

Abstract

Modern society requires reliable measurements that give the same answer wherever they are made. This is achieved by use of the International System of Units referred to as the SI. This system is based on and, in turn, supports continual and long-term research in fundamental science and technology.

However, European metrology is facing a **DILEMMA** of increasing consequence. On the one hand, the **demands** are growing of society for traceable measurement, both in traditional sectors (manufacturing, communication, etc) as well as new areas (such as nanotechnology). On the other hand, **resources** are limited and are not increasing in line with the increasing demand. In broad terms the MERA project, with the support of the European Commission, "*Planning the European research Area in Metrology*", lays the foundations for a co-ordinated approach to meet these metrology needs in Europe. NPL (GB) is project co-ordinator.

The present report concerns the **European Metrology Stakeholders consultation** about increased co-ordination in a European metrology research area, which was work package 6 in the MERA project. The questionnaire structure is motivated and described, as well as the means of distribution and the choice of stakeholder. Each question in the consultation is presented, together with an explanation of the rationale behind each question as well as the responses. The main questions were:

- Identification of respondent (including an account of the number of replies)
- A. Increased funding to European National Metrology Systems (NMS)
- B. European NMS organisation for better efficiency and effectiveness

Amongst the main conclusions and recommendations of this stakeholder consultation:

- European NMS should consider further how to improve collaboration with stakeholder organisations, not only as “end-users” but also as active partners in measurement knowledge transfer and research;
- stakeholders view the provision of traceable measurement and National Metrology as predominantly a continuing public service;
- a recommendation that European NMS formulate more clearly the role of metrology in political - that is, innovation and growth – rather than monetary terms
- stakeholders “...are looking for a European Metrology System/Organization that comprises of:
 - international competence centers, ... for the very high levels metrology
 - local/regional metrology labs that provide bulk traceability”

Key words: European, Metrology, Stakeholders, Consultation

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Preface

European metrology is facing a **DILEMMA** of increasing consequence.

On the one hand, the **demands** are growing of society for traceable measurement, both in traditional sectors (manufacturing, communication, etc) as well as new areas (such as nanotechnology). On the other hand, **resources** are limited and are not increasing in line with the increasing demand. In broad terms the MERA project, with the support of the European Commission, "*Planning the European research Area in Metrology*", lays the foundations for a co-ordinated approach to meet these metrology needs in Europe. NPL (GB) is project co-ordinator.

The present report concerns the **European Metrology Stakeholders consultation** about increased co-ordination in a European metrology research area, which was work package 6 in the MERA project.

Acknowledgements

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*MERA 2003 "*Metrology European Research Area*" (<http://www.euromet.org/pages/projects/MERA.htm>). MERA-G6MA-CT-2002-04012.

Project contractors are the NMIs of:

- UK (NPL, the coordinator), The Netherlands (NMI-VSL), Germany (PTB), Ireland (NML-EI), Sweden (SP), the Czech Republic (CMI) and Switzerland (METAS).
- Additionally supported by a further four NMIs from France (BNM), Denmark (DFM), Italy (IMGC) and Norway (JV).

Conclusions

A number of conclusions and recommendations are formulated, based on the European Metrology Stakeholders consultation of the MERA project, concerning the future of increased collaboration in European metrology as a means of solving the dilemma of providing for increased and extended needs for traceable measurement on a substantially fixed budget.

Stakeholder:NMS relations

National metrology services have, as one of their key tasks, to act as an intermediary, linking academic and industrial research.

- Almost all stakeholders saw it desirable to increase collaboration with NMS.
- NMS and the concept of traceable measurement appear to be reasonably unknown of at the European trade association level.
- It is recommended that the European NMS consider further how to improve collaboration with stakeholder organisations, not only as “end-users” but also as active partners in measurement knowledge transfer and research.
- Metrology research in collaboration with university provide good examples of what the Commission calls “federated excellence”.

Increased funding to European National Metrology Systems (NMS)?

- Stakeholders view the provision of traceable measurement and National Metrology as predominantly a continuing public service.
- They are willing to lobby for increased support to the European NMS but at the same are unprepared to pay much more for the services provided.
- Variable rates of subsidy or core funding between countries make it difficult to achieve European integration of calibration services.
- It is recommended that European NMS formulate more clearly the role of metrology in political - that is, innovation and growth – rather than monetary terms.

Scenarios for future increased collaboration between European NMS

“...We are looking for a European Metrology System/Organization that comprises of competence centers, each performing fundamental research for certain quantities and parameters and provide traceability for the very high levels metrology and calibration applications. Furthermore industry will continue to need local/regional metrology labs that provide traceability for the bulk of their traceability needs accuracy wise but also quantity wise and overcoming the local language issue.”

was the way one major international instrument maker responded to admittedly the most difficult question, that about scenarios for future NMS collaboration.

Redundancy and duplication

are not only a barrier to European integration [PREST 2002] but are also essential in metrology in:

- the elimination of systematic errors
- providing a multidisciplinary environment necessary for the development of metrology

1 Introduction

Modern society requires reliable measurements that give the same answer wherever they are made. This is achieved by use of the International System of Units referred to as the SI. This system is based on and, in turn, supports continual and long-term research in fundamental science and technology.

Increased needs of society for traceable measurement, both in traditional sectors (manufacturing, communication, etc) as well as new areas (such as nanotechnology) can be met with a sustained and further developed European metrology through increased co-operation. In broad terms the EU project “MERA”, with the support of the European Commission, "*Planning the European research Area in Metrology*", lays the foundations for a co-ordinated approach to meet these metrology needs in Europe by planning the implementation of the EUROMET strategy, which calls for increased co-ordination in a European metrology research area. NPL (GB) is project co-ordinator.

The project commenced in September 2002 and will run for approximately 12 months. In addition to the principal project participants, all the National Metrology Institutes (NMI) in the EUROMET countries and applicant countries are able to participate in, input to, and benefit from the project through the workshops and the analysis of national metrological priorities. Another important part are stakeholder consultations, both nationally and internationally, where those with a “vested interest” in metrology are asked for their views.

The present report concerns the European Metrology Stakeholders consultation, which was work package 6 in the MERA [2003] project, as described in Appendix C.

In the next section, the questionnaire structure is motivated and described, as well as the means of distribution.

The choice of stakeholder is then discussed in section 3.

Each question in the consultation is presented in section 4, together with an explanation of the rationale behind each question as well as the responses to each question. The main questions were:

- Identification of respondent (including an account of the number of replies)
- A. Increased funding to European National Metrology Systems (NMS)
- B. European NMS organisation for better efficiency and effectiveness

In the final section section (5), the main conclusions and recommendations of this consultation are given.

2 Questionnaire structure

The main aim of the questionnaire has been to understand how principal European stakeholders in metrology view possible scenarios for increased collaboration.

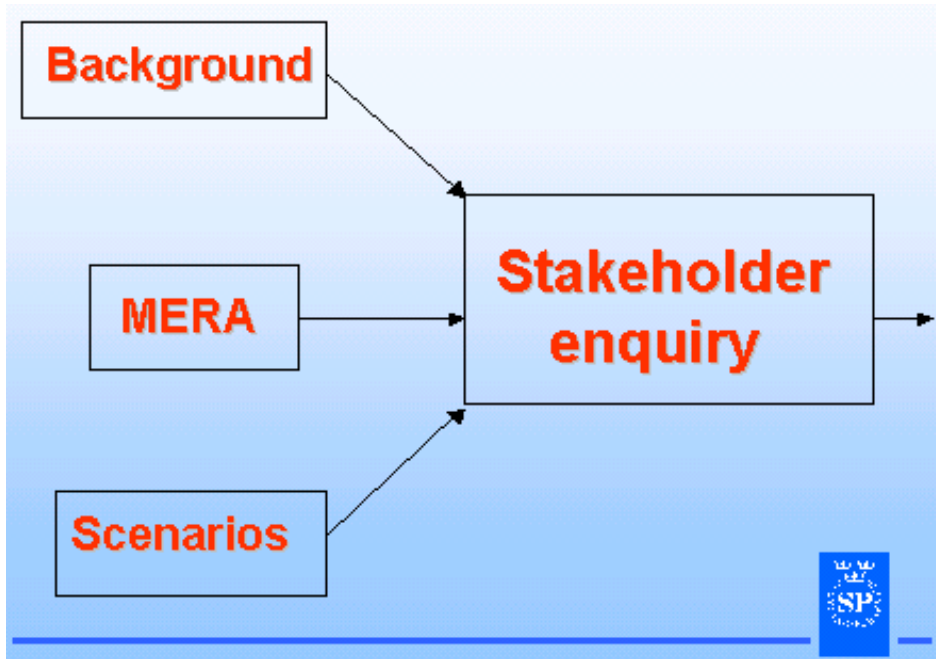


Figure 1 Stakeholder enquiry in relation to MERA project

2.1 Background to questionnaire

In composing the enquiry, it was necessary to consider how to present the questionnaire to the stakeholder in relation to the aims of the MERA project, in particular the possible scenarios for future collaboration in metrology, as shown in figure 1.

In addition, it was necessary to provide the stakeholder with a certain amount of background material in case he should need to consider issues such as the current organisation and role of the national metrology institutes as part of providing traceable measurement within the SI.

The necessary background includes an account of:

International Metrological Traceability

- needs of society (trade, manufacturing etc)
- the SI system
- NMIs
- EUROMET

as well as a short description of the aims of the MERA project:

Aims:

- intensify current EUROMET research cooperation
- lay the foundations of an integrated European Research Area (ERA) in metrology
- meet (extensive) needs for traceable measurement in new technologies (e.g. nanotechnology, bio-technology etc)

3 Choice of stakeholder

3.1 National metrology service activities

In considering the choice of metrology stakeholder (as well as the questions to be asked) it was necessary to realise that the national metrology system (NMS) has a number of different activities, as shown in figure 2.

- I. Metrological Research at NMIs**
Primary and Secondary Realisation
of Definitions of Units
- II. Maintenance of “National Standards”**
- III. Services to National Measurement Infrastructure**
 Calibrations of instruments, measurement standards, etc.
 Production of (primary) measurement standards and devices
 Intercomparisons/QA-programs
 Training and Education
 Technology Exploitation - Consultancy - Projects
- IV. Legal Metrology Services**
 Certifications (e.g. type approval)
 Verification and Inspection
- V. Miscellaneous**
 International Metrology Development Projects
 Assistance to Accreditation
 Assistance to Standardization

Figure 2. Range of activities and services provided by NMS

It is quite conceivable that there are different stakeholders for the different activities and services provided by the NMS.

3.2 Classes of stakeholders

Potential stakeholders were then grouped into two different classes, according to whether they were providers or end-users of NMS competence and services, according to figure 3. As will be seen (in section 4), the frequency and type of response varied considerably between these two classes of stakeholder.

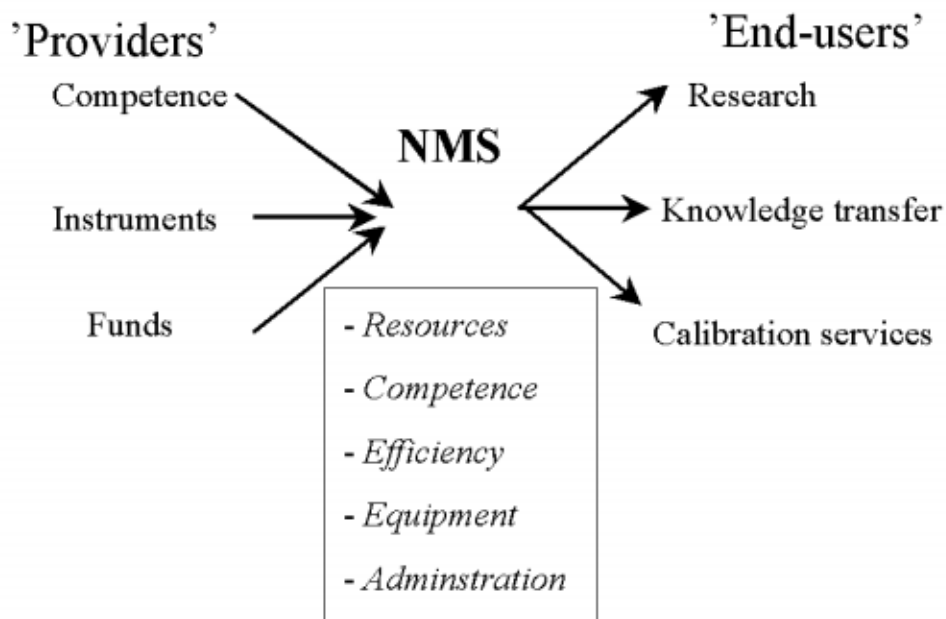


Figure 3 Classes of stakeholders in relation to the different NMS activities and competences

3.2.1 Providers

Examples of provider stakeholders are shown in figure 4, consisting of international organisations of research organisations involved in measurement and testing or legal metrology, accreditation bodies as well as standardisation bodies.

Note that different provider stakeholders may interact with NMS at different levels in the traceability hierarchy, as indicated schematically in figure 4.

This selection of provider stakeholders is not exhaustive: indeed, some so-called “end-user” stakeholders may also act as providers (and *vice versa*), for instance in the supply of measuring instruments to the NMIs.



Figure 4 Provider stakeholders – examples

3.2.2 End-users

A second class of stakeholders is formed of those organisations which receive the services of the NMS (shown in figure 2). A selection of these “end-users” is shown in figure 5.

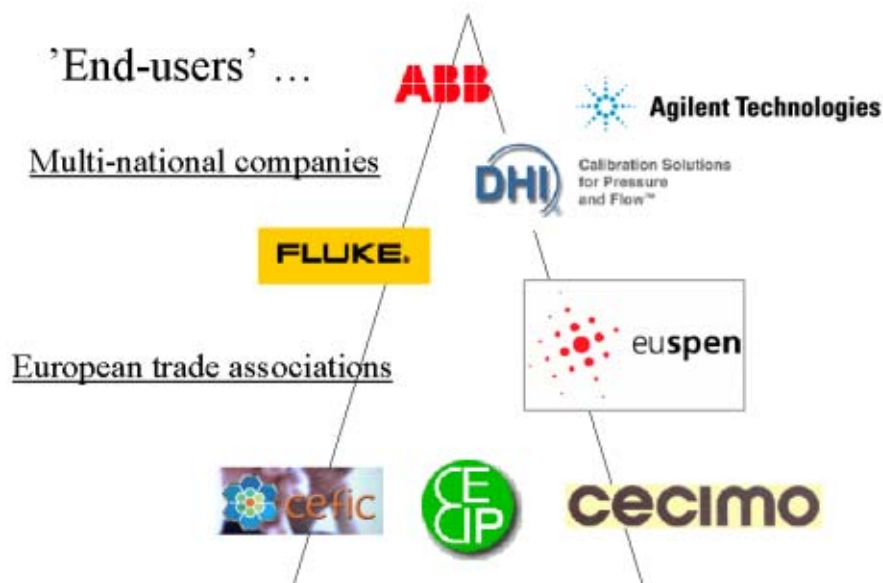


Figure 5 Examples of “End-user” stakeholders in metrology

4 Questions and answers in the consultation

In addition to asking who was responding to the questionnaire, the main aim was to ask the stakeholder his opinion about two ways of overcoming the dilemma of providing for increased and extended needs for traceable measurement on a substantially fixed budget:

- A. Increased funding to European National Metrology Systems (NMS)
- B. European NMS organisation for better efficiency and effectiveness

4.1 Identification of respondent

MERA – Planning the European Research Area in Metrology
WP 6: European Metrology Stakeholders consultation

Identification of respondent

Measurement needs and interests

Does your organisation have an interest in traceable measurement? Yes No

Is your organisation involved in measurement-related research & development? Yes No

The first question posed was to ask the stakeholder about his measurement needs and interests, including which quantities were measured and an estimate of expenditure in the organisation associated with traceable measurement. The name and address of the respondent could also be given, if the stakeholder agreed to this.

The frequency and type of response varied considerably between these two classes of stakeholder. About forty international stakeholders were consulted in total.

4.1.1 End-users

Many of Europe's trade associations, representing industrial sectors which are major end users of NMS services (automobile manufacturers, chemical industries, electrical appliances, etc), failed to respond. Of the 5% who did respond, a typical statement was:

This European trade association: "... represents and defends the interests of this industry in legal and trade policy, internal market, environmental and technical matters; liases with intergovernmental organisations; and manages industry initiatives and joint programmes – particularly in the field of research. As an umbrella organisation, we have also recognised about 100 sector groups and affiliated associations.

As we have neither the expertise nor any working group with our members on metrology issues, I am afraid we are not in a position to fill in your questionnaire."

By contrast, 50% of multinational instrument manufacturers asked responded, including some of the most well-formulated responses (given below). One respondent was a major manufacturer of measuring instruments for electrical, photometry, temperature, pressure and humidity quantities and spent an estimated 2M€ on traceable measurement activities annually.

4.1.2 Providers

International organisations of accreditation bodies as well as standardisation bodies were somewhat reluctant to respond (30%) and those who did typically referred to their corresponding national bodies, who nevertheless provided useful replies to the MERA questionnaire (see below).

A much better response (50%) was obtained from international organisations of research bodies involved in measurement and testing or legal metrology.

4.2 A. Increased funding to European National Metrology Systems (NMS)

Two questions about funding were posed:

4.2.1 A1 Funding

A.1 Funding

Agencies and organisations (national governments, EU Commission, research councils, companies etc) which support European NMS could provide more money

Are you prepared to lobby for increased funding in support of more effective and efficient NMS' in Europe? Yes No

Almost all stakeholders who responded, and irrespective of class of stakeholder (end-user or provider), were prepared to lobby for increased funding on behalf of the European NMS.

4.2.1.1 Question of funding: End-user stakeholder response

Some stakeholders agreed to this on certain conditions:

One respondent was "... a worldwide manufacturer relying on multilateral recognition of test and measurement data. Within Europe this acceptance is reasonably well arranged however the support of our high level test and measurement equipment is not in every European country as guaranteed as we would need.

We understand that within the current European situation (growing and expanding EU) it is not correct to expect that each country (existing and new EU member states) are able to develop top-notch NMs. This requires too much financial effort and it would be for many parameters a matter of re-inventing wheels. This should be avoided in this world of financial resources tightness.

As such we encourage creating a European Metrology System/Organization that

A: is built on existing knowledge

B: integrates all the existing competence

C: utilizes existing infra structure as much as affordable, to allow for the local availability of traceability for the bulk of the industry and overcomes the local language issue.

D: removes the redundancy that exists in terms of costly fundamental research taking place at various places, and although not directly connected to this issue,

E: realizes at the end a single pan-European metrology structure that provides the basis for a pan European accreditation body leaving no room for different interpretations within the European countries and also realizes an even more easy acceptance outside Europe.

If the above needs support for creating understanding at various institutions and or levels, our company is willing to provide that.”

4.2.1.2 Question of Funding: Provider stakeholder response

“Increased funding will be needed for building a fit-for-purpose measurement system in Europe for emerging fields of metrology, e.g. in chemistry, biotechnology, surface and nanotechnology. These tasks require networks of reference institutes co-operating with NMIs, and additional funding will be needed to establish and support these networks.”

4.2.2 A2 Costs of services

A.2 Costs of services

The NMS could charge end-users more for better service

Options	No increase but degrading service over time	Modest increase in cost (10%)	Moderate increase (50%)	Large increase (100%)	Major increase (200%) for state-of-the-art services
How much more should the end-user of NMS services be asked to pay?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

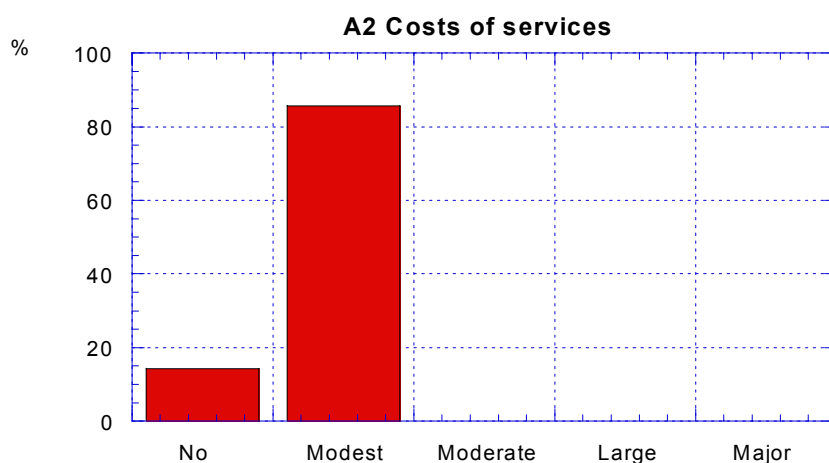


Figure 6. Question A2 Costs of services

An almost unanimous response to the question of whether there was scope for NMS to charge more for better service was that only at best a modest increase was on the cards.

Many stakeholders motivated their unwillingness to contemplate greater increases in end-user charges by referring to the “public service” nature of European metrology:

- “Potential for substantial calibration income is low and conflicts with ‘public good’ task of NMI”
- ”The costs of traceable reference materials should be low”
- ”Cost of services should stay the same or raise modestly. Any higher increase will reduce competitiveness of European Industry”
- ”... plus it will increase risk of lower class and ”el cheapo” calibration and metrology solutions in industry”
- “We would rather expect counter-productive effects of increased costs charged on the end user: reduced requests of services, reduced levels of quality control etc. with adverse effects for public safety as well as for the economy. Therefore we are not in favour of charging increased cost beyond the level of inflation rate.”

One stakeholder demonstratively crossed over this question, finding it unworthy.

4.3 B. European NMS organisation for better efficiency and effectiveness

Two organisational questions were posed, in which stakeholders were to consider:

- a number of possible scenarios for future collaboration amongst the European NMS
- an opportunity for greater collaboration between NMS and their stakeholders

4.3.1 B.1 In what way should the NMS in Europe collaborate more?

B1 In what way should the NMS in Europe collaborate more?

Another way of meeting increased demands for traceable measurement, would be for the NMS to collaborate more

Scenario	A	B	C	D
Rate the different scenarios (A to D) for increased collaboration in order of preference on a scale 1 to 4, where “1” is the best rating.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Rating 1 to 4	Rating 1 to 4	Rating 1 to 4	Rating 1 to 4

(See Enclosure for a description of the different scenarios)

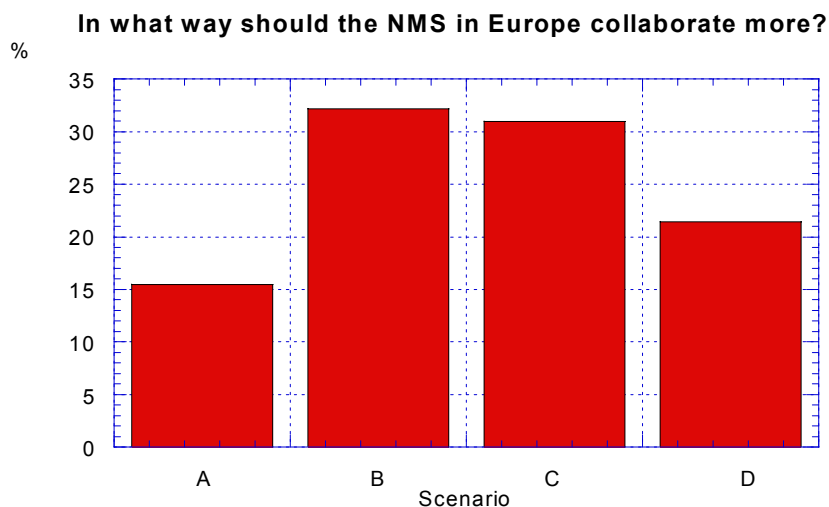


Figure 7. Question B1 In what way should the NMS in Europe collaborate more

The stakeholder was to consider the pros and cons of four different scenarios (A, ...,D) ordered in terms of increasing European integration, and to rate these in order of preference.

To describe each scenario, a separate, double-sided page contained a description of the advantages and disadvantages of each of the four scenarios for future collaboration between European NMS:

- A. A network of autonomous National Metrology Institutes with *ad hoc* collaboration
- B. Devolution of primary standards
- C. Primary standards held only in centres of excellence in a small number of countries
- D. Fully integrated European Metrology system with common funding

These advantages and disadvantages refer to:

- the own resources of the NMS (in terms of personnel, competence, funding, administration, etc)
- the services provided by the NMS (research, calibration services, knowledge transfer (KT), etc)

in accordance with the structure of the NMS shown in figure 3.

This is admittedly the most difficult question, and it was felt necessary to qualify the scenario descriptions, by for instance pointing out that different scenarios might be chosen for the various measurement quantities as well as for the different NMS services.

The scenario descriptions are reproduced in Appendix B.

A majority of stakeholders voted for scenario B, although there was a wide spread across the scenarios.

4.3.1.1 Scenarios for NMI collaboration: End-user stakeholder response

One major international instrument maker preferred scenarios C & D, with the following motivation:

“... *We envision an European Metrology System/Organization that is based on the:*

I: Utilization of the current knowledge and capabilities available.

II: Assignment of number of the existing NMI's to become a competence and research center for a given parameter/quantity (obviously there where the best capabilities are already in place or can be realized with minimum effort). This also allows for consolidation but also cross fertilization of knowledge between the current NMI's (people can move from one NMI to the other!)

III: Assignment of other NMI's (that may not have any core competency at this stage for the existing parameters/quantities) for the research and

realization of standards/references for the "new" quantities. Provided it is financially justifiable!

IV: Equipping the regional (previously national) MI's with those resources (infrastructure, manpower equipment, etc) that allows for a 80% coverage of the national industrial needs. This because logistical complications for certain references and standards make traveling per air cumbersome if not possible at all and local language issues are still a reality within industry.

The result is that today's National Metrology Institutes will become a Regional Metrology Institute, providing traceability for all qualities at such uncertainty levels that support 80% of the local industry.

Furthermore they get a special assignment for being a core competence center (based on existing and in place knowledge) that allows for the fundamental research on a given quantity and be therefore the prime source of traceability for the other regional labs and thus local industries."

4.3.1.2 Scenarios for NMI collaboration: Provider stakeholder response

"The answer reflects our experiences with the development of metrology in chemistry, which will presumably also apply to other emerging fields of metrology:

- The field of metrology in chemistry is far too large to be covered by even the largest NMI.*
- There is a lot of expertise available in other institutes than NMIs.*
- National priorities concerning support for industrial metrology differ from country to country.*

Moreover, it should be noted that certified reference materials (CRMs) provide the majority of reference standards for chemical measurements.

For the reasons indicated above, we consider Scenario C the most appropriate one to meet the challenges on European metrology. More specifically, we advocate a division of tasks on two levels: (a) on a national level between the NMI and competent reference institutes, joining forces to meet national needs for metrology services in a networking approach, and (b) on a European level between these national metrology networks. Concerning the provision of CRMs, such division of tasks is already established practice.

Where traceability to primary standards is explicitly required, it is perfectly acceptable for an NMI (or equivalent) offering a service to "borrow" traceability to primary standards from another NMI. This a.o. motivates the preference of Scenario B over A.

Scenario D is only advocated for metrology fields requiring unique highly specialised facilities. Beyond such cases, centralised European institutes are not considered to be the preferred infrastructure. This does not exclude an NMI or national reference institute as sole provider of particular reference measurements or CRMs. Also, European institutes such as the Joint Research Centers could play an increasing role in co-ordinating national activities for the benefit of the European metrology system."

4.3.2 B2 Provision of measurement science & technological resources to European NMS

The final question asked the stakeholder to consider whether his own organisation would be prepared to collaborate more with the NMS.

This is seen as an obvious way of in part solving the dilemma of providing for increased and extended needs for traceable measurement on a substantially fixed budget, especially when one considers the structure of NMS in relation provider organisations (see figure 3) such as research organisations, universities, measurement & testing laboratories, instrument makers, companies, etc.)

Almost all stakeholders were willing to collaborate more with the European NMS.

4.3.2.1 Question of increased collaboration with NMS. End-user stakeholder response

Industrial stakeholders responded typically by being cautious about the commitment involved:

“Our company has been always found prepared in collaboration and or participation in several projects with NMI's.

However this involvement and participation has been and will be based on the availability of resources within the company.

As such is the answer yes, with the note that we will ask for the expected role and outcome of our participation and will make a decision based on availability of resources.”

4.3.2.2 Question of increased collaboration with NMS. Provider stakeholder response

“The benefits of division of tasks and exchange of personnel are obvious.”

Some European stakeholders already are in the process of strengthening ties with the European NMS, such as in the “4E” co-operation (EA, EURACHEM, EUROLAB, EUROMET). The extension of traceability to measurements in chemistry is an obvious example of a need for NMS to co-operate with often a network of chemical institutes.

Many NMS have research co-operation within their national research infrastructure, e.g. in the field of nano-metrology and electrical quantum standards. This is open research, with a mixture of NMIs and university and is already part of the European research area. These projects are good examples of what the Commission calls “federated excellence” [EC 2002].

NMI meet strong competition for research funding with the much more predominant university research groups. In some cases, research institutes such as NMS have difficulties contributing to the formulation of national research programmes. On the other hand, NMIs see the value of creating and strengthening links with universities and encouraging graduate and post-graduate study on its premises.

It should be noted that there is a key difference between the mission-oriented science of metrology and other academic science. The long-term measurements of NMI metrology are important science but may be regarded as mundane in academic research terms. As

observed in the PREST [2002] study (section 4.4), it is doubtful whether such measurement studies would prosper in the long-term in a university environment, particularly in the fluctuating funding climate of competitive, grant-based research funding.

4.4 PREST – a comparative analysis of public, semi-public and recently privatised research centres

European public sector laboratories, including the NMS, have had much less attention paid to understanding their role and evolution than the other major players in knowledge production in the universities and industrial research and development in Europe. One exception is the recently completed PREST [2002] European project, which is judged to provide important complementary source of information and its results are therefore included as part of the MERA International Stakeholder Consultation. Indeed the PREST project even includes a case study of “Certification and Standards as a Mission – Alternative formats for Metrology” [PREST 2002].

Here we recall the main conclusions of the PREST [2002] study, finding several points of particular relevance to NMS, especially when considering the rationale for the continued existence of national public sector laboratories in the European Research Area.

“There is scope for rationalisation in the provision of many of the services offered by research centres. Overhead cost of maintaining expertise and facilities in particular areas could be borne more easily across the European market as a whole, especially in those services where call on expertise is intermittent but important. The answer, however, does not lie in the creation of monolithic centres; the requirement for local presence and delivery remains important in many cases, especially where the clients are small businesses” [PREST 2002].

“Some perceived barriers to increased European integration of public sector laboratory missions are:

- *continued specificities in local markets for scientific advice and industrial services*
- *variety in legal and ownership structures to perform same mission*
- *variety in scientific and technological structures providing a particular competence*
- *variety in level of scientific achievement and facilities*
- *lack of management capability in operating multi-national service*
- *variable rates of subsidy or core funding between countries “ [PREST 2002]*

5 Conclusions and recommendations

As a result of the International Metrology Stakeholders Consultation, conducted during the Spring 2003, as part of the EU project “MERA – Metrology European Research Area”, a number of conclusions and recommendations concerning the future of increased collaboration in European metrology can be made.

5.1 Stakeholder:NMS relations

A stakeholder consultation such as this reveals information not only about the stakeholders’ views, but also significantly about the relation between the stakeholders and the European NMS. This is particularly important for national metrology services, since one of their key tasks is acting as an intermediary, linking academic and industrial research. Luckily, almost all stakeholders saw increased collaboration with NMS as a means of solving the dilemma of providing for increased and extended needs for traceable measurement on a substantially fixed budget.

5.1.1 NMS:industry relations

Judging by the frequency and type of response to the questionnaire (section 4.1), especially from the European trade associations, it seems that the NMS and the concept of traceable measurement are reasonably unknown of at the European industrial level.

- This could be a reflection of the fact that European trade associations are still most active at the national level. The majority of calibration services are admittedly still delivered to the industries of these trade associations at the national, rather than European level.
- At the same time, a lack of appreciation of metrology at the European trade association level could be a disadvantage in, for instance, influencing the European Commission about future policy issues

It is recommended that the European NMS consider further how to improve collaboration with stakeholder organisations. There is increasing awareness that a key component in national metrology is the role of industry, not only as a so-called “end-user” of NMS services, but increasingly as an active partner with national metrology in measurement knowledge transfer and even in metrological research.

5.1.2 Metrology research in collaboration with university

Many NMS have research co-operation within their national research infrastructure, e.g. in the field of nano-metrology and electrical quantum standards. This is open research, with a mixture of NMIs and university and is already part of the European research area. These projects are good examples of what the Commission calls “federated excellence” [EC 2002].

5.2 Increased funding to European National Metrology Systems (NMS)?

Stakeholders view the provision of traceable measurement and National Metrology as predominantly a continuing public service. They are willing to lobby for increased support to the European NMS but at the same are unprepared to pay much more for the services provided. This is nicely summarised in the PREST [2002] project conclusions:

“Public service laboratories provide services which are important in socio-economic terms but which are difficult to capture in the price mechanism. A responsible government can not expect the market to provide adequate service without a corresponding commitment from its side.”

Metrology, in providing a generic infrastructural support, has such a wide diversity of customers, from all branches of industry and society, that it would be difficult to find one dominant industry prepared to pay more than its fair share. Impartiality is also a hallmark of national metrology much valued by industry.

Another important financial factor is the variable rates of subsidy or core funding between countries. A country who's NMS receives only 30% state subsidy will be much more drastically affected by a reduction in service income from customers than would an NMS with 95% state support. With such disparities it will be difficult to achieve European integration of calibration services.

It is recommended that European NMS formulate more clearly the role of metrology in political - that is, innovation and growth – rather than monetary terms.

5.3 Scenarios for future increased collaboration between European NMS

5.3.1 A difficult question

“... We are looking for a European Metrology System/Organization that comprises of competence centers, each performing fundamental research for certain quantities and parameters and provide traceability for the very high levels metrology and calibration applications. Furthermore industry will continue to need local/regional metrology labs that provide traceability for the bulk of their traceability needs accuracy wise but also quantity wise and overcoming the local language issue.”

was the way one major international instrument maker responded to admittedly the most difficult question, that about scenarios for future NMS collaboration.

5.3.2 Redundancy and duplication

The variety in scientific and technological structures providing a particular competence amongst the national metrology systems of the different European countries can be seen, from a classical managerial viewpoint, as a wasteful and unnecessary duplication of limited resources and as a barrier to European integration [PREST 2002]. At the same time, metrology has the additional aspect of benefiting from redundancy, especially in:

- the elimination of systematic errors
- providing a multidisciplinary environment necessary for the development of metrology.

6 References

ERA-NET 2003 “*Strengthening the foundations of the European Research Area – 11. Support for the co-ordination of national, regional and European activities in the field of research and innovation*”, Work programme

EC 2002 “*The European Research Area – An internal knowledge market*”, European Commission ISBN 92-894-3517-8

MERA 2003 “*Metrology European Research Area*” (<http://www.euromet.org/pages/projects/MERA.htm>). NPL (GB) project co-ordinator, MERA-G6MA-CT-2002-04012

PREST 2002 “*PREST – A comparative analysis of public, semi-public and recently privatised research centres*”, CBSTTII contract ERBHPV2-CT-200-01, Final report July [<http://les.man.ac.uk/PREST/>].

Appendix A. Questionnaire background and motivation



WP 6: European Metrology Stakeholders consultation



European Metrology Stakeholders Consultation

The European metrology infrastructure is underpinned by the National Metrology Institutes (NMIs) in Europe. The NMIs provide the primary measurement capability to the calibration community and to industrial, regulatory and scientific customers. To ensure that this capability remains at the cutting edge many of the NMIs undertake significant Research and Development (R&D). This leading edge capability in turn provides the tools that enable world class R&D in the wider fields. However European metrology is facing a **DILEMMA** of increasing consequence.

On the one hand, the **demands** are growing due to three driving mechanisms:

- New areas of science and technology such as nanotechnology and biotechnology
- The need to support traditional areas in which metrology research is often getting more complex
- Increase recognition of value of Metrology in existing areas (clinical medicine, food safety etc)

On the other hand, **resources** are limited. Whilst end users generally pay the cost of the actual calibration they purchase from the NMI, the underpinning R&D and the costs of the calibration facilities are funded through Government by the European taxpayer. The resources available are not increasing in line with the increasing demand; indeed in real terms across Europe they are broadly static.

If no action is taken European metrology faces:

- Loss of critical mass in metrology R&D
- Poorer facilities and services
- Loss of leading measurement capabilities in Europe that enable cutting edge R&D in other areas

The MERA project is examining a more efficient utilisation of the top-level metrology resources in Europe as a means to solve this dilemma.

If you are familiar with the metrological background in Europe please fill in the questionnaire. More [background](#) information on metrology in Europe and the [MERA](#) project is available for those who would like to reflect on the issues in greater depth.

[Start enquiry](#)

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Planning the European research Area in Metrology: The MERA project

Society and technology are placing ever increasing demands for traceable measurement, both in traditional areas such as manufacturing and process industries as well as areas, such as chemistry, biotechnology where more attention is now being paid to metrological traceability. In broad terms the MERA project, with the support of the European Commission, "*Planning the European research Area in Metrology*", lays the foundations for a co-ordinated approach to meet these metrology needs in Europe by planning the implementation of the EUROMET strategy, which calls for increased co-ordination in a European metrology research area.

The project commenced in September 2002 and will run for approximately 12 months. In addition to the principal project participants, all the National Metrology Institutes (NMI) in the EUROMET countries and applicant countries are able to participate in, input to, and benefit from the project through the workshops and the analysis of national metrological priorities. Another important part are stakeholder consultations, both nationally and internationally, where those with a “vested interest” in metrology are asked for their views.

More information about the MERA project is available on the [MERA](#) page on the EUROMET web site (<http://www.euromet.org>). NPL (GB) is project co-ordinator.

Background: International Metrological Infrastructure

Modern society requires reliable measurements that give the same answer wherever they are made. This is achieved by use of the International System of Units referred to as the [SI](#), covering the base units (metre, kilogram, second, kelvin, candela, ampere, mole) and the derived units. This system is based on and, in turn, supports continual and long-term research in fundamental science and technology.

National metrology systems

The quality and reliability of measurements used in industrial, scientific and regulatory fields are often assured by demonstrating that they are traceable to the SI by calibrating the instruments used either directly at an National Metrology Institute (NMI), or at a calibration laboratory that in turn has its instruments calibrated by an NMI. National Measurement Systems (NMS) cover both the NMI (in some countries consisting of several laboratories for the various national measurement standards) together with organisations responsible for legal metrology and accreditation and are supported by commercial calibration laboratories that provide the majority of calibrations to end-users.

NMIs charge for the calibrations they carry out, but generally the charges do not cover infrastructure and necessary R&D, which is mostly funded by national governments. Additional research funding may be provided by research councils and industry. Most NMIs are active in metrology R&D (sometimes in collaboration with universities, industry and other research organisations). All NMIs participate in scientific inter-laboratory comparisons to establish the degree of equivalence of the different national standards as well as to develop primary metrology. Not all national measurement standards are primary realisations of the SI Unit, but nevertheless are the most accurate standards in each country and of course are traceable to a primary SI realisation at another

NMI or the BIPM. In these ways the different NMIs together ensure international dissemination of metrological traceability to the end-user as well as the continued development of the SI and the science of metrology.

Regional metrology systems

With increasing globalisation of trade and industry as well as more extensive demands for traceable measurement, the various national metrology systems have in recent years formed regional organisations allowing for increased co-ordination of research and traceability efforts. A European collaboration between the NMIs called [EUROMET](#) was inaugurated in 1987 where the main aims are to encourage co-operation in the development of national standards and measuring methods; optimise the use of resources and services; improve measurement facilities and making them accessible to all members; and perform comparisons to ensure a better coherence of measurements.

CIPM Mutual Recognition Arrangement

A further step towards a global metrology system is the CIPM Mutual Recognition Arrangement (MRA) - a response to a growing need for an open, transparent and comprehensive scheme to give users reliable quantitative information on the comparability of national metrology services and to provide the technical basis for wider agreements negotiated for international trade, commerce and regulatory affairs. The MRA has been drawn up by the International Committee of Weights and Measures (CIPM), under the authority given to it in the Metre Convention, for signature by directors of the NMIs of Member States of the Convention and Associates of the CGPM. Further details of the CIPM MRA is available at http://www.bipm.org/enus/8_Key_Comparisons/welcome2.html

Appendix B. Description of Scenarios



WP 6: European Metrology Stakeholders consultation



Possible future organisation for increased coordination in European metrology - a more or less integrated system?

One principal aim of the MERA project is to consider different options of achieving increased cooperation, effectiveness and efficiency within a European Metrology Research Area.

In this stakeholder consultation, we ask you to consider and motivate possible changes to the [present situation](#), where today almost all European countries have a system for national metrology.

A spectrum of options for a future, more effective and efficient system of providing for improved and extended traceability to the SI, can be considered, ranging from:

- [less integrated European system](#) - where each country would continue to maintain and provide primary metrological resources within its own frontiers, albeit in a spirit of increased European collaboration
- [more integrated European system](#) - where primary metrological resources in Europe would be considerably more centralised in an hierarchical way and national devolution of primary metrology would take place.

It must be said that the picture may appear differently:

- for the various measurement quantities
- when one considers the different activities which comprise the services (research, calibration, knowledge transfer etc.) provided by the NMIs.

In the existing [EUROMET cooperation](#) of today, there are certainly more than one country maintaining primary SI standards for the SI kilogram, for instance. The majority of European countries disseminate metrological traceability principally within their own countries, but also benefit to varying degrees from dissemination to secondary levels with other countries.

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Possible future scenarios for increased coordination in European metrology

A: A network of autonomous NMS' with *ad hoc* collaboration

Advantages	Disadvantages
<p><i>Services:</i></p> <ul style="list-style-type: none"> • Fast, unbureaucratic and needs-related local services in own language <p><i>KT:</i></p> <ul style="list-style-type: none"> • NMIs in country providing local and national expertise for most needs <p><i>Competence:</i></p> <ul style="list-style-type: none"> • Good synergy between different measurement areas • Multiplicity of research effort leading to healthy and robust metrological redundancy - minimisation of systematic errors • Some flexibility to adapt to evolving SI system <p><i>Admin:</i> Easy</p>	<p><i>Services:</i></p> <ul style="list-style-type: none"> • Possible loss of State-of-Art services over time <p><i>Competence:</i></p> <ul style="list-style-type: none"> • Lack of critical mass for R&D in some measurement areas • Duplication of research effort = inefficient use of limited resources

B: Devolution of primary standards

Advantages	Disadvantages
<p><i>Research:</i></p> <ul style="list-style-type: none"> • Possibly increased research output through released funds <p><i>KT:</i></p> <ul style="list-style-type: none"> • NMIs in country still providing local expertise for most needs <p><i>Competence:</i></p> <ul style="list-style-type: none"> • Modest resources released for other areas through less duplication at primary level <p><i>Services:</i></p> <ul style="list-style-type: none"> • Fast, unbureaucratic and needs-related local services in own language 	<p><i>Competence:</i></p> <ul style="list-style-type: none"> • With a reduced number of primary standards there is some risk to metrological robustness in Europe • For country without primary standards, some increase in uncertainty budget and loss of status • Risk of lack of competition at primary level <p><i>Personnel:</i></p> <ul style="list-style-type: none"> • Staff mobility may be required to compensate for loss of primary competence in devolved measurement areas <p><i>Admin:</i></p> <ul style="list-style-type: none"> • Some increased complexity in coordination and agreement would be needed (Who does what at primary level?)

C: Primary standards held only in centres of excellence in a small number of countries. Accredited labs and direct end users going directly to primary standards holders

Advantages	Disadvantages
<p><i>Research:</i></p> <ul style="list-style-type: none"> • Funds released making it easier to maintain critical mass for centre of excellence, thereby leading to higher quality research <p><i>Competence:</i></p> <ul style="list-style-type: none"> • Release of significant resources to: <ul style="list-style-type: none"> ○ Maintain European Metrology at the state-of-art in existing areas ○ Develop capability in new domains... • Less duplication in metrological effort • European capability world class • Greater utilisation of facilities 	<p><i>Competence:</i></p> <ul style="list-style-type: none"> • With a reduced number of primary standards there is more risk to metrological robustness in Europe • Less synergy between different measurement areas • "Isolated" centres of excellence • Less multiplicity of research effort therefore loss of healthy metrological redundancy - increased risk of systematic errors • Lack of flexibility to adapt to evolving SI system • National expertise is lost <p><i>Services:</i></p> <ul style="list-style-type: none"> • Reduced competition in service delivery • Further from customers • Less availability of local services • Slower, more bureaucratic and less needs-related services in foreign language <p><i>KT:</i></p> <ul style="list-style-type: none"> • Knowledge transfer more difficult <p><i>Personnel:</i></p> <ul style="list-style-type: none"> • Less incentive for staff mobility due to lack of matching competence <p><i>Funding:</i></p> <ul style="list-style-type: none"> • Risk of funds reduction in some countries <p><i>Admin:</i></p> <ul style="list-style-type: none"> • Complex co-ordination and agreement would be needed

D: Fully integrated European Metrology system with common funding

Advantages	Disadvantages
<p><i>Research:</i></p> <ul style="list-style-type: none"> • Strategic planned research programme • World class in research at primary level <p><i>Competence:</i></p> <ul style="list-style-type: none"> • No unnecessary duplication • Release resources for new areas and to maintain state-of-art in existing areas • Large critical mass • High quality facilities <p><i>Funding:</i></p> <ul style="list-style-type: none"> • Effective use of resources (in terms of funding) • European funding feasible <p><i>Admin:</i></p> <ul style="list-style-type: none"> • Strategic planned use of resources • Greater influence internationally 	<p><i>Competence:</i></p> <ul style="list-style-type: none"> • With a reduced number of primary standards there is considerable risk to metrological robustness in Europe • Considerable loss of national expertise <p><i>Admin:</i></p> <ul style="list-style-type: none"> • Complex co-ordination and agreement would be needed • Politically difficult to manage • Risk of becoming bureaucratic, cost of management • Communication/language difficulties • Practical problems of ‘single’ supplier e.g. geography, monopoly

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Appendix C MERA workpackage 6 description

Workpackage 6: European and national Industrial* consultation

Start date Month:	6
Duration:	2 months
Total effort:	3.9 person months
Lead by:	SP (European Consultation)
Partners involved:	All
Sub-contractors involved:	None

The objective of this workpackage is to allow industrial* input to potential changes to metrology infrastructure.

Industrial* end users of the metrology infrastructure will be consulted at European and national level. Appropriate European industrial* networks (such as EUSPIN) will be consulted to obtain a view of the possible scenarios from the end user perspective. NMIs have a variety of national mechanisms available to them to consult industrial* users and the intention is to make use of these channels. Information will be collated and analysed to give the partners an understanding of the industrial* user perspective.

Deliverable:

A report on national and EU industrial* view of the scenarios for the metrology research infrastructure.

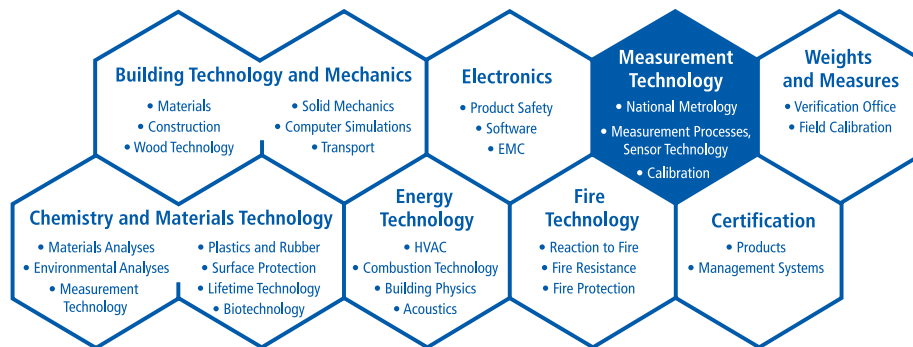
Milestone and expected result:

End user* view of potential changes to the metrology infrastructure.

*Note: the scope of this work package was changed to include not only industrial but also other stakeholders (such as research organisations). [MERA- G6MA-CT-2002-04012 Kick-off meeting minutes, 10-11th September 2002 at Justervesenet (NO)]

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