food and water supplies should be included as a challenge, or within a challenge, because advances in measurement technology and the setting of associated standards could have a huge impact.

42. The following comments and suggestions were made:

- Advanced engineering, which might embrace Micro-Electro-Mechanical-Systems (MEMS), nanotechnology and advanced materials should be specifically referenced and could be envisaged as a technology area to underpin the five specific challenges.
- The space sector was seen as important for the UK economy and presented many opportunities for UK businesses. The measurement needs of the sector should be included in the NMS Strategy.
- The inclusion of measurement science in support of nuclear energy was welcomed.

- In the Energy and Sustainability sections, the opportunity to invest in measurement technology to support the development and use of higher efficiency and less polluting products should be highlighted.
- Attention should be given to the demands for measurement to support the requirements of the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulations. New problems are emerging with the need to determine the engineering properties of substituted materials.
- Materials characterisation, which directly supports innovation in materials technology, should be specifically referenced.
- In the healthcare section, the focus appeared to be very reactive, for example diagnosing, caring and treating, rather than preventing ill-health or promoting well-being.
- In the area of security, forensic measurement was suggested as being worthy of explicit mention for the crime and justice agenda.

Government response to be taken into account in the NMS Strategy

- 1) NMO agrees that legal metrology is an integral part of the NMS and will ensure that it receives appropriate prominence and coverage in the NMS Strategy.
- 2) NMO agrees that safety and supply of food and water are areas that could be considered as national challenges. Before inclusion in the NMS Strategy, advice will be taken on the impact that the NMS could make to the challenges.
- 3) NMO will consider all the suggestions made by respondents on specific proposals for NMS work, which would be at too detailed a level to feature in the high level NMS Strategy. In some cases NMO will instigate a dialogue with the respondent to find out more about the suggested work area.

Question 4: Responding to national challenges

Do you support the establishment of a Centre for Carbon Metrology?

43. NMO's proposition was that it should:

- *Create a Centre for Carbon Metrology to provide measurement and characterisation methods to support the development of low carbon technologies and provide confidence in the data used to support carbon reduction initiatives such as the Emissions Trading System and carbon labelling.*

Of the 91 responses received to the consultation, 40 commented explicitly on the Centre for Carbon Metrology.

44. Of the 40 responses, seven responses saw a role for the proposed Centre in developing measurement science to define carbon measurement standards and accounting systems to verify carbon emission data and support carbon trading and pricing. Several respondents stated that the UK could gain competitive advantage from taking the lead in this area. A suggestion was made that the work should be done in international collaboration, as the international

regulatory dimension would be critical to the adoption of any measurement and accounting standards.

45. A further 22 responses (from a mix of business, academic and public sector backgrounds) gave broad support to the creation of a Centre for Carbon Metrology. These responses did not mention explicitly the proposed work on carbon accounting. They were supportive of an NMS role in solving measurement problems and supporting innovation in low-carbon technologies. They saw benefit in the NMS assuming a leadership role and becoming a focal point for measurement research and collaborations in low-carbon technologies. They favoured a virtual centre that would act like a federation in bringing together and linking relevant expertise and facilities. Many emphasised the importance of securing the backing of the Department of Energy and Climate Change (DECC) and other relevant agencies.

46. A further six responses supported the Centre for Carbon Metrology for the purpose of focussing measurement research on the climate change agenda. Specifically they advocated that the NMS, through the Centre, should become an authority on the evaluation, validation and interpretation of earth observation data and predictive modelling.

47. A further five responses (from various backgrounds) were sceptical or not convinced about the creation of the Centre for Carbon Metrology. They did not disagree that measurement research should be undertaken to advance low-carbon technologies. However, they did not accept that a new Centre should be created. The main reasons cited were that the added value of the Centre, and the business case, had not been demonstrated and that there could be overhead costs.

Government response to be taken into account in the NMS Strategy

- 1) Before making a strategic commitment to establish a Centre for Carbon Metrology, NMO will consult widely and build a business case for investment, based on the need to support measurement to underpin carbon trading, citing the stakes in terms of potential gain for the UK of economic benefit and influence. If this evidence were compelling, the case for investment in building the capability would be strong and would be included in the NMS strategy.
- 2) Within the measurement programmes, NMO will continue to formulate research projects that address the measurement challenges of developing low carbon technologies. Consideration will be given to ear-marking funds dedicated to this purpose and to including the development of this work, in collaboration with business, in the NMS Strategy.
- 3) NMO emphasises that the proposed Centre for Carbon Metrology would be a virtual centre and would not involve significant capital investment.

Question 5: Requirements for measurement technology and expertise

What are your requirements for measurement technology and expertise both now and for the future?

Are they well described and satisfied in the Strategy?

48. Several respondents from business stated that their requirement was for the measurement technology and expertise from the NMS to be practical, relevant, accessible and affordable.

49. The agri-food sector was cited by several respondents as being a growth sector with distinct measurement needs, particularly as regards the regulatory framework in which the agri-food industry operates. Regulations need to be underpinned by relevant measurement science and it was suggested that the NMS should have a role in ensuring that the regulations are reasonable, rational and supported by good quality science. This important area of activity was not well covered in the Strategy.

50. Some respondents had requirements for measurement support for processing and interpreting large data sets. Making sense of data through mathematical modelling was an essential and rapidly expanding area of work. The NMS should conduct work on developing and validating tools such as algorithms or mathematical models to aid interpretation and extract meaning from large data sets. This area was considered not to be well covered in the Strategy.

51. There was a view that a current measurement and standards priority should be the availability of effective predictors of biofuels' integrity and performance. The work needed to be done rapidly as markets were being driven by the political agenda of climate change and the existing standards are inadequate to assure the utility and performance of the range of biofuels that were emerging.

52. There was a plea that R&D intensive organisations should be a major targeted beneficiary of new measurement technologies.

Government response to be taken into account in the NMS Strategy

- 1) NMO agrees that the needs of the agri-food sector, the requirement for measurement support for processing and interpreting large data sets and the suggested work on biofuels' performance indicators could be worthy of inclusion in the NMS Strategy. Advice will be taken on the potential impact of NMS work on these areas.
- 2) NMO will consider other suggestions from respondents on specific requirements for NMS work, which would be at too detailed a level to feature in the high level NMS Strategy. In some cases NMO will instigate a dialogue with the respondent to find out more about the suggested requirement.

Question 6: Leading UK measurement

How far do you agree with NMO's proposed approach to exercising national and international leadership in measurement?

53. There was widespread support from respondents for NMO's leadership aspirations. A high profile for this leadership effort was encouraged, with effort being put in to make the UK's work visible and acknowledged. The ways that this measurement leadership could convert to commercial benefit for UK business should have greater focus in the Strategy.

54. Several comments were made about the need for the UK to have a strong voice in areas of regulation and standardisation. It was felt that having influence could be just as important as leading, particularly on the international stage.

55. Comments were made about the NMO's international leadership seeming to be Europe-centric in the strategy. Nevertheless, it was pointed out that the UK's role in leading EURAMET (the European Association of National Metrology Institutes) was not mentioned.

56. Several respondents believed that NMO should exercise leadership in the devolution of measurement standards and should challenge the need for some standards to be maintained by the NMS laboratories. When standards were devolved, NMO should ensure that businesses knew where to go to find alternative provision.

57. A number of respondents advocated a leadership role for the NMO in encouraging the study of measurement science and the development of more effective vocational training in basic measurement.

Government response to be taken into account in the NMS Strategy

- 1) The NMS Strategy will state the priority for a strong leading and influencing role for the NMO and the NMS laboratories, particularly in international scientific and legal metrology groups and committees. The Strategy will emphasise the economic benefits that flow to the UK from these representative activities.
- 2) The NMS Strategy will state as a priority the UK's leadership and influence within EURAMET and the European Metrology Research Programme, whilst emphasising the benefits and added-value that such international collaborations will bring to the NMS.
- 3) NMO will include in the NMS Strategy a leadership role for NMO in considering the devolution of national standards
- 4) The NMS Strategy will also describe a leadership role for NMO and the NMS laboratories in promoting and providing measurement training, education and skills, including the provision of support for the NMS to underpin vocational training in measurement techniques in order to remedy existing skills deficits and be responsive to emerging skills needs. Consideration will be given to providing NMS funding for the development of a national vocational qualification in measurement technology linked to National Occupational Standards.

Question 7: Investing in measurement assets

Do you have views on the priorities for investment in measurement assets?

For example do you believe that NMO should invest in new advanced laboratories in order that the UK should continue to be a world leader in advanced measurement science?

What are your views on the optimum site for this advanced facility?

Measurement assets

58. A number of respondents stated that the scientists working in the NMS laboratories were the prime asset of the NMS. Support was given to the strategy's proposals to develop the pool of talent. Several respondents mentioned the need for an active recruitment policy and inducements to attract world class scientists to work in the NMS laboratories.

59. Several respondents advised that the NMS should engage with national and regional innovation infrastructure, for example the science and innovation campuses at Harwell and Daresbury and science parks, as hubs for world-class companies.

60. At least ten respondents commented that the NMS Strategy should place greater emphasis on partnerships to utilise existing measurement resources and facilities not currently classed as part of the NMS. Examples were the facilities and expertise at the National Institute for Biological Standards and Control and the National Nuclear Laboratory, as well as the unique facilities that are in place in universities and business. Particular mention was made of the need for linkages with the network of local authority metrology laboratories operated in support of trading standards enforcement.

Advanced metrology laboratories

61. Of the 91 responses received to the consultation, 36 commented explicitly on the need for new advanced metrology laboratories.

62. 32 respondents stated support for the construction of world class laboratories which were on the next level in terms of highly specified control of laboratory working environments. Other points were that the new facilities should be easily accessible and open for use by industrial and academic scientists. The facilities should foster collaborative research and attract top scientists to the measurement programmes. There was support for a Centre for Quantum Technology within the advanced facilities which would form a national focus and bring together research teams working in the field of atomic, optical and quantum physics. Respondents stated that this would allow NPL scientists to remain world leaders in clock technology, gain competitive advantage for the UK and set the stage for a new generation of atomic clocks.

63. Four respondents were sceptical, or raised issues about the proposed advanced laboratories. They commented that there should be a sound business case for the development which clearly specified the benefits and impact on a national basis.

64. 22 respondents were in favour of locating the facility on the NPL site at Teddington in order to exploit the association with other pioneering measurement research carried out at NPL and the synergies derived from the proximity of the existing critical mass of expert measurement scientists.

65. Ten respondents who supported the advanced facilities either had no view or were not convinced that the facility needed to be at Teddington and suggested that other factors, such as scope for collaboration and better access, might point to a location that offered greater facilitation of inter-disciplinary use.

Government response to be taken into account in the NMS Strategy

- 1) NMO agrees that a partnership approach should be adopted for sharing expertise and facilities. NMO will state this in the NMS Strategy.
- 2) NMO will continue to exploit the Teddington site to ensure that it can sustain a world-class reputation for measurement science.
- 3) A decision to build an AML has not yet been taken. NMO will take respondents' views into account. A design concept had been commissioned in order to assess the likely cost.
- 4) If a decision to build an AML is taken, the location chosen would be the one that offered the best value for money and satisfies the business case, as long as the essential controlled laboratory environments could be achieved.

Question 8: Working with the measurement community

How can NMO, the NMS laboratories and the NMS community best work together to maximise the impact of NMS research and support?

66. There was widespread support for the key players listed in the strategy to work much closer together on common agendas and to exploit synergies and to look for opportunities for joint-funded activities. In particular, it was advocated that agencies such as NMO, British Standards Institution, the Intellectual Property Office, the UK Accreditation Service, the Trading Standards Institute, the Technology Strategy Board, Regional Development Agencies and Research Councils could form a more coherent innovation support network.

67. Several respondents questioned the composition of the "NMS Community" and suggested that the NMS partnership approach with the organisations set out in the Strategy should be less selective and widened to include others such as the calibration and testing laboratories, the National Institute for Biological Standards and Control and selected relevant Government Departments. In particular, mention should be made of the Trading Standards community as part of the NMS community. There was an absence of reference to consumers and citizens in the Strategy. NMO should add consumer organisations to its community of potential beneficiaries of NMS outputs.

68. A number of respondents urged NMO and its partners to devote significant resources to actively engaging with businesses, academia and other measurement science bodies including regulatory agencies in order to assess their true needs. It was suggested that the NMS community should work with business at an earlier stage to ensure better commercial application. Greater emphasis should be put on the commercial exploitation of scientific research and the transfer of technology from NMS measurement research.

69. Several respondents advocated stronger links between the NMS laboratories and the instrument makers' community. This would benefit the NMS as the needs of the sector would be better appreciated, and would benefit the sector by gaining access to the latest technical advances.

Government response to be taken into account in the NMS Strategy

- 1) NMO is taking part in a review conducted by the Department for Business, Innovation and Skills of the infrastructure that supports business innovation through the work of agencies such as the NMO, British Standards Institution, the Intellectual Property Office and the UK Accreditation Service. The aim is to enhance the customer experience and create opportunities to add value by closer working. The NMS Strategy when published will reflect the conclusions of this review.
- 2) NMO is using a stakeholder mapping approach to decide the nature of relationships with stakeholders and customers, which is dependent on the goal for the relationship. Tailored engagement plans will then be drawn up for the “NMS Community”, which would be wider than that specified in the draft NMS Strategy. The NMS Strategy will state the key partnerships and wider community, as well as making clear the benefits of the relationships.
- 3) The NMS Strategy will state clearly the priority for the NMO and the NMS laboratories to engage in an effective and timely way with businesses, academia and organisations, including regulatory agencies, in order to increase the impact of NMS activities through knowledge of measurement needs and collaborative ventures.

Question 9: Achieving impact through sharing knowledge

How can NMO and the NMS laboratories best engage with customers and beneficiaries to maximise the impact of measurement research and support?

70. Most respondents supported the conventional methods of knowledge transfer as a means of engaging with end users, particularly businesses, and raising awareness of the NMS. This included guides, website, training courses, newsletters, events and networking clubs. However, the respondents emphasised that they wanted NMO and the NMS laboratories to be much more proactive and imaginative in making contact and establishing a two-way ongoing relationship. A number of people suggested that NMO and NMS representatives should be much more visible at high-profile science and innovation events, and take speaker slots. Generally the preferred means of engagement was face-to-face contact at events, symposia, workshops, lectures, trade fairs etc.

71. In addition, there was widespread support for NMO and the NMS laboratories to use intermediaries to engage with potential customers and beneficiaries of the NMS. The most frequent suggestions were to work with the Technology Strategy Board’s Knowledge Transfer Networks and with business associations and professional institutions, as they were trusted points of contact for information and advice. There were also suggestions to engage with consumer associations who represent the citizen. A means of engagement via an intermediary could be for the intermediary to carry information and a newsfeed from the NMS on its website.

72. Several respondents encouraged NMO to dedicate resources to developing innovative ways of spreading knowledge, such as videos of achievements available on accessible websites and the use of new media.

73. Some respondents made the point that the NMS could only engage with customers and beneficiaries if they knew who they are.

Government response to be taken into account in the NMS Strategy

- 1) The NMS Strategy will support a pan-programme approach to knowledge transfer. This will focus on market sectors and key national challenges, designed to cut across technical programme boundaries and to provide consistency and economy in the design and delivery of products such as events, newsletters etc. The Strategy will highlight the establishment of a Measurement Knowledge Exchange Network which will draw together a measurement community from the members of the many fragmented, disparate clubs and networks that have operated in isolation under the auspices of the technical programmes.
- 2) NMO will work with the Technology Strategy Board's Knowledge Transfer Networks to raise awareness of good measurement and to gain feedback on business needs for measurement technology. NMO will similarly work with business associations and professional bodies in the instrumentation, testing, control and trading standards sectors.
- 3) NEL (one of the NMS laboratories) has carried out a study of the effectiveness of knowledge transfer mechanisms commonly used in the NMS and elsewhere. Many of the findings echo the views of respondents to the consultation. NMO will take account of the findings to create a flexible portfolio of effective, tailored and targeted knowledge transfer.
- 4) The NMS Strategy will include a commitment to promote better engagement with stakeholders and beneficiaries. This will be based on a stakeholder mapping exercise which will identify and categorise key organisations and businesses with whom the NMS should engage to raise awareness of measurement advances and/or to draw in views about future needs.

Question 10: Measuring impact

How should NMO develop and improve its evidence-base of the economic and social impact of the NMS?

74. There was widespread support for the work that NMO had commissioned to assess and demonstrate the economic impact of the NMS. The consensus was that NMO should continue to devote resources to building the evidence base and should adapt and use it wisely to influence various audiences and communities (especially the business community).

75. The economic case studies were praised by many respondents as they were close to market and provided examples of the tangible financial benefit of the output of the NMS project on individual companies.

76. Many respondents recognised an influential role for descriptive case studies as a means of showing the impact of the NMS, and particularly the social impact which is often intangible. Together, the case studies build a picture. They should be readily available on websites to promote the importance of good measurement.

77. There were several comments that the evidence base for the NMS should include evidence of impact on citizens and consumers. For example, case studies could be used to show the impact of weights and measures legislation and enforcement. A further comment was that the impact of the NMS “pure” science should be included in the evidence base.

78. Several respondents said that the evidence of impact gathered after completion of each project was the most compelling in terms of justifying the original funding. Relationships with the project’s beneficiaries should be maintained after completion, and information should be sought from them about the effect of the NMS work and its impact.

Government response to be taken into account in the NMS Strategy

- 1) To support the NMS Strategy, NMO will continue to build up the evidence base of impact of the NMS through a spread of indicators. These will feature economic analyses, case studies and surveys. Particular attention will be given to producing case studies showing a variety of impacts on different communities, including businesses and consumers.
- 2) The NMS Strategy will include commitments to build an evaluation framework for NMS programmes and projects, including evaluation of a project after completion. As part of project monitoring, NMO will consider extending the monitoring process beyond project completion dates, although it would be important to make the process as simple as possible and to have a means of analysing the new information and using it to identify (and publicise) impact and achievements.

Question 11: Operating efficiently

Do you have any suggestions on how the NMS programmes could be delivered more efficiently and effectively?

79. There were at least 25 responses to this question. Most respondents were supportive of NMO’s efforts in recent years to simplify the structure of the portfolio of NMS programmes and to create technology roadmaps that set out medium to long term plans for turning scientific endeavour into technologies with commercial applications that would have impact on targeted challenges.

80. Several respondents advised that NMS funds could be targeted more effectively if there was a more comprehensive process in place for assessing the needs for measurement solutions, both for commercial exploitation and for the public good, for example to underpin legislation and standards. There were suggestions that measurement needs should be determined on a sectoral or community basis rather than from within technology-facing programmes. There was a suggestion that NMO should collaborate with the Technology Strategy Board and the Engineering and Physical Sciences Research Council in order to prioritise the needs of different communities and develop co-ordinated action plans. There was also a call for more rigorous horizon scanning.

81. The creation of NMO was seen as a positive factor in increasing the efficiency and effectiveness of the delivery of NMS programmes as it could provide a supportive delivery framework and customer focus. NMO was advised to include an experienced measurement scientist or engineer, from a business background, in its top level management structure, including its board.

82. Several respondents recommended that more effort should be put into evaluations of projects once completed. The selective evaluations should be deep and probing, looking at the design of the project, its operation and progress and whether it had delivered what had been promised in terms of outputs and impact. The emphasis should be on learning lessons from successful and not so successful projects and making improvements in future project definition and operation.

83. There was a recommendation that there should be a separation between the functions of defining programmes/projects and their delivery. There should be an open tendering process for projects to ensure value for money.

84. The technology roadmaps were praised by a number of respondents. It was suggested that there should be a mechanism to identify gaps and synergies between roadmaps and programmes so that NMS programmes could work synergistically to contribute to measurement challenges. It was also suggested that there could be integrated roadmaps involving not only measurement but other factors such as patents and standardisation in order to present a fuller view.

85. Several respondents praised the network of independent advisory Working Groups which helps NMO to commission the best value projects. It was suggested that a plenary meeting of advisers could be fruitful in sharing best practice and making the advisers aware of the high level challenges and how the portfolio as a whole is lined up to meet them.

Government response to be taken into account in the NMS Strategy

- 1) The NMS Strategy will include plans to incorporate sector-based assessments of measurement needs into the process of formulating new work areas. For example the needs of the energy supply sector for advances in measurement technology and standardisation will be looked at as a whole and prioritised.
- 2) NMO has recently strengthened its management structure and Steering Board representation to reflect the increased scope of the organisation and the need to make policy decisions about a complex measurement research portfolio. Two people with a strong science and engineering business background have recently been appointed to NMO's Steering Board.
- 3) The NMS Strategy will include commitments to build an evaluation framework for NMS programmes and projects, including evaluation of a project after completion. NMO agrees that this would provide valuable information about the quality of the project and its achievements. For in depth evaluations, NMO already has undertaken some post-completion project case studies which specifically calculated the economic benefit in terms of a cost:benefit ratio. NMO will build upon this and consider commissioning similar selective in depth evaluations of a project's life-cycle stages from design through to impact.

- 4) NMO has supported NPL in a reorganisation of its operations which has created a core team for assessing measurement needs in priority sectors and proposing work to meet the needs. This is a separate from the teams that deliver the programmes.
- 5) NMO agrees that the programme roadmaps should mesh together to form a coherent picture for the NMS. Work has been undertaken to identify gaps and synergies. NMO will consider the provision of suitable opportunities for cross-programme networking for the members of the advisory Working Groups.

Other issues raised in the consultation

86. As well as the responses to the specific questions in the draft NMS Strategy, respondents made other detailed comments on the strategy document, including drafting suggestions and advice on presentational aspects and layout. NMO will review all these detailed comments when revising the draft strategy.

Acknowledgement

87. NMO is very grateful to all those who took time and effort to respond to the consultation. Many responses contained detailed and specific points that would not be appropriate for inclusion in the final NMS Strategy. These points will be followed up by NMO in dialogue with the relevant individuals and organisations.

Annex: Responses to the consultation

The following respondents agreed to be named.

Respondent	Organisation
Prof Tony Anson	Diameter Ltd
Norman Bolton	Independent Consultant
Dr Julian Braybrook	LGC
Dr Rodney Burnham	Registrar, Royal College of Physicians
Adrian Chapman	Norfolk Calibration Services
Dr W. T. Chyla	Central Office of Measures (GUM), Poland
Dr KD Cleaver	BOC Limited
Phil Clow	United Kingdom Accreditation Service
Dr Derek Craston	The Government Chemist
David Crellin	Science Scope
Albert Dalhuijsen	Managing Director, VSL, Dutch Metrology Institute
Carl Dingle	Private Individual
Eric Emmerson	Private Individual
Anne Farr	Managing Director, Rothera Group Ltd
Mike Fenner	Indium Corporation
Dr Gordon Ferrier	Air Products Plc
Dr Stephen Fletcher	Chemistry Innovation Knowledge Transfer Network
Dr Mike Ford	Private Individual
Graham Frost	PC Werth Ltd
Ron Gainsford	Trading Standards Institute
Martin Hall	Campden BRI
Colin Harper	Qinetiq
Dr Peter Hatto	IonBond Limited

The Institute of Physics	
Dr Chris Jones	on behalf of National Institute for Biological Standards and Control
Peter Kerry	EMC Consultant
Dr David Kingham	Chairman, The Research and Development Society
Prof Sir Peter Knight FRS	Imperial College London
Tom Langdon-Davies	Torbay Coast and Countryside Trust
Prof Jamie Lead	Environmental Nanoscience, University of Birmingham
Dr Alex Lepek	Newton Metrology Ltd
Prof Alastair Lewis	University of York
Dr J W Llewellyn	British Measurement and Testing Association
Pete Loftus	Rolls-Royce
Mark Lowen	Petrofac Offshore Engineering & Operations
William Lyons	Claude Lyons Limited
Daniel Mansfield	BSI British Standards
Peter Martindale	Institute of Measurement and Control
Sabine K McNeill	3D Metrics
Dr Nafees Meah	Department of Energy and Climate Change
Dr Brian Millington	TUV NEL
Prof Ian Mills	President of the Consultative Committee on Units at the International Bureau of Weights and Measures
Philip A Monger	RMI Independent Petrol Retailers Association
Prof Harry Moseley	Ninewells Hospital and Medical School
Dr David Mulligan	South East England Development Agency
National Physical Laboratory	
John Pickering	Metron Designs Ltd
Prof Isobel Pollock	University of Leeds

Barry Pratt	Norbar Torque Tools Ltd
Research Councils UK	On behalf of Engineering and Physical Sciences Research Council, Natural Environment Research Council, and Science and Technology Facilities Council
Malcolm Rhodes PhD	Health Technologies & Medicines Knowledge Transfer Network
Prof David Richardson	University of Southampton
Dr David Robinson	Psi-tran Ltd
Roger Saunders	Met Office
Dr Mark Seymour	Syngenta UK
Anne Silk	Independent Researcher, currently member of SAGE Electromagnetic Field Dialogue.
David W Smith	Past Master, The Worshipful Company of Scientific Instrument Makers
Dr Chris Stevens	NGF Europe Limited
David Sweetman	Private Individual
Harry Tee	Master, The Worshipful Company of Scientific Instrument Makers
Prof Pankaj Vadgama	Queen Mary, University of London
Robert Venn	Cambridge Microfab Limited
Prof Andrew Wallard	Bureau International des Poids et Mesures
Prof Ian Walmsley	Department of Physics, University of Oxford
Norman Waterman	Institute of Materials, Minerals and Mining
Dr Nick Webb	Delta-T Devices Ltd
Dr P Whittle	PW Environmental Sciences Ltd
Dr Dave Woodwark	Bioscience for Business Knowledge Transfer Network
Geoff Young	Group of Association of Manufacturers of British Instruments, Controls and Automation (UK)