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2. EXECUTIVE PUBLISHABLE SUMMARY

Regulation, trade, and economic activity depend on effective, consistent measurements and on the interoperability of systems and manufactured components. The underpinning state-of-the-art measurement standards are maintained by National Metrology Institutes (NMIs), which provide traceability to the standards through a wide range of calibration services. In Europe, the 30 or so NMIs are finding it increasingly difficult to meet ever-growing demands for new standards, particularly in emerging areas of technology, whilst still meeting the expectations of existing sectors – the so-called metrology dilemma.

EUROMET [1], the European collaboration in measurement standards, is addressing this issue by developing closer collaboration between its member NMIs. This strategy is based on closer collaboration in research as well as increased sharing of major facilities and rationalisation of calibration services. EUROMET quickly recognised that increasing cooperation beyond the current level - a move that could be characterised by a transition from *ad hoc* cooperation to strategically planned collaboration - represented a major challenge. The MERA project is investigating all the issues associated with an infrastructure that would embrace a common metrological European Research Area.

The project was divided into 10 work packages, including preparatory data collection and analysis, two workshops and consultation with stakeholders at European and national level, with a specific work package looking at the particular challenges faced by NMIs in the Newly Associated States (Accession countries). Lessons have been learnt from each of the work packages. The various surveys of the NMI user communities identified the importance of maintaining the technical competence in individual NMIs, but were concerned that any rationalisation in Europe would reduce the local availability of calibration services. Users understood the need for each NMI to focus on the capabilities that are most relevant nationally, so that it might be necessary to rely on other foreign NMIs for more marginal needs. Many of the EUROMET countries already adopt this approach, although the larger NMIs have traditionally offered a fully comprehensive calibration capability.

The project confirmed that significantly increased collaboration in R&D should be the cornerstone of any solution to the dilemma and identified the key issues coming to the conclusion that a new paradigm for NMI collaboration is warranted. The project presented to EUROMET - and EUROMET has accepted - the challenge, which can be summarised, in the words of the EUROMET Chairman, as follows:

“Currently EUROMET could be described as a collaboration amongst the holders of the national measurement standards, NMIs which also perform R&D to keep the standards up to date. The current ad hoc collaborations have added value to the R&D, although a variety of factors limit the potential impact. These factors include differences in planning cycles, variations in the ways of formulating and prioritising research and restrictions on funding. The project recommends that facilitating R&D collaboration be moved to the heart of EUROMET activity. It is suggested that EUROMET aspire to recognition as a collaboration of institutes engaged in measurement science R&D that provides enabling capability to all other fields of R&D, enabling European industry to remain world class and enhancing efforts to improve the quality of life. That R&D must be embodied in the development and validation of measurement techniques and tools, and made available in emerging areas of technology such as food, medicine, chemistry and pharmaceutical, whilst still maintaining cutting edge capabilities in traditional areas”.

3. OBJECTIVES OF THE PROJECT

The aim of the project was to enable the EUROMET NMIs to understand whether and how the “European metrology dilemma” – that is need to free resources to deliver new metrology for new technology whilst still servicing existing demands – may be addressed through closer collaboration. The demand drivers can be considered as threefold. Firstly new areas of technology are emerging that require metrological support, for example the desire to move nano-scale science from an interesting curiosity to a key industrial activity. Likewise measurement science is vital if the potential of the emerging biotechnology opportunities is to be exploited. Secondly there are areas of activity such as clinical medicine and food safety that are not in themselves new, but in which the value of metrology is increasingly being recognised. Finally, the traditional areas of industry, whilst not necessarily expanding, nor the metrology becoming more widespread, are nevertheless becoming more complex and the metrology more costly. Examples include demands for dynamic high-pressure measurements for the oil and power industry, a wide variety of measurements from the semiconductor industry, the need to calibrate intensity-modulated radiotherapy for treatment of tumours.

Currently, the NMIs are strongly focused on national research needs and address these needs individually with limited national resources. NMIs do collaborate. In 1986 the NMIs in Europe formed a group, EUROMET, specifically with the objective of fostering collaboration. EUROMET has made considerable progress towards this objective, but recognises the need to increase the extent and impact of its collaborative research. An evaluation of the current collaboration in European metrology at NMI level conducted as part of the project identified that that most collaboration has revolved around joint R&D projects. By the end of 2002 some 275 projects had been recorded as completed in the EUROMET projects database [1], with a further 175 “Agreed” (effectively under way) and 44 with “Proposed” status. Over and above R&D collaboration some 80 traceability arrangements are already in place between the NMIs, whereby an NMI in one country does not hold a primary standard, but holds a national standard traceable to the primary realisation at another NMI. Although limited at present, the joint use by the NMIs of key facilities such as BESSY¹ [2] in Germany, which provides synchrotron radiation to the European metrology community through its accelerators and storage rings, demonstrates the practicality of a more closely integrated infrastructure.

Formally within EUROMET collaboration occurs at a number of levels. EUROMET is structured with each member providing a delegate, the delegates selecting an Executive Committee of 9 members. The technical scope of EUROMET activities is divided into ten areas (acoustics, ultrasound and vibration, electricity and magnetism, flow, ionising radiation, length, mass and related quantities, metrology in chemistry, photometry and radiometry, thermometry, time and frequency) each with a Technical Committee (TC) and elected Chairperson. In addition to this an Interdisciplinary Group, as its name suggests, deals with matters that cut across more than one of the TCs. Formal collaborations are classed within one of four types (comparisons, consultation, cooperation and traceability). Over the years collaborative R&D related to comparisons has developed very successfully, as has the consultation activities between the NMIs. Many collaborations have been “bottom up” and therefore somewhat spontaneous, not necessarily reflecting the strategic aims of NMIs. Resources are not normally identified and committed at the outset, so that the objectives are often not well defined and progress can be too slow. The impact on R&D collaboration has been exacerbated in recent years by the need to focus the energies of the NMIs in a different direction.

¹ Berliner Elektronenspeicherring-Gesellschaft für Synchrotron Strahlung m. b. H. (Berlin electron storage ring company for synchrotron radiation)

In 1999, under the auspices of the Metre Convention the NMIs from some 50 countries signed the CIPM² mutual recognition of national measurement standards and of calibration and measurement certificates issued by national metrology institutes known as the CIPM Mutual Recognition Arrangement (MRA) [3]. Unlike many such agreements the CIPM MRA was not solely paper based, it committed the NMIs:

- To take part in appropriate scientific comparisons: the key and supplementary comparisons;
- To declare and subject their Calibration and Measurement capabilities to extensive peer review;
- To implement and demonstrate an appropriate quality system.

One consequence of this was that huge amounts of NMI resource, and much of the efforts to foster closer collaboration, has been focused towards the CIPM MRA obligations, that is the quality systems, the comparisons, and the technical reviews of the calibration and measurement capabilities – the CMCs.

Recognising all of the above the objective of this project was to explore the issues associated with expanding this vision to one that takes into account European needs but which continues to encompass the principle of subsidiarity for local national needs.

The MERA project involves developing the plans to optimise and increase significantly the impact of European metrology research and exploitation by strengthening the coherence of national and EU funded activities. The project commenced in September 2002 and was completed at the end of November 2003. The project participants reflected the make up (at the time of the proposal submission) of the EUROMET Executive Committee, augmented by those NMIs not on the Committee but who were contributing to the strategic planning within EUROMET. All of the other Members of EUROMET were kept apprised of the project through EUROMET reporting and were invited to participate in the workshops.

4. SCIENTIFIC AND TECHNICAL DESCRIPTION OF THE RESULTS

The activities are divided into ten main packages. These are:

- State-of-the-art review of relevant collaborative activity;
- Identification of future trends for metrology research;
- Metrology infrastructure scenarios and decision tool development allowing areas and degree of cooperation to be identified);
- National Metrology Institute Workshop – involving the NMIs from across Europe, addressing issues, elaborating scenarios and presenting models and research trends;
- National review of structures and priorities for collaboration (not funded by this action) taking due account of national industrial need and issues that hinder greater collaboration;
- An industrial consultation at European level to ascertain the end user perspective on potential structural changes in the metrology infrastructure;
- A consultation to ascertain the Newly Associated States (Accession Countries) perspective on potential changes in the metrology infrastructure;
- A summary of the national, industrial and NAS findings;

² Comité International des Poids et Mesures (International Committee for Weights and Measures)

- European Research Area Workshop – proposing metrology infrastructure options and research priorities, identifying actions to overcome hurdles;
- Foresight Report and dissemination – summarising and justifying the conclusions of the project, and providing recommendations and roadmap for selected scenarios.

An additional work package addresses the management of the project.

4.1 Workpackage 1: State-of-the-art Review

The objective of this workpackage was to have a clear understanding of the level of cooperation between the NMIs in Europe as a baseline for measuring future progress. This workpackage was led by NPL, and a full report is given in Annex A.

EUROMET Database

The work involved a review of the EUROMET registered collaborative activities of all EUROMET NMIs. EUROMET maintains a database of some of those activities, however it was acknowledged that the database was somewhat out of date and that a number of activities have not been entered, or were entered incorrectly. Consequently the workpackage commenced with NML-EI (current Chair of EUROMET and custodian of the database) leading a thorough review of the database to weed out incorrect entries, update out of date entries and generally clean up the quality of the historical data. This was followed by a field-by-field review of activities listed in the database by NPL. The review was across the spectrum of NMI activity, and based on the EUROMET Technical Committee designations:

- Acoustics, Ultrasound and Vibration
- Metrology in Chemistry
- Electricity and Magnetism
- Flow
- Ionising Radiation
- Length
- Mass and Related Quantities
- Photometry and Radiometry
- Thermometry
- Time and Frequency
- Interdisciplinary

The projects are classified in 4 different types described below:

Comparisons: the fundamental scientific comparisons that establish the degree of equivalence between the national standards

Traceability: where one national metrology institute (NMI) takes formal traceability from another rather than holding primary standards.

Consultation: at the heart of EUROMET is the policy that each member, on an equal partner basis, will cooperate with other members and makes its knowledge available to other EUROMET members.

Cooperation: Cooperation in research but also includes the exchange of information between partners in expert meetings and a multitude of other activities.

Figure 1 shows the total number of projects (agreed, proposed and completed) per year since the establishment of EUROMET in 1988.

Since the establishment of EUROMET in 1988, the number of agreed projects has increased, with between 20 to 45 projects being proposed each year from 1992 onwards (with a peak of 71 in 2000). The number of active projects in traceability and consultation has remained relatively constant, the focus on the CIPM Mutual Recognition Arrangement activities can be seen from the increase in the number of active comparisons. Cooperation within EUROMET therefore does exist and work but still tends to be undertaken on an ad-hoc basis and a more systematic approach would be beneficial. An example could be taken from the European Commission Fifth Framework Programme where projects have formal start and finish dates, a defined work programme and defined responsibilities. Many EUROMET projects are undertaken and completed without this formal EC support and framework, however the risk of project “drift” is noticeably increased.

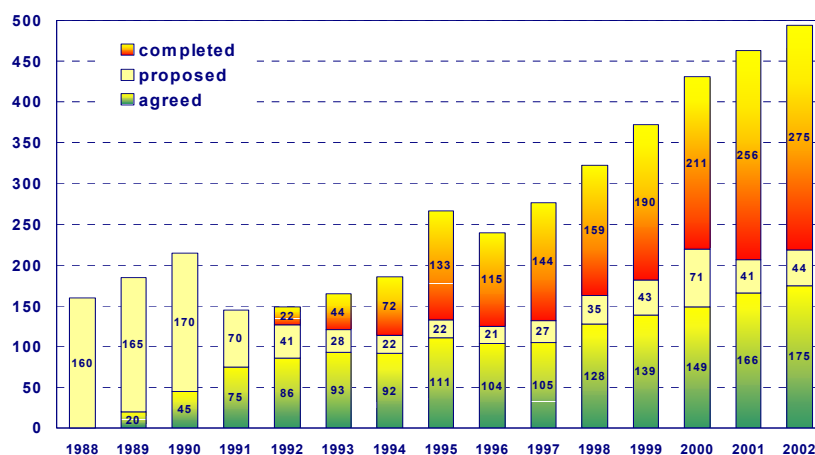


Figure 1: Evolution of the EUROMET projects since 1988

The “Airline Maps”

The database records activities listed as formal projects. During the review it quickly became clear that limiting the review to the database would result in a failure to capture other important information related to the interdependencies between the NMIs related to primary and national standards, as this information is not rigorously captured by the databases. Not all NMIs realise all (any) quantities at the highest level. In the case of small NMIs, or larger NMIs for marginal demand services the NMI may maintain a national standard that is not in itself primary, but rather is traceable to a primary realisation held at another NMI. In other cases where demand in a country is very low indeed, there may be no provision at all at the national NMI, but an agreement may be in place to enable the NMI to direct customers to the NMI within EUROMET that holds the standard and provides a service. These arrangements may be formal arrangements (listed as “traceability” projects in the EUROMET database), informal, or simply based on re-directing customers to another NMI who take up the service on a commercial basis. To try to capture the extent of these interdependencies an additional piece of work was initiated which resulted in the pictorial representations known colloquially as the “airline maps”. The airline maps give an indication of the complexity of metrological dependency in Europe, but need to

be read with extreme caution. It must be understood that representation on the map does not give an indication of the depth of dependency (for example a line will exist if traceability is taken for just one of many services, or for all services). Each map covers many parameters and broad measuring ranges. Also for a line to exist it is sufficient that only one secondary standard is traceable to another NMI. The fact that the laboratory maintains primary standards in other areas or participates in international intercomparisons is not apparent. The maps represent a snapshot in time, as new arrangements come into force or are terminated from time to time. Nevertheless the airline maps do give a visual overview of the traceability chains between the NMIs (also include BIPM³ [3] and in some special cases, companies). A full suite of airline maps are shown in Annex A, the example below is for the Quantity “Electricity and Magnetism”.

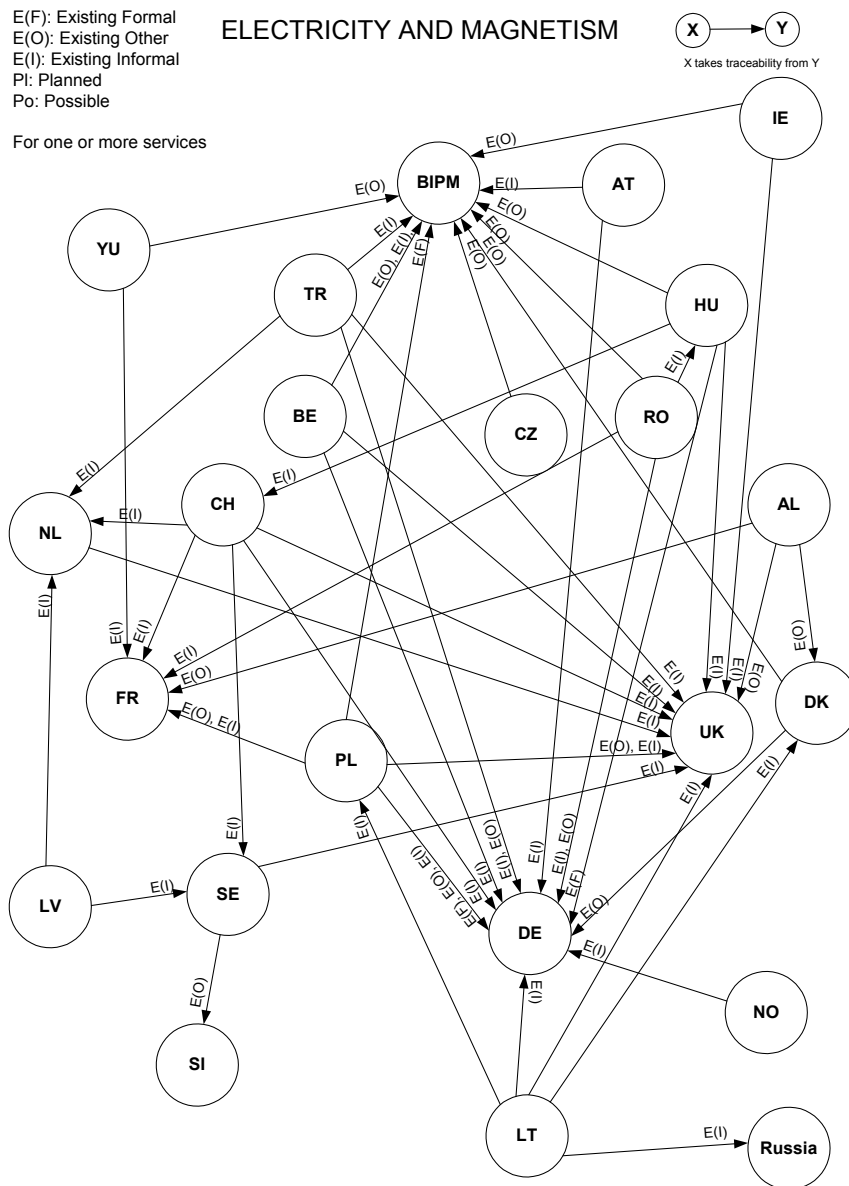


Figure 2: An example of a EUROMET “airline map”

³ Bureau International des Poids et Mesures (International Bureau of Weight and Measures)

Calibration and Measurement Capabilities: Traceability arrangements

As a consequence of the CIPM MRA, the NMIs are required to declare and subject their Calibration and Measurement Capabilities (CMCs) [4] for extensive peer review. The CMC tables as circulated between the Regional Metrology Organisations (RMOs) Contact Persons contain details of traceability between NMIs, that is where an NMI chooses not to carry out a primary realisation but holds a national standard traceable to a primary standard at another NMI. Using this information, the percentage of CMCs entries traceable to another NMI was calculated (Figure 3). The airline maps show all traceability arrangements (agreed, planned, possible etc) that could be identified existing between NMIs within EUROMET. The two sources of information show that it is quite common for NMIs within EUROMET to seek and obtain traceability from other countries, although this tends to be less common for the larger NMIs as shown in Figure 4 where less than 1% of CMCs at NPL and PTB for example are traceable to another NMI. The airline map for Electricity and Magnetism, for example, demonstrates that Centres of Excellence exist and that they provide traceability to other NMIs in EUROMET.

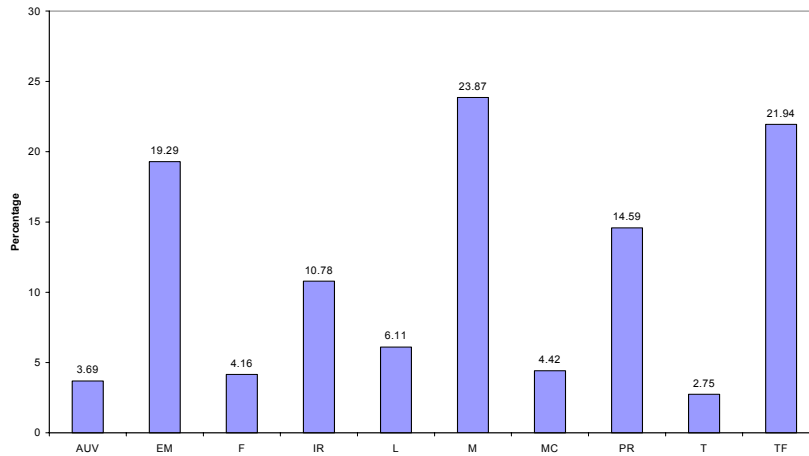


Figure 3: Percentage of CMCs traceable to another NMI in Europe per area

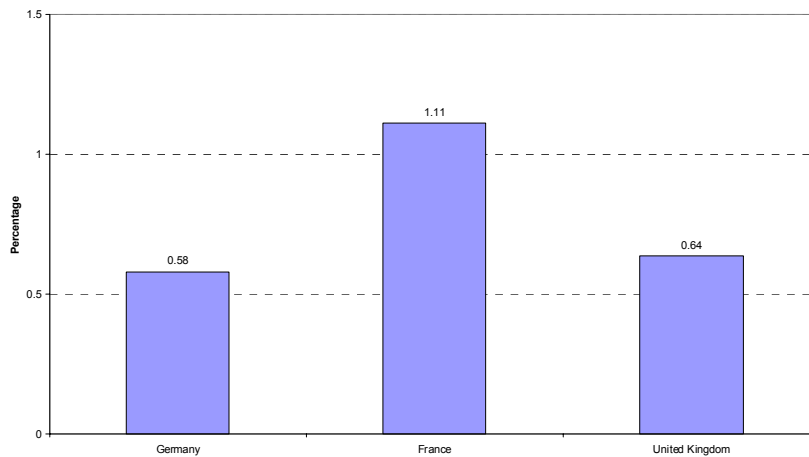


Figure 4: Percentage of CMCs entries, which are traceable to another NMI for 3 large European NMIs

4.2 Workpackage 2: Trends Analysis

The objective of this workpackage was to identify the main thrust of metrological research for the next decade. This workpackage was led by NML-EI and involved all the partners. The first task in projecting the metrological needs in the future was to examine the predicted manufacturing and technological advances. This was done by utilising international and EU Foresight studies which had been available. To assist us in the collection of Research & Development trends in metrology, it was decided to undertake a survey of all EUROMET member NMIs and Corresponding Applicant NMIs.

EUROMET Technical Committee Chairmen (for the subject fields of Acoustics, Electricity & Magnetism, Flow, Ionising Radiation, Length, Mass, Photometry/Radiometry, Temperature and Time & Frequency) were also consulted. These parties were asked to report on the current metrological research being undertaken in their respective NMI and to give some projection on major areas of metrology R&D in the future. Other organisations surveyed in this way were:

- Bureau International de Poids et Mesures (BIPM)
- NMIs from regions outside of Europe
- Other RMOs.

In addition to these sources a number of foresight studies produced by the High Level Expert Group of the Standards, Measurement & Testing division in the EU 5th Framework Programme were consulted.

The output from these surveys and analysis allowed NML to produce an initial set of metrology research topics subdivided into:

- Research resulting in an incremental development of existing capability
- Research in new areas of metrology.

This preliminary list of research topics was presented to EUROMET delegates and Corresponding Applicants at the 1st MERA Workshop in Rotterdam in December 2002. A ‘brainstorming’ session during this workshop enabled delegates and Corresponding applicants to discuss the trends identified and to add to the list, modify the trends identified and prioritise them.

An interim report, listing the updated research trends, was circulated to EUROMET member NMIs and NMIs from the Corresponding Applicants. The NMIs were requested at this stage to detail their current R&D capabilities in the listed research areas and to highlight their potential for collaboration with other NMIs in these fields.

This second survey of NMIs allowed NML to undertake a further prioritisation exercise and produce a list of research topics which can be consulted and used as a reference source.

The research trends identified can be divided into three distinct areas:

- Research trends – developments in existing capabilities;
- Research trends – long term underpinning research;
- Research trends – new research areas.

This characterisation is useful for EUROMET as the approach to collaboration is likely to vary somewhat for each of the cases.

The detailed results are given in Annex B.

4.3 Workpackage 3: Development of Process

Metrological Scenario Preparation:

The objective was to enable each NMI to develop a clear understanding of the various options for the future of the metrology infrastructure in Europe, and to identify the preferred options and the reasons for that preference. This workpackage was led by NPL.

The workpackage involved the development of a series of scenarios to enable the full range of possibilities to be considered. The so-called scenarios caused some confusion initially, as some thought them to be specific solutions that were to be proposed by the project. In reality none of them is intended directly as a desired description of the metrological infrastructure, rather to allow the various points raised by each possibility to be understood and explored. As such the scenarios should be considered as illustrative tools to aid open exchange of views.

Current discussions in the metrology community indicate that the scenarios favoured involve some sort of network(s) of excellence or virtual institute(s), and are consistent with the Commission's ERA initiative. It should be recognised that there is a strong likelihood that the optimum solution will vary across the differing quantities (acoustics, metrology in chemistry, Electricity and Magnetism etc).

Developing the scenarios

Highly simplified, highly stylised visualisations:

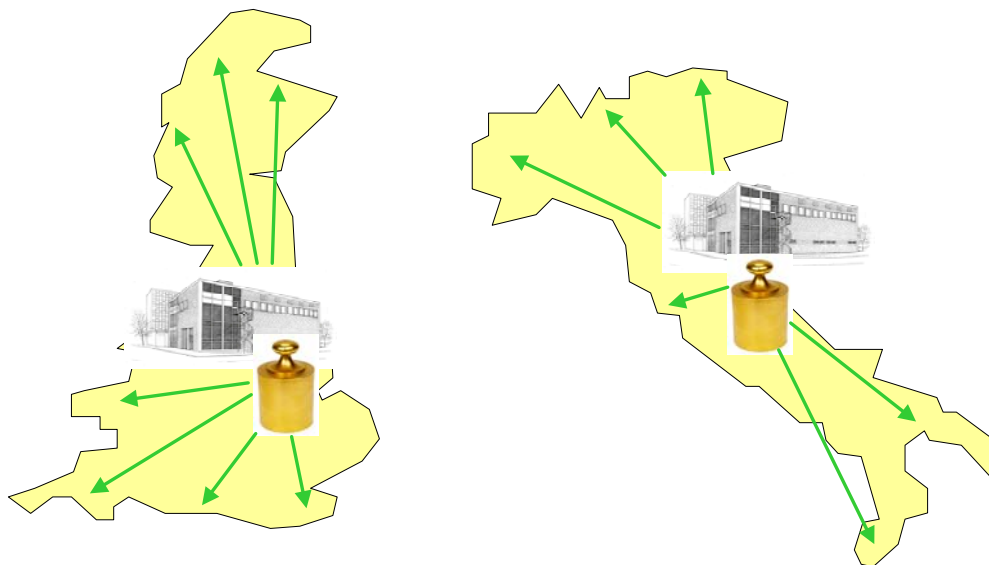
- A Comprehensive national provision**
- B Selected standard holders**
- C Specialised centres of excellence**
- D Single European Metrology Institute**

The map below (figure 5) shows the extent of the EUROMET countries.

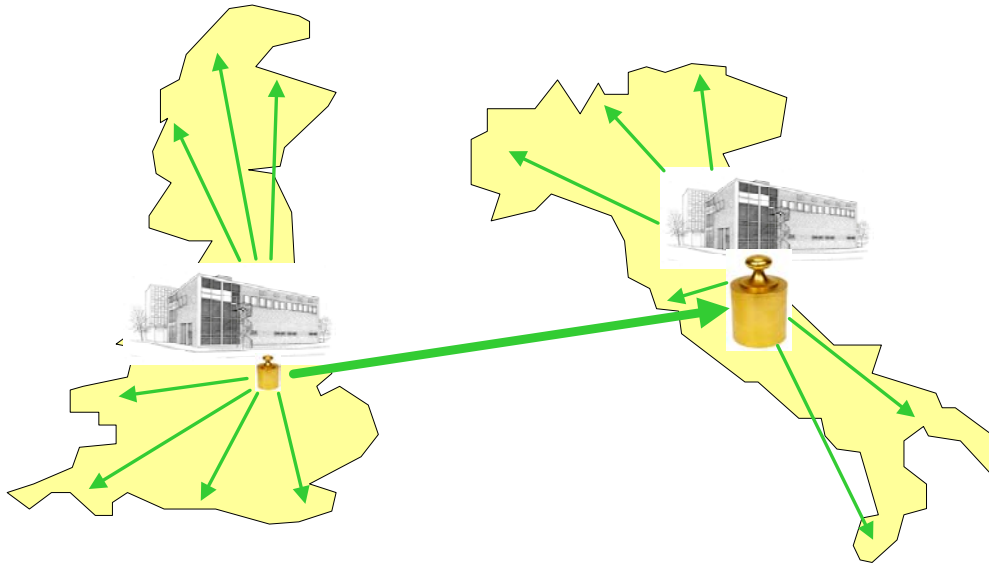


Figure 5: The EUROMET map

To explain the concept the illustrations show an example with two countries for one quantity for illustrative purposes



**Figure 6: Scenario A - Comprehensive provision:
Each country holds a full set of primary standards**



**Figure 7: Scenario B for quantity M - Selected standard holder:
Not every country holds a primary standard**

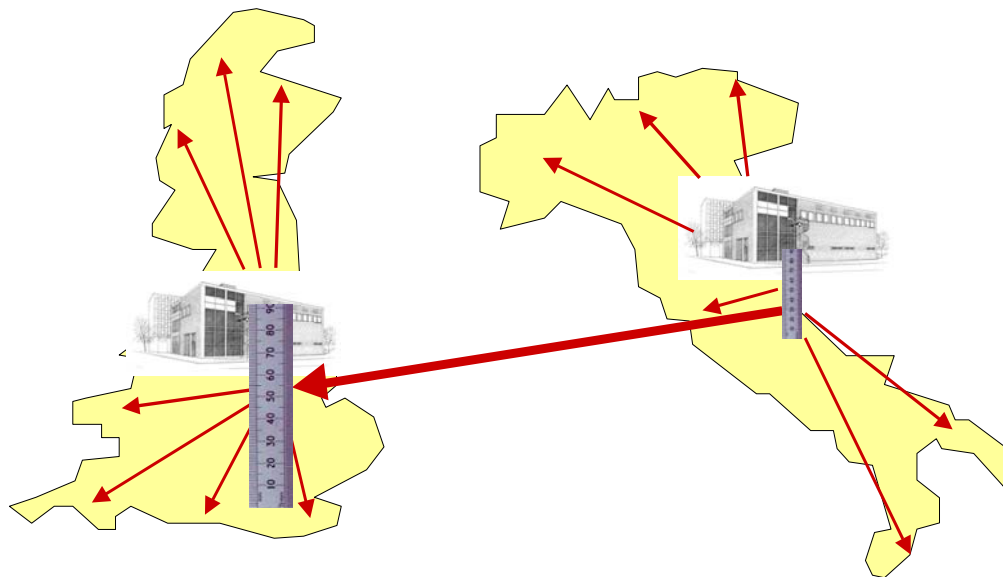


Figure 8: Scenario B for quantity L - some sort of quid pro quo could be considered

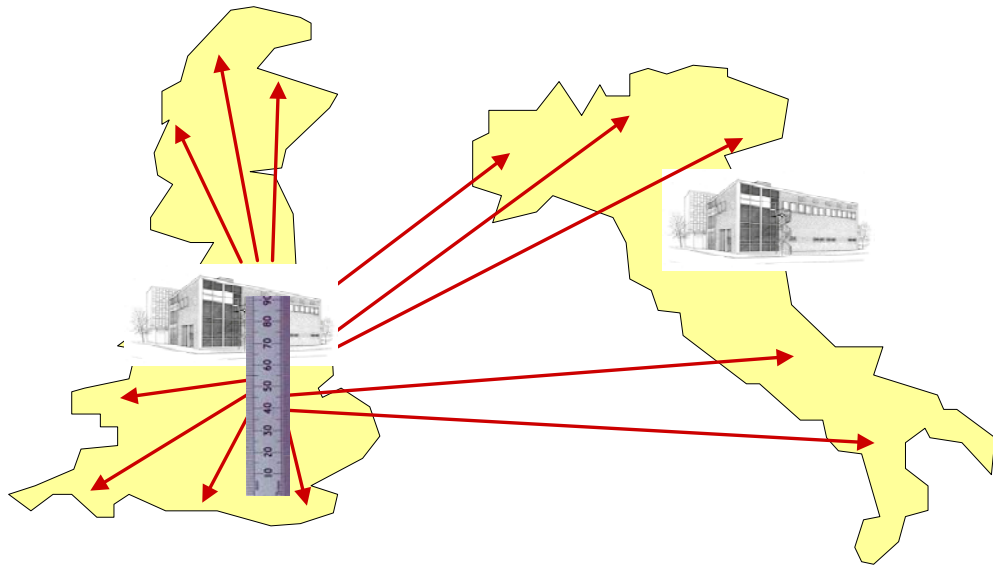


Figure 9: Scenario C for quantity M - Specialised centre of traceability disseminating directly to customers both nationally and in other EUROMET countries

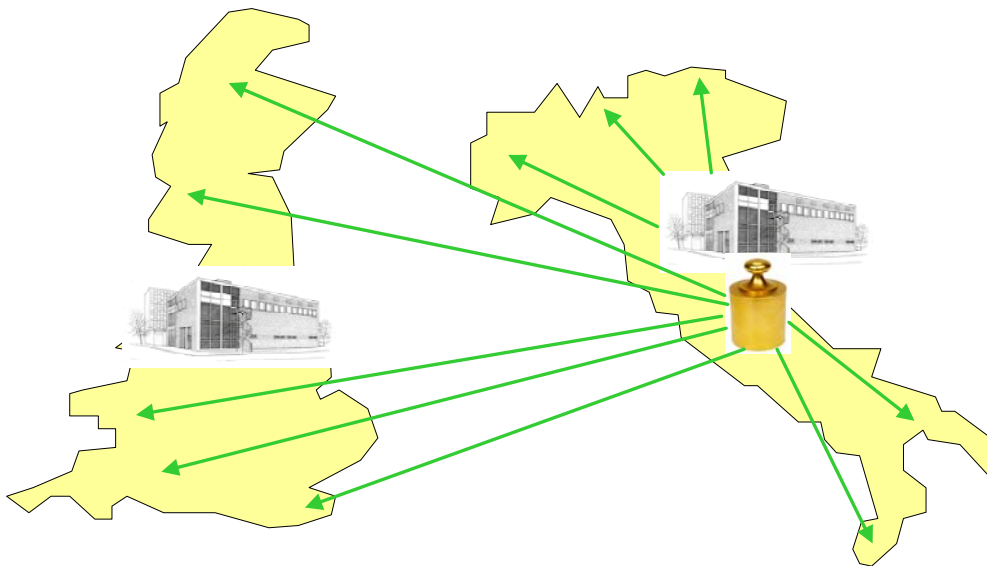


Figure 10: Scenario C for quantity L:

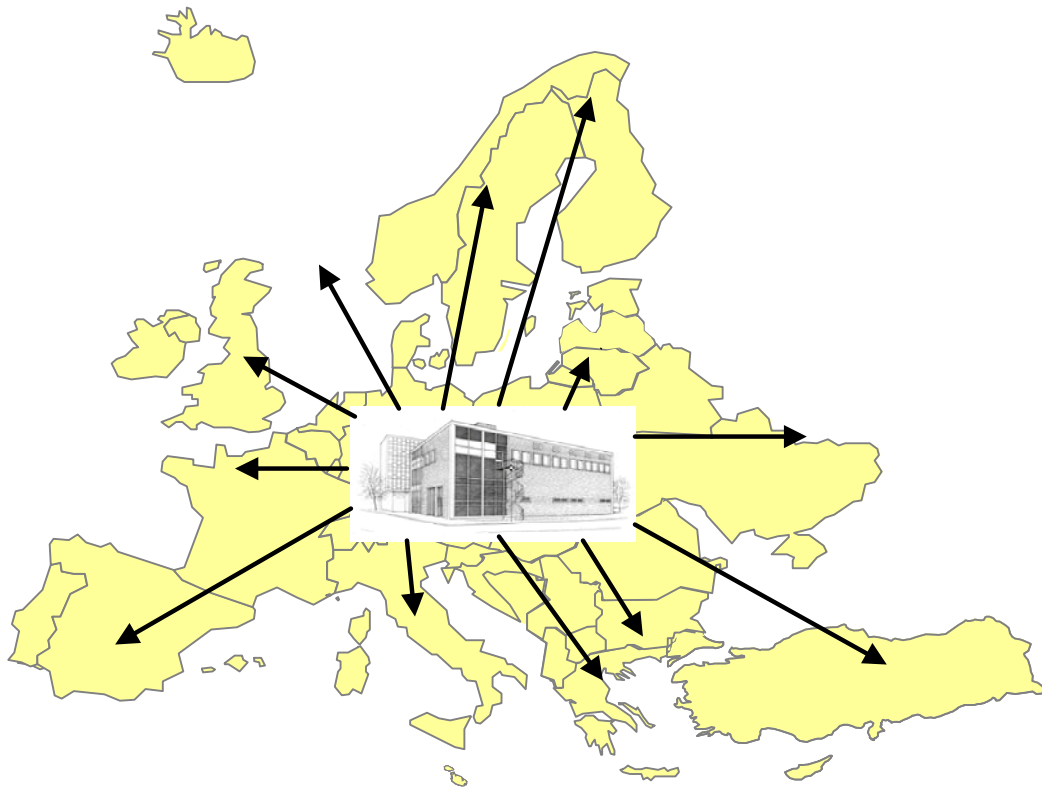


Figure 11: Scenario D - A single NMI for Europe, virtual or real

The scenarios were used in two ways: for discussions with the participants (project partners and invited NMIs) in the first workshop, and in the European stakeholder consultation. The findings are reported in the appropriate workpackage reports.

The scenarios were developed to allow the key issues for the future of the NMI European structure to be considered and balanced:

- | | |
|----------------------|-----------------------------|
| Efficiency | Choice |
| Duplication | Robustness |
| Critical mass in R&D | Need for national expertise |
| Major facilities | Local delivery |
| Responsiveness | Complexity |
| Coordination | Centralisation |
| Competition | Collaboration |

Decision Tool Development

In addition to the “scenarios” approach, partners currently use a variety of approaches to priority setting ranging from very informal through to the complex analytical model developed by NPL during the project, that is qualitative rather than quantitative.

Qualitative and Quantitative approaches to identifying priorities

The “Bull’s Eye Model” model, presented by presented by DFM at the first workshop, is typical of the simple but structured approach favoured by many NMIs.

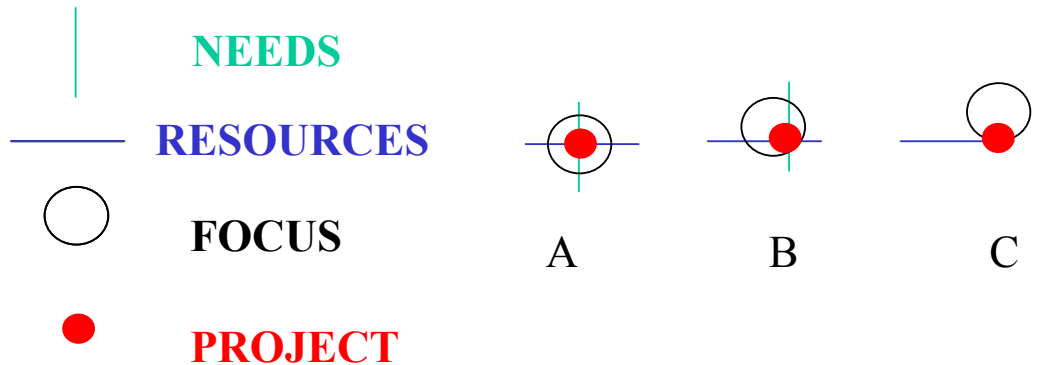


Figure 12: The Bull’s Eye Model approach

This approach was utilised in DFM in developing their strategy and prioritisation for R&D. The strategy for developing products (services, knowledge, facilities) has to be seen in the light of an increased use of reference- and user-groups. At each specific selection the “bull’s eye model” (see figure 12 above) gives rise to the following considerations:

- Needs. It is specifically considered which Danish and foreign needs have been identified for the product in question, including which income from clients it will generate. Possible partnerships with enterprises are investigated. Correspondence with available forecasts is ensured.
- Resources. Fit for purpose human and material resources are identified. In general collaboration is established, often through EUROMET and EU, but also through national organisations such as DANIAMet⁴ [5] and DFM. Overall attention is paid to the fact that DFM must be collaborating with its strategic partners. It is ensured that products are fundamental in nature and fall within DFM’s strategic scope. Financing and Gantt-charts are made in accordance with DFM’s quality system.
- Focus (International visibility): In order for DFM to maintain its reputation as centre of excellence, products must have international visibility, even if it serves Danish interests only. Results are published in international journals and at conferences; but visibility is also ensured by adhering to subjects that are of concern to EUROMET and the CGPM⁵ [3].

Models such as the one described above identify needs and capabilities, but do not attempt to provide guidance on the value of one area of activity versus another in any detail. This need to compare and “value” activities that are quite unlike each other is an inherent aspect of the operation of an NMI. To address this need a tool, based on “multi criteria decision analysis” - MCDA - was developed by NPL and made available to any partners wishing to use the tool, and a training day was held to explain the complex tool in more depth. The tool was designed to be sufficiently sophisticated to allow operation at

⁴ A decentralized metrological organization of primary and reference laboratories in Denmark

⁵ Conférence Générale des Poids et Mesures (General Conference on Weights and Measures)

different levels (for example to examine research teams, or research facilities, or measurement services).

4.4 Workpackage 4: NMI Workshop

The objective of this workpackage was to brief all NMIs in Europe on the scenarios and the process to identify areas for greater collaboration and to disseminate tools for them to provide their national input. Participation was not limited to the partner NMIs. All EUROMET NMIs and designated laboratories were invited to participate, and funding was made available for their travel and subsistence.

Workshop report: December 16 and 17, 2002

4.4.1 Introduction

The first workshop in the framework of the MERA project was organized by NMi Van Swinden Laboratorium and took place in the World Trade Centre of Rotterdam on 16-17 December 2002. The aim of the MERA project is to intensify current EUROMET research cooperation and lay the foundations for an integrated European Research Area (ERA) in metrology.

During the workshop, 66 leading experts from 28 European NMIs and guests from the BIPM, CIPM and DG Research:

- reviewed the current level of EUROMET cooperation;
- visualized and discussed four different scenarios for the restructuring of European metrology;
- identified the key challenges and discussed the associated risks for the future research in metrology;
- discussed priority setting for research in small and large NMIs using common decision tools;
- reviewed the issues to be addressed during the national activities.

Two discussion sessions were organized in three parallel groups. The first discussion session focussed on the different scenarios for the restructuring of European metrology, and in the second session the three groups identified the future priorities for metrology research in nanotechnology, physics and chemistry.

The programme of the workshop and the list of participants are attached as Annex D.

4.4.2 Workshop results

4.4.2.1 List of metrology structural scenarios

The first day of the workshop started with an introduction by the EUROMET chair to the MERA project and an overview of the EUROMET strategy, followed by a review of the current level of EUROMET collaboration.

Then four different scenarios were presented for future cooperation in metrology research. The four scenarios are:

A: Comprehensive national provision

B: Selected standard holders

C: Specialised centres of excellence

D: Single metrology institute for Europe

In model A every country has an NMI, which offers a comprehensive national service, mostly in the field of calibration. National measurement standards are primary realisations of the SI⁶, as far as economically possible.

In model B the NMI provides a service as comprehensive as possible, but instead of realising the traceability to the SI via their own primary realisations, the NMI takes traceability from other NMIs which are selected to maintain the primary realisation for the designated standards.

In model C the NMIs specialise in areas of excellence and provide primary realisations and national measurement standards only in these areas. Local customers need to go to other NMIs for services not offered locally.

In model D the national NMIs are discontinued, and a single European NMI is established which maintains all primary realisations and delivers all calibration services.

The four models were discussed in three parallel workshop sessions. The major advantages and disadvantages identified are given in the four following tables. The current status lies somewhere between “A” and “B” in that the larger laboratories provide nearly all capabilities directly from their primary realisations, whilst in smaller laboratories some quantities are delivered as national standards traceable to a primary realisation in another NMI (or the BIPM).

The following diagram (figure 13) depicts the advantages and disadvantages of the various degrees of integration. Each issue is highlighted red, green or blue for disadvantages, advantages and neutral. The horizontal axis indicates the level of integration, with a high degree of integration being towards the right, and four important themes are indicated on the vertical axis. Divisions between scenarios should not be considered absolute; there is a continuum of development from a less (scenario A) to a more (scenario D) integrated infrastructure.

⁶ Système international d'unités (International System of Units)

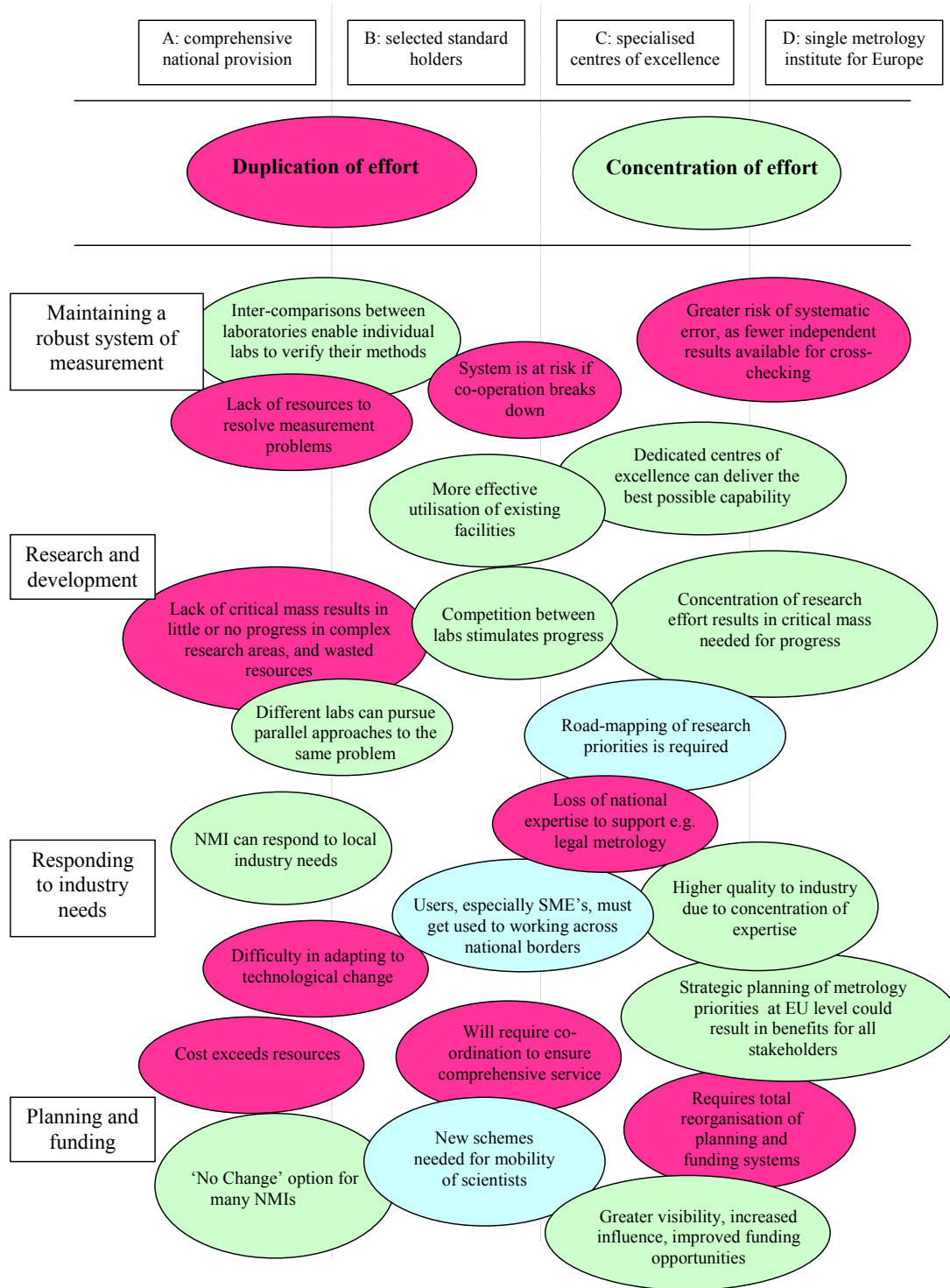
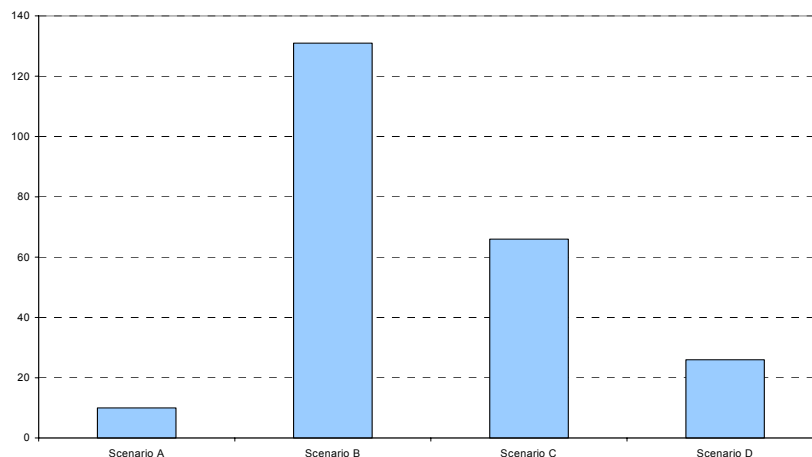


Figure 13: Advantages and disadvantages of the various degrees of integration

At the end of the three sessions the participants were requested to give their preference for the four scenarios and the result is given in the figure 14.

Figure 14: How did the workshop participants vote at the workshop?



All sessions of the workshop were organised in a way that sufficient time was available for in-depth discussions between the participants.

Many points were raised in the discussion and the most prominent conclusion is that there is a common feeling that an intensification of the cooperation between NMIs is desirable. However, it is also clear that a single cooperation concept cannot be applied to each NMI. The activities of an NMI vary from fundamental metrology research, research to develop primary and secondary measurement standards, national or regional calibration services, production of certified reference materials for national and international use, metrology services for maintaining a national legal metrology infrastructure, industry consultation, etc. and the degree of cooperation possible and desirable will be different in each country for each level. A majority supported the concept of an NMI with local services, with greater emphasis on R&D collaboration.

4.4.2.2 List of priority topics for research in metrology

On the second day, the workshops focused on the future for research in metrology. The subject was introduced by the chair of EUROMET with a view on “Future Trends and the Impact for Research in Metrology”, which set the tone for the three workshops for metrology in Nanotechnology, Physics and Chemistry. The short reports from the three workshops are added in Annex D.

4.4.2.3 Further discussion items

The program gave further discussions about:

- Dissemination tools for assisting national prioritisation of areas of collaboration. Two contributions about prioritisation in a large (NPL) and a small (DFM) were given and two contributions were given on present collaborations on research in metrology (BESSY and COUNT⁷ [6]);
- The questionnaire to be used for the stakeholder consultation;

⁷ Counting Electrons One by One: Measurement of Very Small Electrical Currents – EC project

- The NAS perspective on the future research collaboration scenarios.

The presentations are given on the CD ROM

4.5 Workpackage 5: National Analysis

The objective of this workpackage was to allow each NMI to develop a view on the areas of research best addressed through European collaboration.

This part of the project was optional, it was not funded by the project and each participant worked independently. As many of the issues relate directly to the NMI and national strategy and involved the confidential aspects of the operations of the laboratories not all details are included. Each country will take due account of the issues associated with further cooperation.

Specifically:

- The EUROMET Strategy, agreed by its members from the (then) 24 countries, calls for closer European collaboration in metrology research and associated activities, but as yet has no clear mechanisms to increase the level of cooperation;
- The need to develop the metrological infrastructure provided by the NMIs to encompass new technologies, e.g. biotechnology and nanotechnology, whilst continuing to provide services and supporting research for more traditional areas. This probably requires specialisation and team working within Europe whilst managing the risk that such rationalisation may be viewed as a cost cutting exercise;
- The recent recognition that even the larger European NMIs do not have the resources to continue to remain individually at the forefront of metrology research in all areas. Furthermore these institutes are concerned that spreading resources ever more thinly over more and more topics raises serious concerns about critical mass for research even on existing priority topics;
- The reality that whilst closer collaboration and specialisation to optimise impact and ensure critical mass is attractive in principle, there are many practical difficulties for nationally funded laboratories that make this closer collaboration difficult;
- The reality that closer integration of NMI activities in Europe raises real and genuine concerns, particularly regarding the role for the smaller NMIs and the SME customers;
- The recognition that many of the smaller NMIs have already had to make choices regarding the areas in which they will be active;
- The reality that in certain key areas collaboration may not be appropriate for a variety of reasons (logistics, level of local demand, political need...);
- That NMIs often use competition in the exploitation of collaborative R&D as a way of improving service to the end users, and wish to continue this practice;
- The recognition that the ERA represents a significant shift of European research policy that aligns remarkably well with the EUROMET strategy. The NMIs realise that exploration of the interaction between the EUROMET strategy, the various EU NMS strategies, the ERA and the new Framework Programme needs to be carried out in a timely manner if all the potential benefits are to be realised.

The outputs from the various national analysis activities were provided to the coordinator on a confidential basis, collated and analysed by the coordinator, prepared for the project team, and are reported under workpackage 8. A number of countries used a questionnaire-based enquiry, developed by PTB and adapted as appropriate. An example of the UK version (which is given as it is in English) is shown in Annex E. Some countries prepared summaries and presentations of their findings that were presented at the second workshop (and are included on the second workshop CD).

Of particular note was the impact of the project in the Nordic countries, where the project has resulted in a spin off project "NAMERA" funded by the respective Governments, facilitating collaborations on a regional basis (see Annex F).

4.6 Workpackage 6: European stakeholder consultation

The objective of this workpackage, led by SP, was to allow industrial input to potential changes to metrology infrastructure. After launching the project it became clear that the national stakeholder analysis was better performed as part of the national analysis. This workpackage was therefore reoriented somewhat and also broadened to be a stakeholder survey at European level.

The full report is given in Annex G.

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/National Measurement Systems (NMS) relationships:

NMIs 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 universities provide good examples of what the Commission calls “federated excellence”.

Funding to European National Metrology Systems (NMS)

- Stakeholders view the provision of traceable measurement and National Metrology Systems as predominantly a continuing public service.
- Many of them are willing to lobby for increased support to the European NMS but at the same time are not prepared to pay much more for the services provided.
- Variable rates of 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 comprising of competence centres, each performing fundamental research for certain quantities and parameters and providing 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 (PREST⁸ 2002 [7]) but are also essential in metrology in:

- The elimination of systematic errors;
- Providing a multidisciplinary environment necessary for the development of metrology.

4.7 Workpackage 7: Newly Associated States perspective

This workpackage was led by CMI of the Czech Republic, and ensured that the interests of the Accession countries were appropriately addressed in the project. In recent years the thrust has been to establish independent national metrological capability in many of the Newly Associated States as part of the Accession process. However this approach is somewhat contradictory with the more recent ERA concept, and to a degree with the EUROMET strategy. Consequently it was particularly important that NAS perspective of the concept of an interdependent ERA in metrology be properly examined and the implications analysed.

The views of the NAS countries were collected by means of a questionnaire that enabled CMI to evaluate and formulate a NAS position. The questionnaire was distributed, after a presentation and taking into account subsequent comments on the methodology during the MERA workshop in December 2002, in early January 2003 to NMIs of the following countries: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, the Slovak Republic, Slovenia and Turkey (Cyprus is not an EUROMET member). The individual responses and a paper summarizing and analysing the findings are in Annex H. The paper was distributed to the contributing NMIs involved in the data collection.

It should be borne in mind that the NAS countries have NMIs with a wide range of sizes, capabilities and aspirations. With this caveat, the findings can be summarized as follows:

- Metrological laboratories in the NAS countries have acquired a lot of new equipment under the PHARE scheme, but there has not always been a concurrent increase in staff expertise;
- Many of the NAS laboratories aspire to become involved in cutting-edge research and see European collaborative projects as a means of doing so;
- National stakeholders in the NAS countries are not enthusiastic about the prospect of losing national expertise through further devolution of capability;
- Overall, scenario B is the preferred option, corresponding to no change from the current situation in most of the NAS countries.

⁸ PREST (Policy Research in Engineering, Science and Technology)

4.8 Workpackage 8: Summary and analysis

The objective was to have a clear input to the ERA workshop to enable and facilitate an informed debate, and the collation and analysis was led by NPL.

A standard proforma was developed and the NMIs surveyed to identify the areas in which they wish to increase the amount of R&D collaboration, and to identify opportunities for greater collaboration related to the use of facilities and delivery of services. For ease of use a common proforma was circulated with the pre-defined topics, additionally NMIs were encouraged to enter topics over and above the pre-defined list where they considered it appropriate. Additionally the common points that were identified from the national analysis were distilled into a common presentation for the workshop (available on the CD ROM).

Examples of the proforma are given in Annex I. The proforma returns were analysed and the information presented graphically (See figure 15, 16 and 17). From the returns it was quite clear that there is considerable demand within the NMIs to step up the amount of collaboration that currently takes place. The number of NMIs wishing to collaborate correlates to some degree with the number active in any given area, for example all NMIs are active in “length” whilst only a few NMIs are active in, say healthcare.

Whilst the main thrust of collaborative desire focused around R&D, there was also interest in use of facilities in other NMIs and in an increased level of cooperation regarding delivery of services.

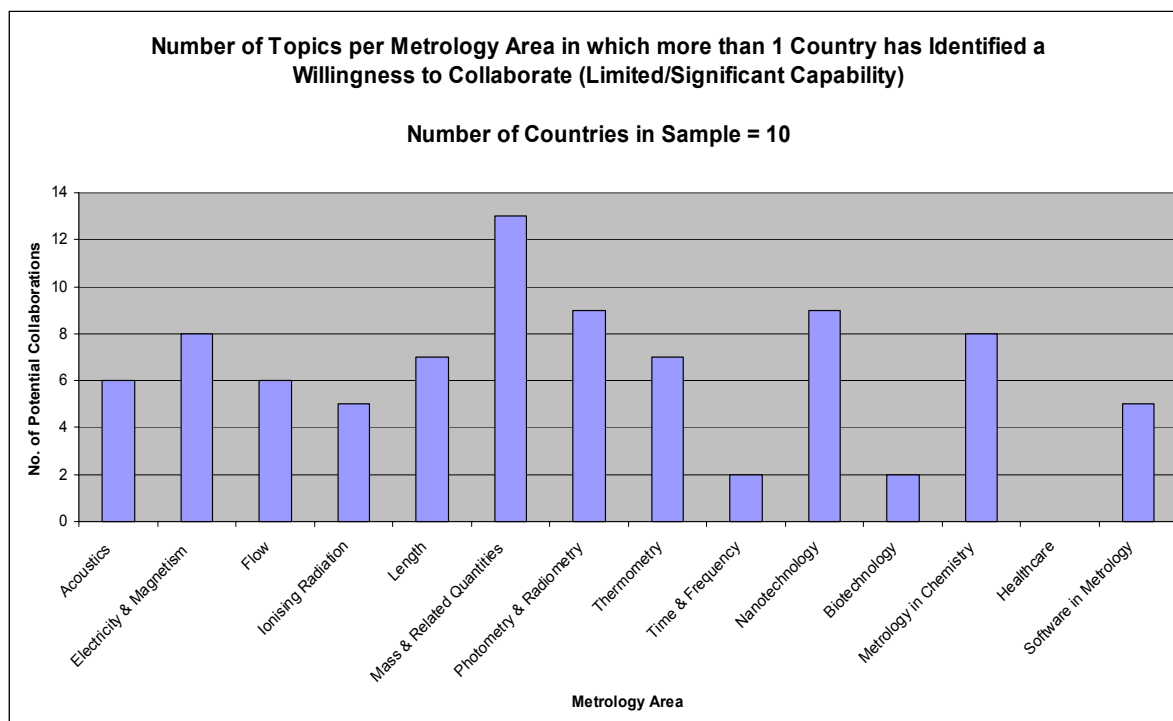


Figure 15: Number of topics per metrology area in which more than 1 country has identified a willingness to collaborate

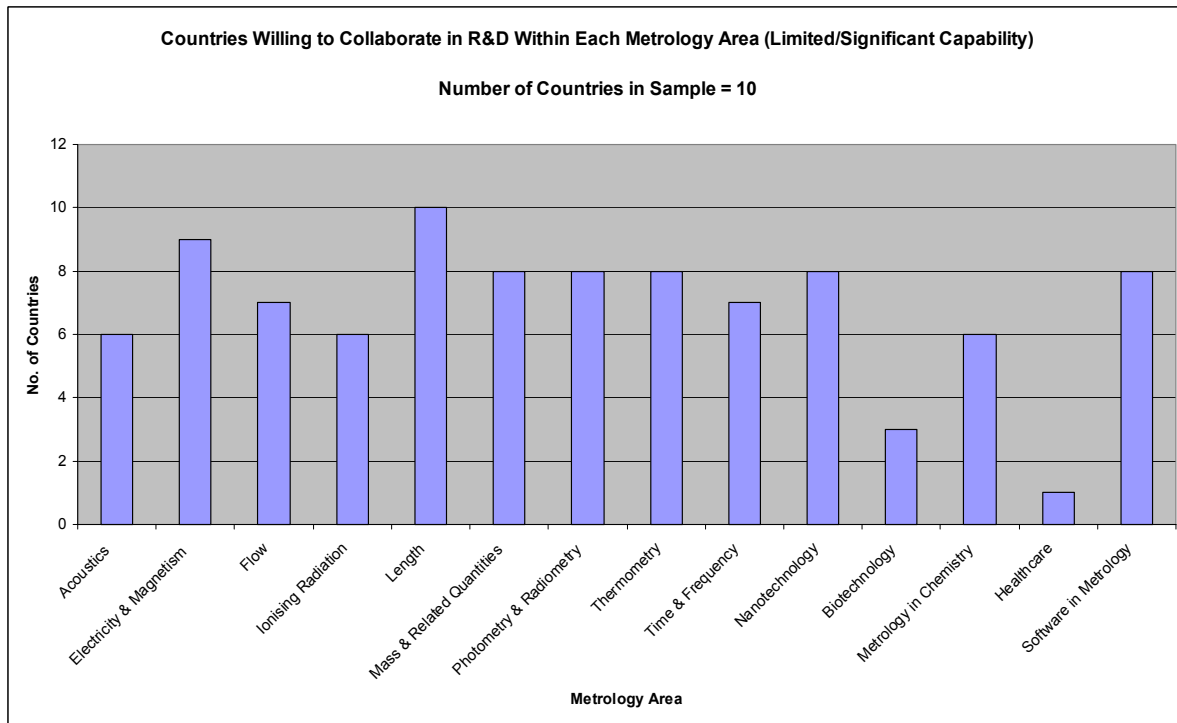


Figure 16: Countries willing to collaborate within each metrology area

Level of Desired Collaboration by Programme Area

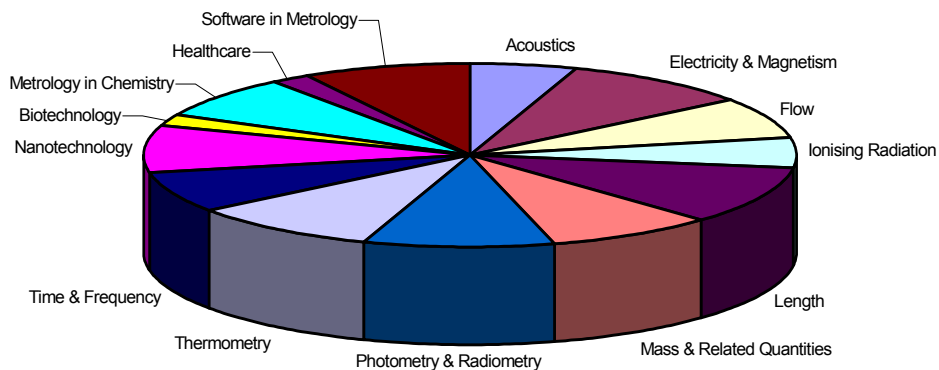


Figure 17: Level of desired collaboration by programme area

4.9 Workpackage 9: ERA workshop

The objective of this workpackage was to provide a forum in which the outline plans for the construction of a European Research Area in metrology could be agreed. The European Research Area

in Metrology workshop, was hosted by PTB and focused on identifying common themes emerging from the review process. The Commission was invited to the workshop which outlined to the wider audience (ie. All European NMIs, not limited to the partners) the outcome of the analysis, including the scenarios, research and infrastructure implications and asked for broad endorsement of the preferred options for the future. Integration with EC Framework Programme activities was discussed.

On the second of the two days each NMI was able to invite a Government Official to hear the issues discussed at first hand. Indeed officials from two Ministries (Germany and the UK) made presentations supporting the MERA concepts at the workshop.

Report on the ERA workshop held at PTB, Berlin, on June 16 and 17, 2003

During the first workshop hosted by NMI Van-Swinden Laboratory in Rotterdam on December 16/17/2002, the leading experts of the European National Metrology Institutes (NMIs) among other activities:

- Reviewed the current level of cooperation;
- Visualised four different scenarios for the restructuring of European metrology;
- Identified the key challenges for the future, and
- Reviewed the issues to be addressed during the national activities.

The second ERA workshop held in Berlin and organised by PTB built on the achievements of Rotterdam workshop. The programme of the workshop is attached as Annex A.

The workshop was organised in two main parts: The directors of the European National Metrology Institutes including the institutes of the Newly Associated States met during the first day. On the second day the conclusions drawn so far by the NMI directors were presented and jointly discussed with representatives from the funding agencies of the NMIs.

The first day started with a follow-up of the Rotterdam workshop, consisting mainly of updated reviews of cooperation within EUROMET and the evaluation of future trends in metrology. Broad room was then given to the presentations of the views of the European stakeholders and to various national analysis reports from the Nordic countries, France, Germany, Italy, the Netherlands and the UK. In addition, the perspectives of the Newly Associated States were provided.

Based on these results a discussion was started about conclusions regarding the different types of scenarios for the future of European metrology. Generally speaking the European manufacturers have been found open minded towards a European metrology system where not necessarily all calibrations are performed nationally. The most important aspect to all customers of NMIs is the high technical competence. The willingness to go abroad for calibrations increases with increasing company size.

All sessions of the workshop were organized in a way that sufficient time was available for in-depths discussions between the participants.

The dinner on the first day provided the possibility for a continued informal discussion of the first day's topics, with participation of representatives of the funding agencies.

On the second day the representatives from the funding agencies were introduced to the present status of metrology in Europe and to foreseen future challenges by high level presentations given by the Head of the UK DTI National Measurement System Directorate, Dr. Denis Walker (view from the funding agent) and from Prof. Ernst Göbel, president of PTB (view from an NMI).

In the subsequent session the representatives of the funding agencies were familiarised with the different possible scenarios for metrology in Europe and with the results achieved by the MERA project so far.

A panel discussion with leading experts both from the NMIs and from the funding agencies gave the possibility to exchange views and to come to conclusions on how to further proceed to strengthen European metrology. A preliminary summary was agreed by all participants and the way forward was discussed.

All talks given at the workshop were collected and are available on a CD-ROM which is also attached to this report. The list of the workshop attendees can be found in Annex B.

The results of the workshop has been integrated into the project findings. This workshop report therefore contains only a brief summary, which addresses the following topics:

- **scenario(s) to enable discussions fo the move towards an ERA in metrology:**

The four scenarios are:

A: Comprehensive national provision

B: Selected standard holders

C: Specialised centres of excellence

D: Single European metrology institute

In model A every NMI offers a service as comprehensive as possible. National measurement standards are primary realisations of the SI as far as possible. In model B the NMI provides a service as comprehensive as possible, but instead of primary realisations of the SI it takes traceability from other NMIs. In model C the NMIs specialise in areas of excellence and provide primary realisations and national measurement standards only in these areas. Local customers need to go to other NMIs for services not offered locally. In model D a single European NMI is established. However, the separation of the models is not sharp. E.g., a single European NMI – model D – could be a virtual NMI consisting of type C institutions.

The participants came to the conclusion that no simple recommendation can be given. The best choice was seen somewhere between model B and D. However, in some areas only one facility can be operated (model D) due to high costs, e.g. synchrotron radiation metrology at PTB in Berlin.

- **Identification and recognition of a collaborative European metrology research “work programme”:**

It was regretted by all participants that in the 6th Framework Programme no generic metrology programme has been established. The participants regard collaborative metrology research as the

backbone of European cooperation in metrology. This cooperation is seen as especially important for smaller NMIs and in particular those of the Newly Associated States as for them it is difficult to establish the necessary critical mass for state of the art research. An idea that found broad positive resonance was to establish a selection process for joint research activities within EUROMET, using similar selection criteria as in the 5th Framework Programme for the generic metrology.

- **Definition of the tools, mechanism and actions to achieve the above and its applicability to the metrology ERA**

The above-mentioned internal EUROMET proposal selection process was regarded as one of the most important elements for joint European research in metrology. It would lead to a strong participation of personnel from smaller NMIs in research projects performed at state-of-the-art facilities of larger NMIs. To support the activities, intensive use should be made of the Marie Curie Programme of the 6th Framework Programme.

- **Proposals for integrating EUROMET strategy and ERA concepts into an ERA in metrology during the 6th Framework Programme, including a draft “road map” with indicative timing**

This topic will be a focus of the project findings and therefore will not be described in detail in this summary.

- **Identification of issues that require action**

During the workshop several issues were identified that will require further evaluation and action.

Among the most important are:

- Outlining the procedures for the evaluation of joint research programmes;
- Assure ways to use the Marie Curie Programme of the 6th Framework Programme to support scientists from smaller NMI during their research stays at the facilities of larger NMIs;
- Develop mechanisms for the coordination of metrological research in Europe;
- Develop ways to fund and operate new joint research facilities;
- Integrate the funding agencies in the process for increased cooperation in European metrology.

A more detailed outline on how to proceed will be found in the project findings.

- **Identification of those organisations/partners/individuals who will need to address the identified issues**

The organisations instrumental to establish the ERA in metrology are primarily the European metrology organisation EUROMET, the National Metrology Institutes, their funding agencies, and the relevant organisations of the European Commission. In addition valuable and important partners are the

European stakeholders in metrology like multinational companies, European and national industrial associations and other interested parties.

- **A forum in which agreement can be achieved**

After consulting their national funding agencies and their national stakeholders the NMIs have come to an agreement on how to proceed further at the General Assembly of EUROMET. It should be kept in mind that EUROMET is a voluntary association which cannot make binding decisions for its members. All solutions require consent. Therefore any solution to be established will be open to all members but no member will be forced to participate.

4.10 Workpackage 10: Dissemination and Foresight report

The project was presented at the 5 following conferences:

- ‘Towards an integrated infrastructure for measurements’ conference, 18-19 June, Warsaw (poster)
- XVII IMEKO World Congress, 22–27 June 2003, Dubrovnik, Croatia (paper and poster)
- The International ILAC/IAF conference on accreditation in global trade, 23-25 September 2002, Berlin (poster)
- NCSLi conference, 18-21 August 2003, Tampa (paper and presentation – not funded by the project)
- Métrologie 2003, 20-23 October 2003, Toulon (paper and presentation)

The European Stakeholder consultation (workpackage 6) report has been separately published by SP, and distributed at the Métrologie Congress in Toulon. The report is detailed in Annex G. Handouts: Handouts based on the posters were prepared and distributed, including opportunistic distribution at the various events attended by the partners.

All papers and the handouts are detailed in Annex J.

4.11 Partners contributions

A brief description of each partner’s (including subcontractors) individual contribution to the project is given in Annex K.

5. LIST OF DELIVERABLES

- Report of State of the Art Review
- Report of Trends Analysis
- Scenarios and Decision Tool
- Report of NMI Workshop
- Summary of National Analysis
- Summary of the Industrial consultation
- Summary of NAS perspective

- Summary and Analysis
- Report of ERA Workshop
- Final Report EC
- Report to National Funding Bodies
- Report to EUROMET
- EUR report

6. COMPARISON OF INITIALLY PLANNED ACTIVITIES AND WORK ACTUALLY ACCOMPLISHED

The key change during the project was the re orientation of workpackage 6, originally the “European and National Industrial Consultation”. It became apparent that the national industrial consultation could be more effectively included in the national analysis, and that this workpackage should concentrate on those stakeholders (no longer limited to industry only) who are European in nature, either by virtue of being large multinational companies, trade associations or similar. The workpackage was therefore re-titled: European stakeholder consultation.

7. MANAGEMENT AND CO-ORDINATION ASPECTS

NPL was the project manager and coordinator of the project. Management issues preceded smoothly, the main difficulty being that much of the input needed to come directly from the NMI senior managers, in many cases the Directors of the Institutes. Thus it was vital that inputs were carefully followed up. The project held a kick off meeting (originally planned to be held at NPL, but in fact held at JV in Norway (10 and 11th September 2002) to take advantage of a EUROMET meeting already scheduled), a second meeting at BNM in Paris (January 28, 2003), the two workshops (Rotterdam and Berlin) and a final meeting at the Toulon conference (October 23, 2003).

Minutes of each of the meeting, and associated documentation is given in Annex M.

Comments from the Coordinator on the managements and coordination aspects:

The project has successfully addressed complex and sensitive issues that are critical to the well being of the NMI laboratories, and to industry and wider society. Many aspects proved challenging, the organisation, and to a lesser extent aspirations of the NMIs inevitably vary somewhat, but what has been most significant is the commitment of the partners to increase collaboration, particularly in R&D. Discussions around rationalisation of services were more controversial. In many NMIs the concept had little meaning, because they have always had to make choices, knowing that they could turn to the larger and more comprehensive NMIs to fill in the gaps. On the other hand if the larger NMIs acted unilaterally the result could damage the overall European capability. At the practical level the participants in the project were for the most part either the Director of the laboratory, or other very senior staff. Demands on their time were such that a certain amount of chasing up was inevitable.

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8. RESULTS AND CONCLUSIONS

Metrological traceability provides an essential infrastructural support to the quality assurance of measurements made in all sectors of society. Increased needs of society for traceable measurement, in traditional sectors (manufacturing, communication, food, environment etc) as well as new areas (such as nanotechnology and biotechnology) become increasingly resource intensive. This is a challenge both at the national and European levels, which can be met through a more efficient use of resources by increased co-operation in metrology research in Europe. A sustained and further developed metrology may be achieved even within restrained budgets.

The MERA project has provided an overview of metrology research topics that are deemed to be a priority, over the next decade, as well as descriptions of scenarios for greater co-operation between the NMIs in Europe at research infrastructure level. A presentation is also made of the views of the New Accession States positions in a European perspective. Strategy aims at enhancing the competitiveness of European industry and society through better metrology, including increased mobility and co-operation.

The project has involved extensive consultation with stakeholders, detailed discussions within and between NMIs, quantitative evaluation and analysis of the issues. Those issues and aspects of the project identified as key are:

Foresight:

The project has, for the first time, established a multidisciplinary foresight report for top-level metrology, and the project team are convinced of the value of this type of exercise in facilitating collaboration. Furthermore this “trends” exercise has highlighted the value of categorising the research objectives that can benefit from collaboration into:

- Developments in existing capabilities
- Long term underpinning research
- New research areas

Particularly in the new areas, such as metrology in chemistry, biotechnology etc, there is a clear need for NMIs to interact not only with each other but also increasingly with other research organisations. This foresight characterisation will enable joint strategic planning of the longer-term research, and of new areas as they emerge; whilst still enabling ad hoc collaboration as existing capabilities are developed. Implicitly the project team also identify that there are areas of research, for example related to close to market instrumentation, where the NMIs will prefer to make industrial alliances and effectively compete rather than collaborate. High quality foresight exercises significantly enhance medium and long-term planning and resource allocation at a national level that is crucial for strategic collaboration.

Views of the stakeholders:

Stakeholders identify outstanding scientific and technical competence, in the field of measurement, as the rationale for interacting more with the NMIs. Stakeholders need to be viewed increasingly not simply as “end users” of NMI services, but also as active partners with NMIs in metrology, both nationally and on the European level. Stakeholders expect NMIs to support new areas of technology, whilst still supporting traditional sectors. European stakeholders, particularly trade associations, admitted to not always placing a high priority on metrology, and the European NMIs are encouraged to increase understanding of the importance of metrology by these organisations. In their responses to the MERA surveys most stakeholders were, unsurprisingly, supportive of an increase in public funding for metrology, but opposed to customer price increases. They recognise that as metrology demands grow national funding agents are unlikely to increase resources at a comparable rate. They recommend that collaboration be increased, both between the NMIs and between individual NMIs and other research players at national level to cope with this situation. A single geographic institute (one possible interpretation of scenario D) was felt by stakeholders not likely to meet these aspirations.

Current Collaboration:

EUROMET oversees and coordinates a variety of types of collaboration for its members; scientific comparisons (the backbone of metrological confidence), shared use of facilities, traceability arrangements, and consultation between NMIs. However there is a clear “glass ceiling” that limits the degree of collaboration that can be achieved with the current arrangements. The causes are complex but the study identifies: internal processes in NMIs and Ministries that finalise national plans before exploring collaborative solutions, limiting collaborative opportunities to an “ad hoc” basis, lack of clear goals at the European level for metrology R&D, difficulties associated with mobility and lack of formal commitment of resources when launching collaborations. Additionally there are other “legitimate” factors that inhibit collaboration, and are likely to remain. Examples include scientific competition, the desire to work with national industry on close to market applications and the need to maintain national flexibility. Although within the remit of the current EUROMET collaboration, in reality there has only been very limited shared use of facilities, an example of what is achievable is that of BESSY, the shared radiation facility in Germany. Efforts need to focus around better use of existing facilities, and coordinated development of new major facilities. Additionally since 1999 NMI collaborative efforts have focused around successful launching of a Mutual Recognition Arrangement under the auspices of the intergovernmental Metre Convention (involving 67 governments worldwide). With 120 cooperation projects completed, and a further 59 currently approved, EUROMET has established a framework for many types of collaboration, but the MERA project identifies a need for EUROMET to shift the emphasis of collaborative effort towards R&D whilst still supporting the other aspects of the collaboration. As the implications of the project were assessed it became clear that the current EUROMET structures will need to evolve or change.

Complexity in the organisation and delivery of top level European metrology:

Whilst the fundamental mission of the NMIs across Europe is common the current arrangements have evolved over time and is characterised by the complexity and variety of solutions amongst the member States and Accession countries. This complexity and diversity encompasses; size of economies and the NMIs that serve them, differing “ownership” arrangements for the NMIs, the portion of income earned from industry, variations in national structuring of the NMI from single institute to nationally distributed arrangements, variations in the scope of technical coverage and the balance between R&D and service

provision, variations associated with the different technical areas that fall within the scope of operations of NMIs, and finally differing aspirations.

Critical Mass In R&D:

Almost every aspect of the study has highlighted the need for R&D collaboration to be at the heart of EUROMET processes. Research within the NMIs is simulated by interaction with both academic and industrial organisations. A ‘critical mass’ in R&D tends to be necessary for useful progress in complex technical areas. The attainment of this critical mass through shared resource use and strategic planning is the main driver for EUROMET’s strategy. Solutions must recognise that metrology is in the first case a multi-disciplinary research area, where advances in say length metrology are based on advances in a host of related disciplines, such as optics, mechanics and time & frequency. In EUROMET there is no “typical” NMI in terms of research. A few currently have no significant research capability, many NMIs perform research in a few areas of metrology at the primary level, supported by secondary level but nevertheless essential research over a broader span of measurement fields. A few NMIs (particularly in larger countries) have a more comprehensive primary research capability. The size of the institute does not necessarily indicate the quality of the research, evident from broad and balanced participation in Consultative Committees within the Meter Convention and MRA activities by European NMIs from both large and small countries. Particular efforts will be necessary to unlock the potential from NMIs (and countries) that currently have limited or no current R&D capability.

Planning and prioritisation:

Responsibility for planning and prioritisation of R&D, investment in new facilities, and allocation of resources vary from country to country. In some, once the overall budget has been agreed the detailed development of plans rests with the NMI. In other countries this may be done at Ministry level. If collaboration is to be increased significantly and made more effective, support by the relevant Ministry is a prerequisite in most countries, and highly desirable in the remainder. Increased collaboration at the planning stage, and the adoption of mechanisms in national prioritisation processes that can account for the value of collaborative initiatives before national priorities and plans are fixed, are seen as vital.

Mobility and communications:

Discussions around the practical aspects of increasing collaboration frequently touched on the need for more intimate interaction between R&D teams in different institutes during project collaboration. Currently project tasks are divided between member NMIs who then work on that task on their own. There are only a few cases of truly integrated reach projects, and greater mobility of staff was identified as one of the issues enabling this higher level of collaboration. Existing mobility schemes are not necessarily well suited to the requirements of the kind of collaborative projects envisaged here. The second issue relates to an improvement in general communications. One or two NMIs have investigated and initiated improved capabilities ranging from video conferencing to remote control of experimental equipment. Clearly the concepts need to be further developed, efforts accelerated and the solutions adopted more widely by the NMIs.

Accession Countries:

Although their aspirations vary widely, the Accession countries (soon to be new Member States) face a particular challenge characterised by limited resources and capabilities. The Accession

countries are often referred to as a single block. In reality the size of the country, their economies and the aspirations of their NMIs vary considerably. R&D collaboration is seen as vital to technological and consequent economic development in these countries. For some the only realistic route will be through collaboration, whilst others are likely to achieve their aims through a mixture of increased collaboration and indigenous growth in national capability. The MERA proposals extend the range of options available to individual NMIs in the Accession countries and the increased flexibility will help them realise their aspirations.

A reappraisal of EUROMET:

As is clear from the key issues identified above, the project team considers that EUROMET will need to evolve or change its internal structures if metrology in Europe is to be improved to meet future challenges. EUROMET has already considered this need in response to the emerging MERA proposals, and some improvements in structure and process have been recommended. More radical changes to the status of EUROMET and its relationships with other bodies and groups will require further study and agreement as the MERA recommendations are implemented.

Rationalisation of services:

Rationalisation of services is likely to be a major issue for the small number of NMIs that currently offer a comprehensive capability. These NMIs will look to others to provide marginal demand services as resources demands become more critical, allocating the resources released to areas of specialisation. This approach is consistent with the EUROMET strategy provided that interests of the wider EUROMET community are appropriately considered. The process may offer opportunities for example in Accession countries to provide high quality cost effective calibration services. The majority of NMIs in Europe will continue to focus on a limited number of national priorities, drawing on the wider expertise within the EUROMET NMIs where that is complimentary.

Interaction with the European Commission Framework Programme:

The changes in the structure of the Framework Programme moving from FP 5 to FP 6 are having an increasing negative impact on collaboration. The European Commission justified the ending of a dedicated EC Framework activity for measurement and testing on the basis that measurement and testing, and support for standardisation, should be included in all the thematic priorities. Experience has shown that in practice the critical underpinning R&D, which tends to be multi sector, has not been supported in FP6, and only very limited support has been forthcoming for areas that are more focused. By definition sector lobbies are likely to promote their sector rather than generic metrology, measurement and testing needs. Implementing MERA could improve the quality of future proposals by identifying priorities and developing a collaborative culture.

NMI commitment to move forward:

This final point is not so much an issue as a clear commitment. With the complexity referred to in the first key issue there is inevitably a wide variety of views as to how top-level metrology should evolve in Europe. However the scene painted in this project has the support of the partners, and there is strong support from the team for the recommendations made, and a commitment to move to an implementation phase. Indeed, some of the major partners have already proposed in EUROMET that some aspects of the structure should be changed immediately, to reflect a strong and commitment to a more extensive and focussed research collaboration.

RECOMENDATIONS

Note: Responsibility and authority between the supporting Ministry and the NMI varies from country to country. Consequently the recommendations to NMI Directors and the Ministries may need to be interpreted accordingly.

Key Issues	General recommendation	To NMI Directors	To EUROMET	To Ministries	To the European Commission
Increasing scope and recognition of importance of metrology is straining resources – current collaboration mechanisms not sufficiently effective	Allocate increased resources to metrology Increase impact from resources through collaboration	Lobby nationally for increased resources Support the review and any subsequent changes in the operation of EUROMET	Provide an enhanced forum facilitating collaboration. Refocus EUROMET energies towards R&D collaboration, whilst not ignoring other activities Evaluate the existing organisational structures and terms of reference to optimise the above	Where possible increase funding for metrology Consider flexibility in national processes to encourage collaborations that bring national benefit	Recognise the contribution of metrology to sound science, industrial development and quality of life of European citizens. Provide a source of dedicated measurement and testing R&D funding
Critical mass is important to R&D	Avoid continually diluting critical mass in larger NMIs by stretching same resources over larger scope Identify mechanisms to ensure Europe can assemble critical mass in all key areas of metrology In particular ensure smaller NMIs and Accession countries are able to effectively contribute	Introduce a policy of reviewing R&D resources allocated to particular objectives for critical mass. Look for collaborations within EUROMET (and nationally) to attain critical mass Support mobility of staff. Investigate advanced communications options	Include an assessment of the required resources to achieve goals identified during roadmapping exercises Consider a common framework for mobility of researchers Provide appropriate forum for exchange of information Provide a forum for sharing advanced communications options information	Take roadmapped priorities into account Consider mechanisms that ensure the benefits of collaborative R&D are considered when critical mass is beyond national resources Fund national mobility schemes	Support medium-term road-mapping of R&D objectives Support secondment schemes between NMIs through Marie Currie or similar schemes
Metrology foresight	To build on the MERA trends analysis and develop and maintain a metrology foresight plan	Support and participate in foresight exercises Consider contribution to foresight objectives during national prioritisation processes	Own the foresight process Develop a time table for sustainability	Take metrology foresight into account when allocating resources	Support foresight process directly Consult foresight during FP development
Challenge for Accession countries related to historical legacy, resources	Help accession countries develop metrological expertise without excessive	Provide informal support to AC NMIs where possible	Review policy and strategy to ensure that the widely varying aspirations of the accession	Make support schemes known/available to the metrology community	Provide appropriate support to Accession countries to acquire

and transition to EU	<p>duplication of capability.</p> <p>Ensure accession countries are able to make the maximum contribution to the overall European metrological capability</p>		countries have been appropriately considered		<p>capability, recognising that this requires a stable base of expert personnel.</p> <p>Provide mobility support to enhance personnel capabilities, including return to country schemes.</p>
Stakeholders want as many services as possible delivered locally, but NMI resources are insufficient to do this everywhere all of the times	<p>NMIs to strike the right balance between local delivery of services and best use of resources</p> <p>The NMIs that have the greatest resource dedicated to R&D also tend to provide services across the full spectrum of metrology. Continuing to do so is likely to compromise scientific excellence as the growth in scope outpaces the growth in resources.</p> <p>Many smaller NMIs rely on these comprehensive NMIs as sources of traceability</p>	<p>In the comprehensive NMIs; Identify the necessity and depth of rationalisation.</p> <p>Consider maintenance of non-primary national standards as an alternative to full devolution.</p> <p>Ensure overall metrological robustness in Europe is not compromised.</p> <p>Educate and liaise with customers to ensure overall quality of services that are devolved.</p> <p>Enter into appropriate service level agreements when devolving</p> <p>Where services can no longer be delivered float the idea of devolution with customers, collect data on utilisation of measurement services by national / international customers</p>	Review Guide 6	Strategic devolutions may require long-term commitments. Understand the concepts and work with and support the NMI where devolution is necessary.	
Limited sharing of NMI facilities	Increase sharing of facilities	Exchange information about key facilities and their utilisation. Develop schemes for increasing mobility of researchers.		<p>Review arrangements to enable non national access/collaboration</p> <p>Share information at an early stage on nationally planned future facilities</p>	In conjunction with road-mapping of objectives, identify which facilities can usefully be shared.

				investments Consider joint planning of facilities	
Planning and prioritisation: Collaboration is limited because national decision making occurs before collaboration is explored	Adjust the balance such that national decision making can take appropriate consideration of collaborative benefits when deciding on priorities	Adapt decision making processes to ensure benefits of collaboration can be considered when prioritising R&D projects at the national level	Facilitate sharing of appropriate information Provide a forum for decision makers	Adapt decision making processes to ensure benefits of collaboration can be considered when prioritising R&D projects at the national level	Promote and support links between the national metrology funding bodies and also directly with the EC
Failure of Framework Programme support for metrology and related R&D	The Commission has indicated the importance of measurement and testing R&D, but the current FP6 structure and instruments do not reflect this	Provide evidence of need and value of impact	Become a recognised interlocutor with the EC on metrology and M&T Collate information from the NMIs and lobby the EC	Ensure the value of metrology and related activities are distilled into proposals from the Member State to the EC during FP development.	Identify dedicated funding for metrology, measurement and testing in FP7
Ensuring the MERA findings are acted on	The MERA findings need to be digested and a response implemented	Contribute to EUROMET debate, support consensus, allocate resources to implement changes, lobby Ministries for support, Educate staff Develop clear understanding of “room for manoeuvre” – particularly associated with timely identification of collaborative opportunities Support the development of a proposal to the EC to implement the MERA findings	Distil findings and develop an implementation plan. Ensure “buy in” by NMIs Consider preparing a proposal to the European Commission to facilitate implementation	Support NMIs and EUROMET Develop clear understanding of “room for manoeuvre” – particularly associated with timely identification of collaborative opportunities Within this be prepared to adjust operating practices to facilitate more effective utilisation and impact through collaboration from the NMI investment	Review MERA findings Support implementation phase with funding for restructuring Support the implementation phase with R&D funding for collaborative projects

IMPLEMENTING MERA – THE IMERA ROADMAP

The conclusions of the MERA project point the way ahead for closer collaboration between the European NMIs. In particular, arrangements are needed to enable longer term underpinning R&D collaboration to be strategically planned, whilst greatly enhancing mechanisms to facilitate and enable shorter-term collaborations between NMIs. In addition, there is scope for further rationalisation of the calibration services provided by the NMIs and improved planning and sharing of major facilities.

The project recommends that facilitating R&D collaboration be moved to the heart of EUROMET activity. Currently EUROMET could be described as a collaboration involving the holders of national measurement standards. This collaboration has undoubtedly added value to the R&D performed in each NMI, although a number of factors limit its impact. MERA recommends that EUROMET should address these factors, which include planning cycles, variations in the ways of formulating and prioritising research, and restrictions on funding. In this way closer collaboration will meet the aspirations of individual NMIs, while developing a consortium of institutes engaged in measurement science R&D that will provide enabling metrology capability to other research fields in the ERA. Once implemented this will result in an increased contribution to the world-class development of European industry, and enhance efforts to maintain and improve quality of life.

EUROMET has taken some steps towards closer collaboration. Its strategy document commits EUROMET members to increasing their involvement in collaborative research, advance planning and notification of major investments, and a more structured and at times formal approach to the selective provision of services. However the roadmap for this collaboration is not well developed because of the uncertainty associated with the above factors, and the limited resources available to address them. Without specific goals and objectives, the time required to implement fully an integrated European Metrology Infrastructure (EMI) which will meet national as well as European needs is likely to remain indeterminate.

In order to maintain progress towards an EMI in a shorter timescale, a clear plan to remove the obstacles, which have been identified, is essential. The roadmap indicates how a project to implement the MERA recommendations would achieve this through a number of workpackages addressing the major issues and facilitating collaboration on a shorter timescale. In this way, with clear signposting, specific milestones, and the necessary additional resources, real progress in the form of a substantial joint research portfolio could be expected to be achieved within five years.

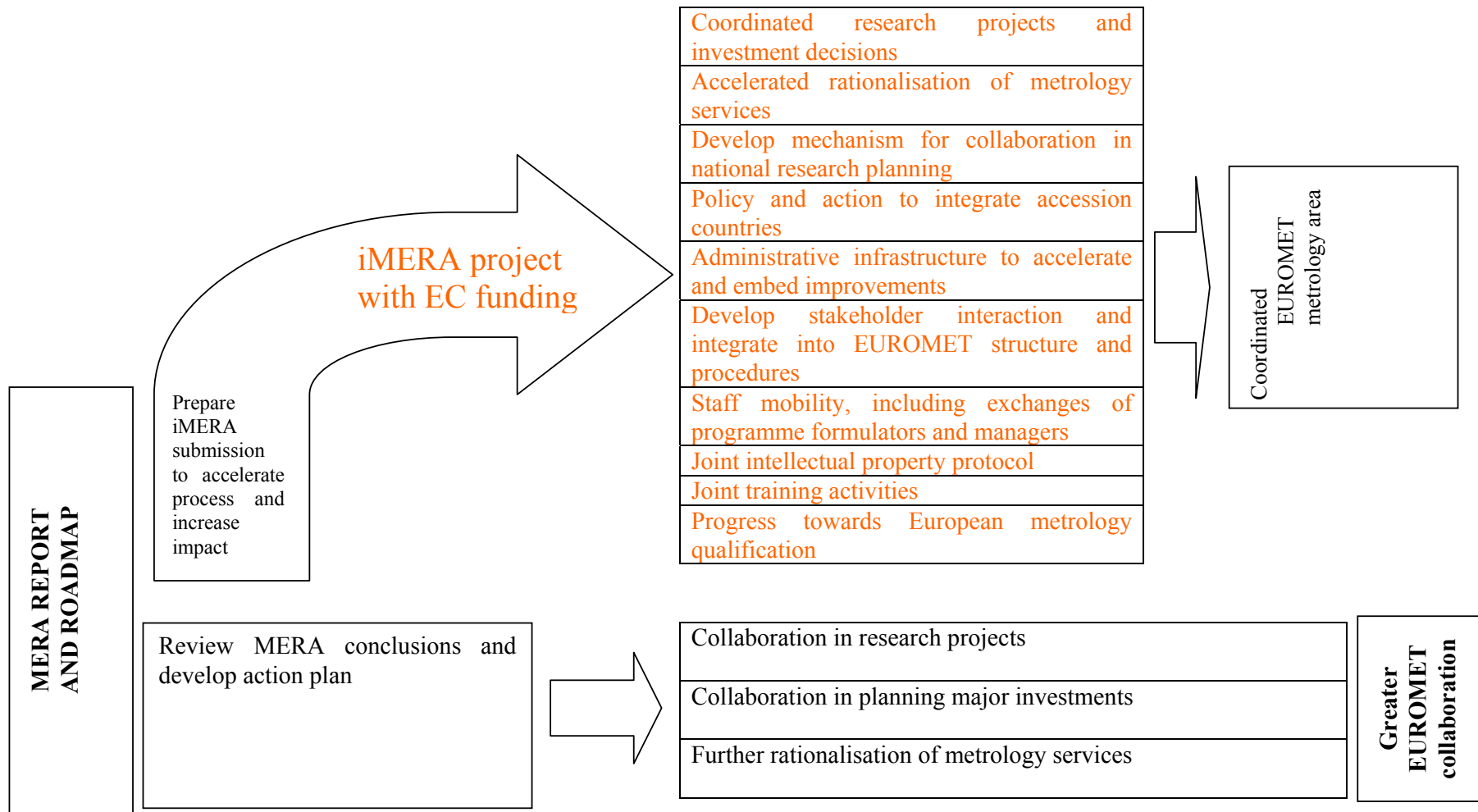


Figure 18: Roadmapping the options for implementing MERA

9. ACKNOWLEDGEMENTS

The resources required to complete the MERA project were considerably greater than the funding, with activities such as the national analysis conducted entirely with NMI funding. Therefore the project would like to thank the NMIs and Ministries that provided additional resources for the project.

The project team would also like to acknowledge:

Representatives from industry, regulators and other stakeholders took the time to contribute to the various questionnaires.

The NMIs and designated laboratories that are not partners in the project gave up their time to attend the workshop and provide comment to the partners.

The project team would like to acknowledge the support from the European Commission Framework Programme 5 Competitive and Sustainable Growth Programme.

10. REFERENCES

- [1] See EUROMET website: www.euromet.org
- [2] See BESSY website: www.bessy.de
- [3] See BIPM web site: www.bipm.org
- [4] The Calibration and Measurement Capabilities as defined in the CIPM MRA and are available in the Key comparison database (KCDB) on the BIPM website.
- [5] See website: www.daniamet.dk
- [6] See project COUNT website: <http://www.count.nl>
- [7] See PREST website: <http://les.man.ac.uk/PREST/>

ANNEX A – STATE of the ART REVIEW (WORKPACKAGE 1) REPORT

The objective of this workpackage was to develop a clear understanding of the current level of cooperation between the National Metrology Institutes (NMIs) in Europe. The work involved a review of the EUROMET projects as listed on the EUROMET database, a review of information on traceability arrangements as shown in the airline maps and analysis of data included within EUROMET Calibration and Measurement Capabilities (CMCs).

The review was undertaken across the spectrum of NMI activity and based on the EUROMET Technical Committee designations:

- Acoustics, Ultrasound and Vibration
- Metrology in Chemistry
- Electricity and Magnetism
- Flow
- Ionising Radiation
- Length
- Mass and Related Quantities
- Photometry and Radiometry
- Thermometry
- Time and Frequency
- Interdisciplinary

1-EUROMET projects:

The review was undertaken using the data available in the EUROMET projects database in November 2000. The EUROMET projects can be in a proposed, agreed or completed stage and they are declared for the 10 quantities plus Interdisciplinary Metrology. There are 4 types of EUROMET projects and these are described below:

–Comparisons

–Traceability: one national metrology institute (NMI) takes formal traceability from another.

–Consultation: at the heart of EUROMET is the policy that each member, on an equal partner basis, will cooperate with other members and makes its knowledge available to other EUROMET members.

–Cooperation: Cooperation in research but also includes the exchange of information between partners in expert meetings and a multitude of other activities.

Figure 1 shows the total number of projects (agreed, proposed and completed) per year since the establishment of EUROMET in 1988. Figure 2 shows the evolution of the number of active projects per type since 1993. Figure 3 to Figure 6 show the number of projects (proposed-agreed-completed) per quantity for each of the 4 project types.

Since the establishment of EUROMET in 1988, the number of agreed projects has increased, with between 20 to 45 projects being proposed each year from 1992 onwards (with a peak of 71 in 2000); the repartition of the projects per quantity is shown in Figure 3 to Figure 6. From Figure 2 it can be seen that although the number of active projects in traceability and consultation has remained relatively constant, the focus on the CIPM Mutual Recognition Arrangement activities clearly seen from the increase in the number of active comparisons. Figure 2 also shows a high number of active cooperation type projects including a slight increase in 2000. Cooperation within EUROMET therefore does exist and work but still tends to be undertaken on an ad-hoc basis and a more systematic approach would be beneficial. An example could be taken from the European Commission Fifth Framework Programme where projects have formal start and finish dates, a defined work programme and defined responsibilities. Many EUROMET projects are undertaken and completed without this formal EC support and framework, however the risk of project “drift” is noticeably increased.

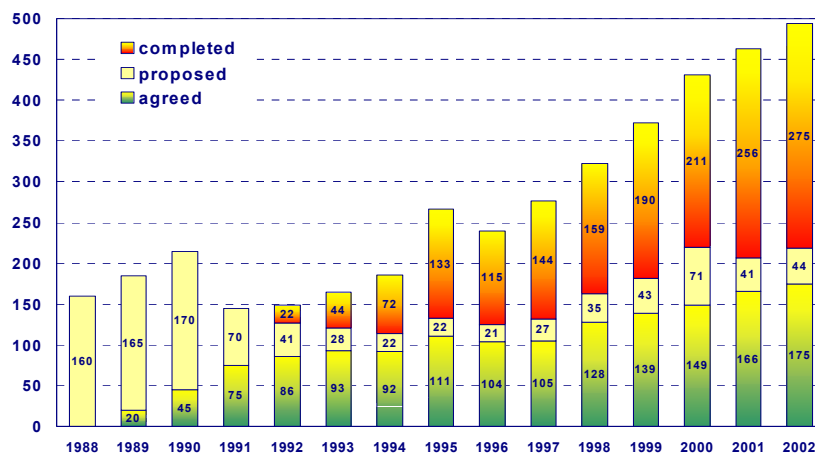


Figure A1: Evolution of the EUROMET projects since 1988

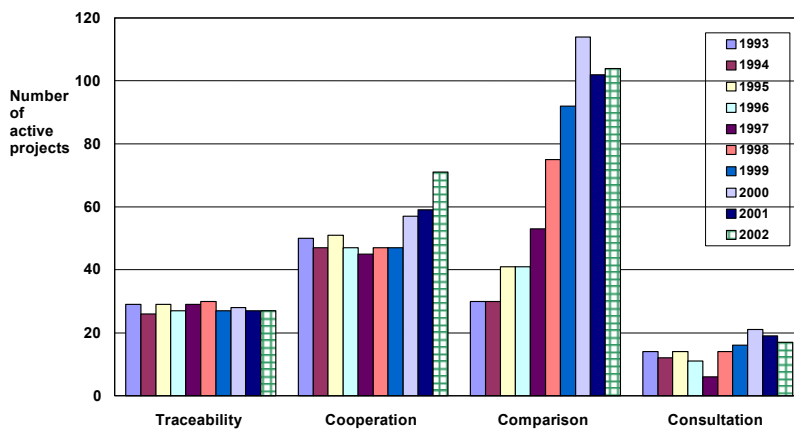


Figure A2: Development of active projects 1993-2002

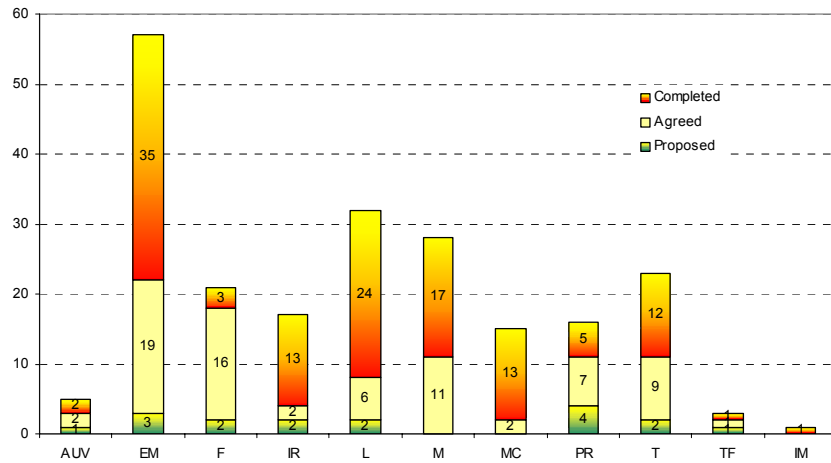


Figure A3: EUROMET Comparisons projects

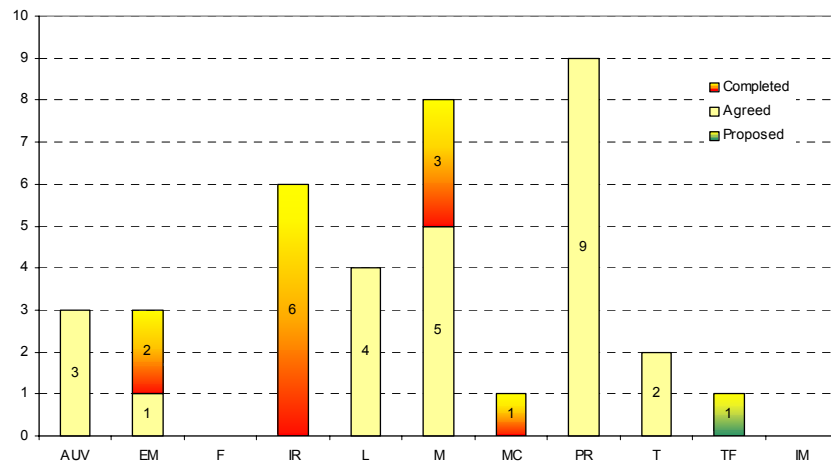


Figure A4: EUROMET Traceability projects

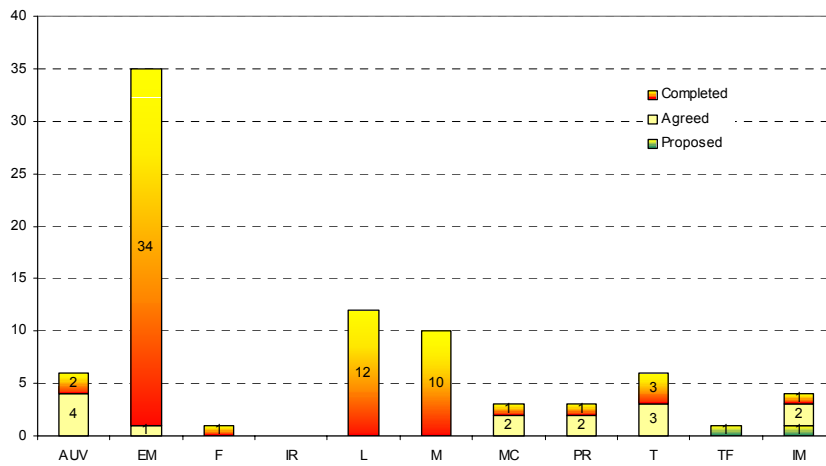


Figure A5: EUROMET Consultation projects

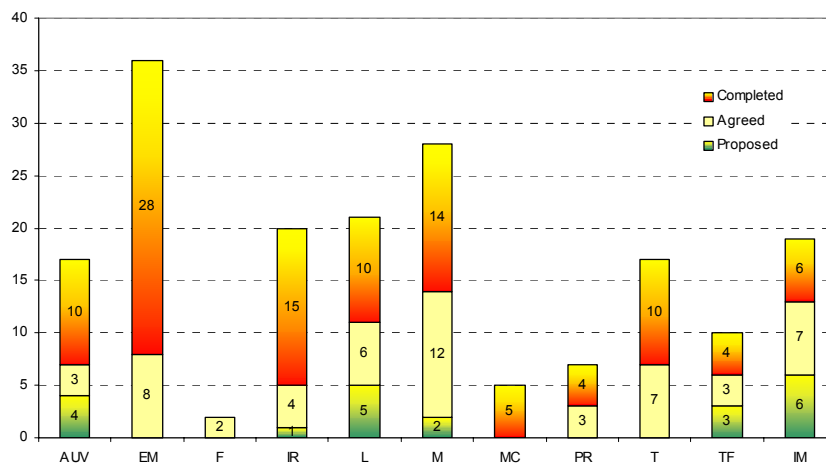


Figure A6: EUROMET Cooperation projects

2- Calibration and Measurement Capabilities (CMCs) and the airline maps

As a consequence of the MRA, the NMIs are required to declare and subject their Calibration and Measurement Capabilities (CMCs) for extensive peer review. The CMCs tables as circulated between the RMOs Contact Persons contains details of traceability between NMIs, that is where an NMI chooses not to carry out a primary realisation but holds a national standard traceable to a primary standard at another NMI. Using this information, the percentage of CMCs entries traceable to another NMI was calculated (Figure 7 and Figure 8). The airline maps (Figure 9) show all traceability arrangements (agreed, planned, possible etc) existing between NMIs within EUROMET (also include BIPM and companies).

The two sources of information show that it is quite common for NMIs within EUROMET to seek and obtain traceability from other countries, although this tends to be less common for the larger NMIs as shown in Figure 8 where only 0.6% of CMCs at PTB for example are traceable to another NMI. The airline map for Electricity and Magnetism (Figure 11) however demonstrates that Centres of Excellence exist and that they provide traceability to other NMIs in EUROMET.

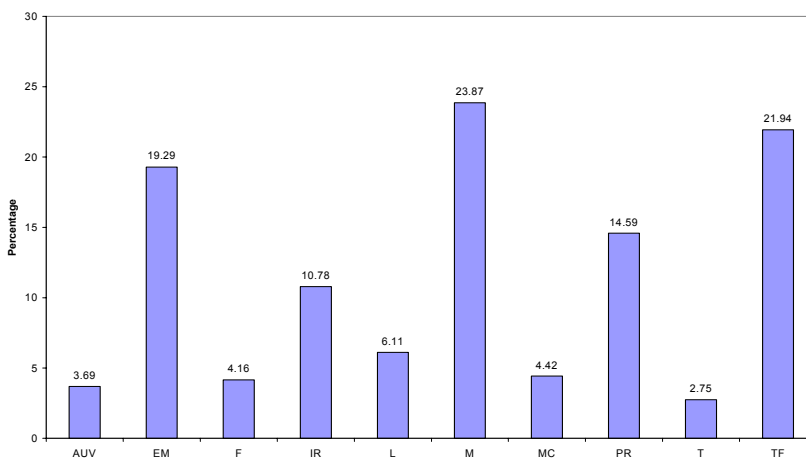


Figure A7: Percentage of CMCs traceable to another NMI in Europe

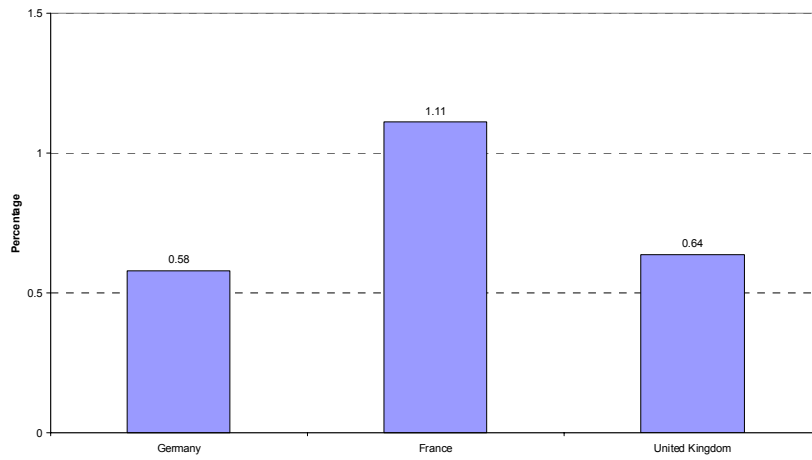


Figure A8: Percentage of CMCs entries, which are traceable to another NMI for 3 large European NMIs

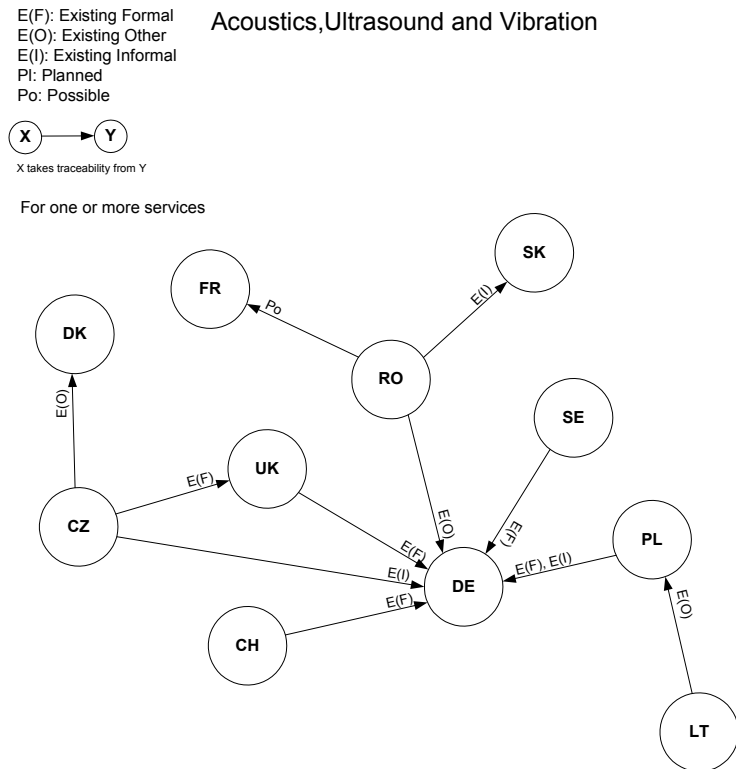


Figure A9: ‘Airline map’ for Acoustics, Ultrasound and Vibration

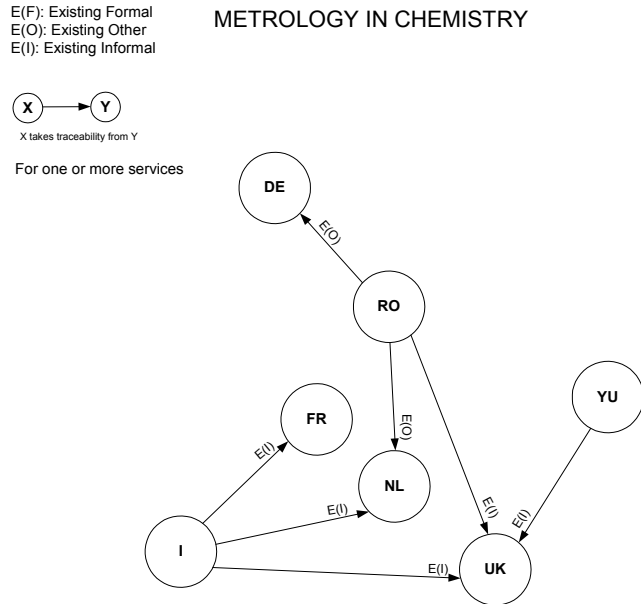


Figure A10: ‘Airline map’ for Metrology in Chemistry

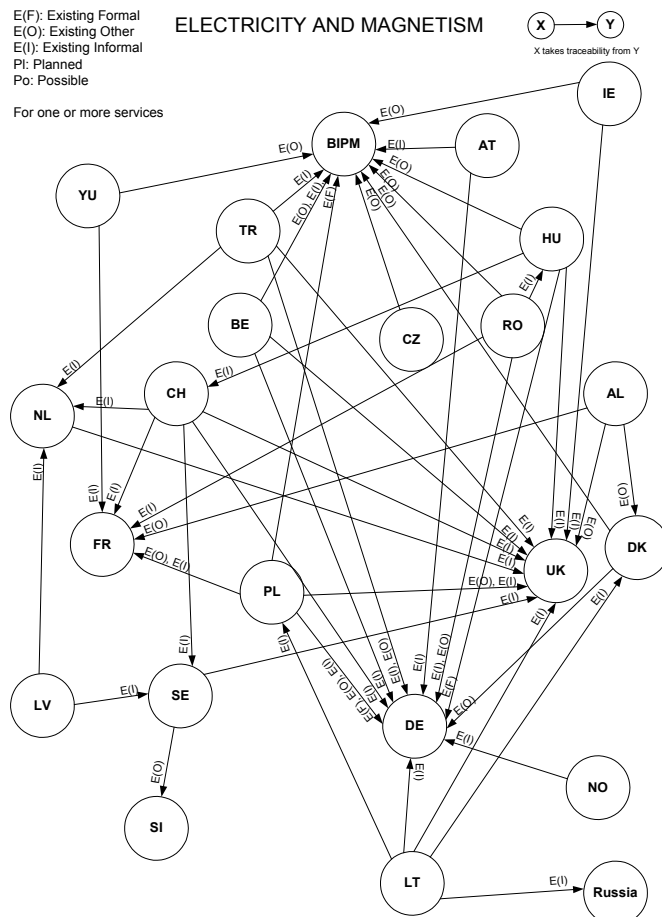


Figure A11: ‘Airline map’ for the quantity Electricity and Magnetism

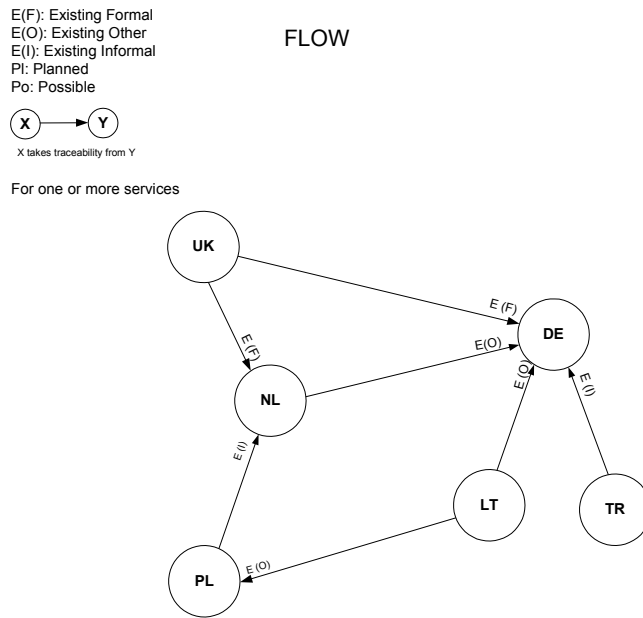


Figure A12: ‘Airline map’ for Flow

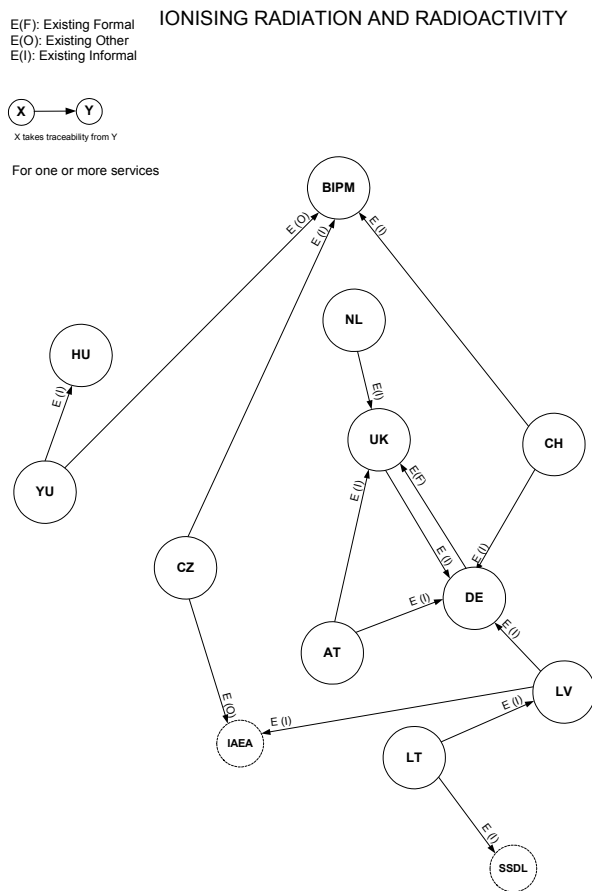


Figure A13: ‘Airline map’ for Ionising Radiation and Radioactivity

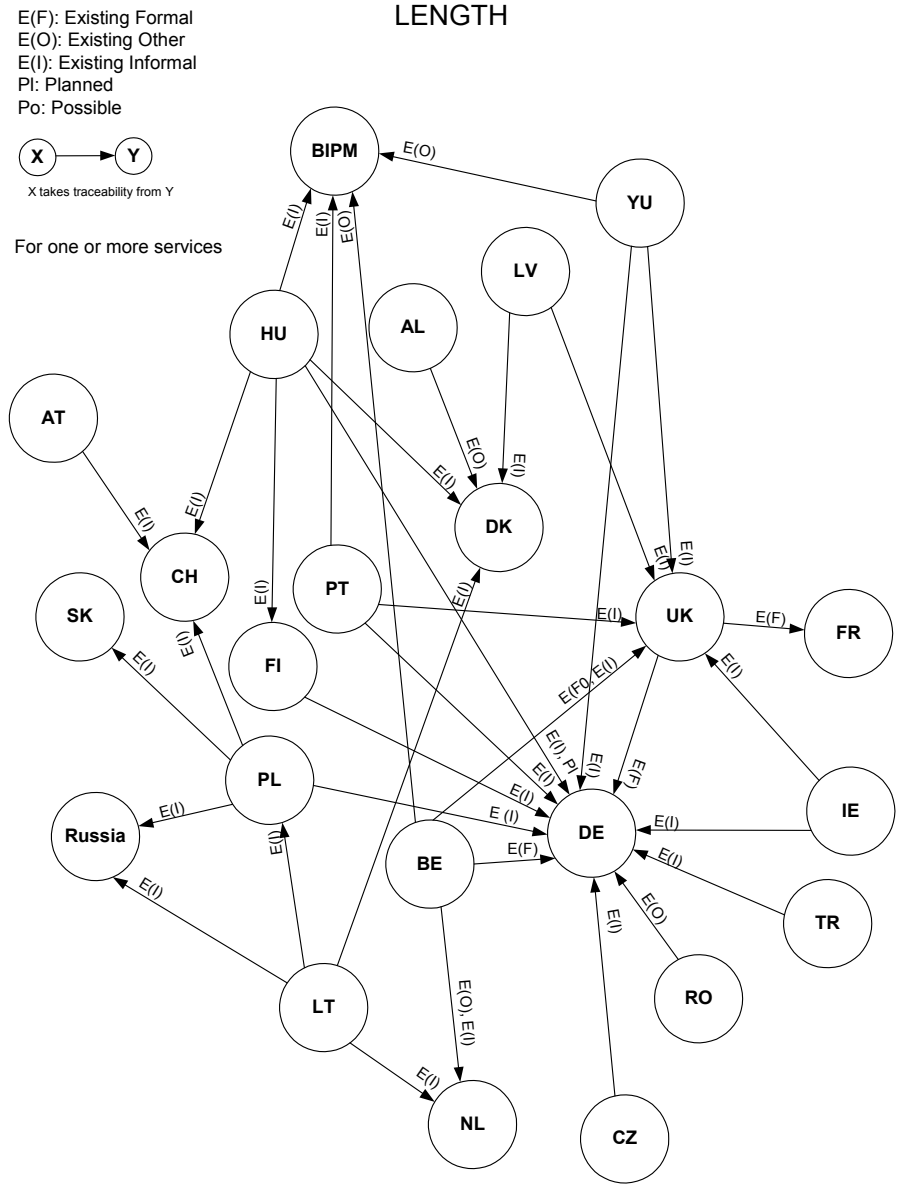


Figure A14: ‘Airline map’ for Length

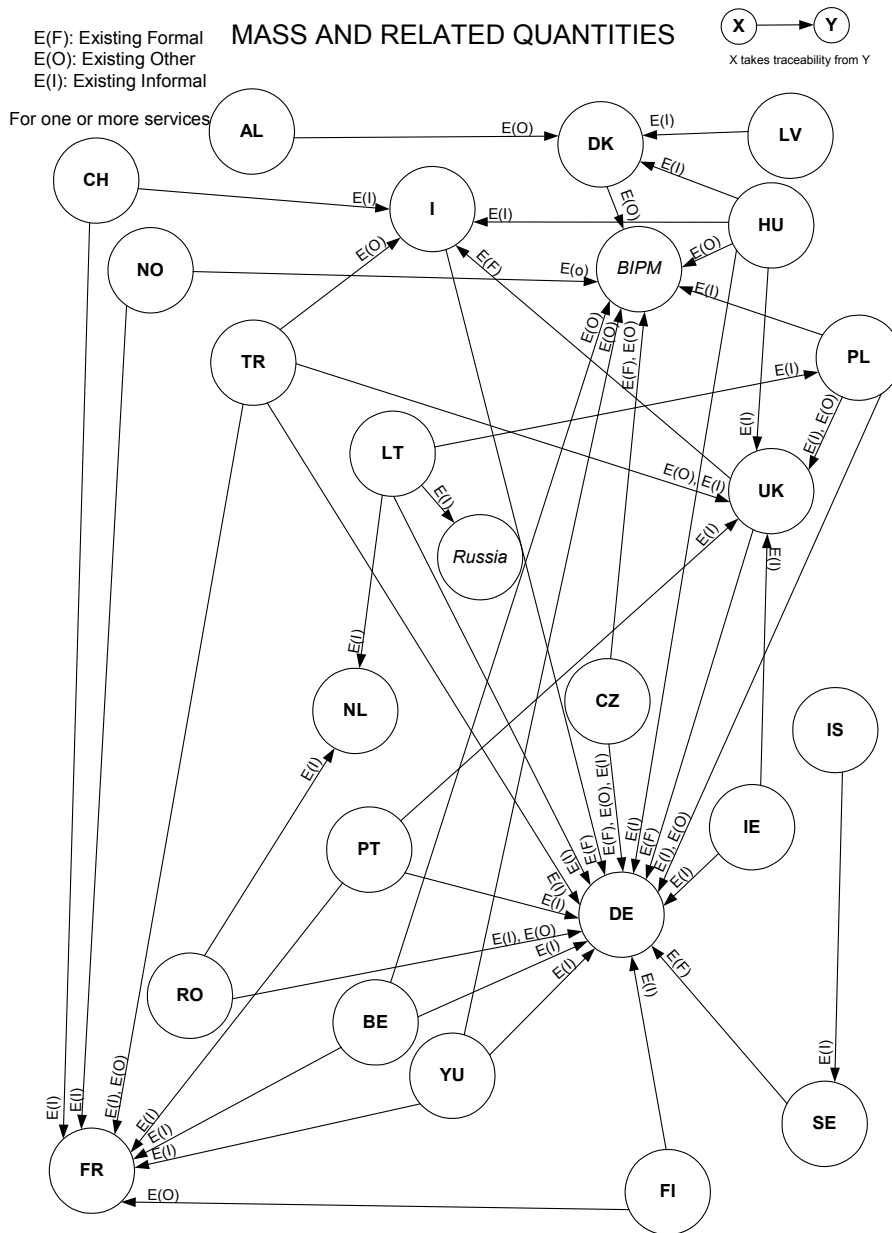


Figure A15: ‘Airline map’ for Mass and Related Qualities

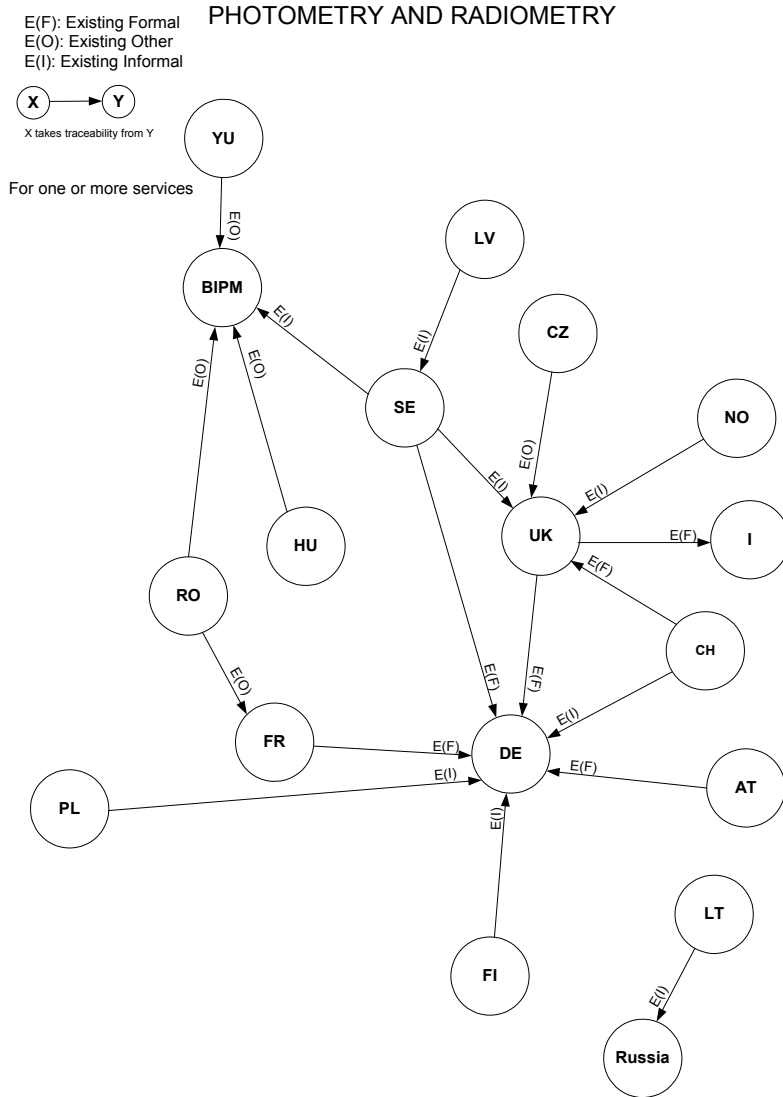


Figure A16: ‘Airline map’ for Photometry and Radiometry

E(F): Existing Formal
 E(O): Existing Other
 E(I): Existing Informal

THERMOMETRY



For one or more services

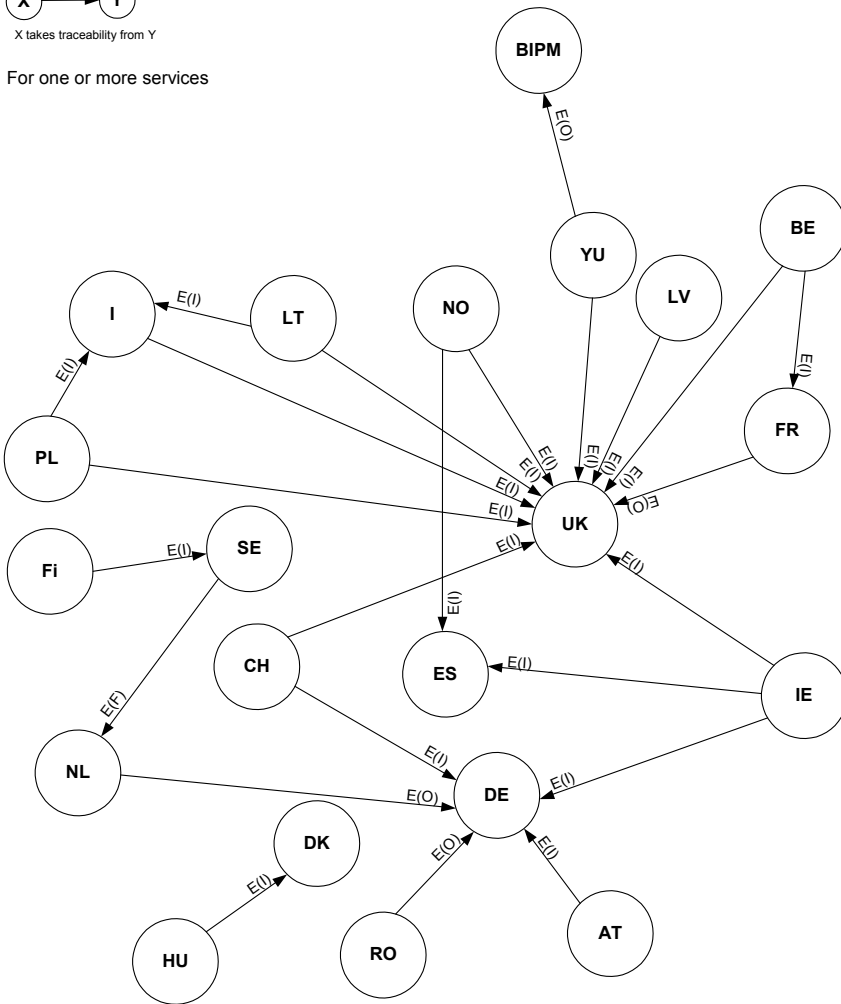


Figure A17: ‘Airline map’ for Thermometry

E(F): Existing Formal
E(O): Existing Other
E(I): Existing Informal

TIME AND FREQUENCY



X takes traceability from Y

For one or more services

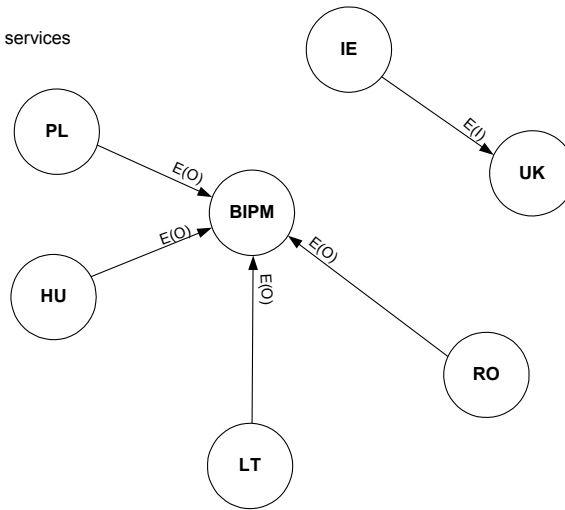


Figure A18: ‘Airline map’ for Time and Frequency

ANNEX B – FINAL REPORT ON WORKPACKAGE TWO: TRENDS ANALYSIS

ABSTRACT

A core element of the MERA project is the identification of the technical trends and challenges, which will have to be addressed by National Metrology Institutes (NMIs) into the future.

This report proposes to identify the main thrust of metrological research, for the next decade in Europe. The National Metrology Laboratory (NML), Enterprise Ireland, is a partner to the MERA project and has responsibility in leading this work package.

Chapter One gives some background to the work package and the rationale for undertaking this task. It then briefly sets out the underlying principles of this study and defines the objectives of the work. Following this, the remainder of the report is as follows.

In Chapters Two, the broad methodology for the study is outlined, describing the three-pronged approach to collecting and evaluation information.

Chapter Three, Four and Five contain the actual list of identified trends. Chapters Three and Four covers projected future trends in the traditional metrological research areas per conventional EUROMET subject field (subdivided into research which is market driven and that which is long-term, underpinning research). Chapter Five lists possible R&D topics in new metrological research areas.

In Chapter Six, both the review and the analysis of issues are synthesised into a set of conclusions as to what is needed to catalyse the priority areas of metrological research over the next decade.

1. INTRODUCTION

1.1 Background

At the 16th EM-GA, Delegates endorsed the EUROMET strategy 2002. The core aims of the strategy are to intensify current EUROMET research cooperation through greater collaboration in research, shared use of facilities, increased mobility of researchers as well as more effective exploitation of research. Currently, NMIs are more strongly focused on national research needs and address these needs with limited national resources. The MERA project aims to expand this vision to one that takes into account European needs but which continues to encompass the principle of subsidiarity for local national needs. The project represents the European metrology community planning for its contribution to the European Research Area (ERA). A key element in fostering this increased collaboration is firstly to evaluate current collaborative research between NMIs and then to identify future research trends and topics in metrology over the next decade.

1.2 Objectives of this study

The first objective of this ‘Trends analysis’ report is to establish the metrology research topics that are deemed to be a priority for Europe over the next decade. Secondly, to list the research topics that can be consulted when discussing potential future collaborations⁹ and to undertake an initial identification of those topics where NMIs currently have significant capability and express a willingness to collaborate.

2. METHODOLOGY

⁹ The MERA project is split into eleven Work-Packages (WP’s). This report is WP2. For more information, see the ‘technical Annex’ of the MERA report

2.1 Tackling the objectives

In order to establish how metrology could identify the main thrust of metrological research for the next decade, NML undertook a number of surveys, meetings and workshops. It also undertook a comprehensive literature and Internet search.

2.2 Methodology

The first task in projecting the metrological needs in the future was to examine the manufacturing and technological advances predicted into the future. This was done by utilising international and EU Foresight studies which had been available. To assist us in the collection of Research & Development trends in metrology, it was decided to undertake a survey of all EUROMET member NMIs and Corresponding Applicant NMIs.

EUROMET Technical Committee Chairmen (for the subject fields of Acoustics, Electricity & Magnetism, Flow, Ionising Radiation, Length, Mass, Photometry/Radiometry, Temperature and Time & Frequency) were also consulted. These parties were asked to report on the current metrological research being undertaken in their respective NMI and to give some projection on major areas of metrology R&D in the future. Other organisations surveyed in this way were:

- Bureau International de Poids et Mesures (BIPM)
- NMIs from regions outside of Europe
- Other RMOs.

In addition to these sources a number of foresight studies produced by the High Level Expert Group of the Standards, Measurement & Testing division in the EU 5th Frame work Programme were consulted. The output from these surveys and analysis allowed NML produce an initial set of metrology research topics subdivided into:

- Research resulting in an incremental development of existing capability
- Research in new areas of metrology.

This preliminary list of research topics was presented to EUROMET delegates and Corresponding Applicants at the 1st MERA Workshop in Rotterdam in December 2002. A ‘brainstorming’ session during this workshop enabled delegates and Corresponding applicants to discuss the trends identified and to add to the list, modify the trends identified and prioritise them.

An interim report, listing the updates research trends, was circulated to EUROMET member NMIs and NMIs from the Corresponding Applicants. The NMIs were requested at this stage to detail their current R&D capabilities in these research areas and to highlight their potential for collaboration with other NMIs in these research fields.

This second survey of NMIs allowed NML to undertake a further prioritisation exercise and produce a list of research topics which can consulted and used as a reference source.

The research trends identified can be divided into three distinct areas:

- Research trends – developments in existing capabilities
- Research Trends – Long term underpinning research
- Research trends – new research areas.

3. RESEARCH TRENDS – DEVELOPMENTS IN EXISTING CAPABILITIES

3.1 Acoustics, Ultrasound & Vibration (AUV)

- Calibration/ Comparison of microphones/ hydrophones:
 - Different frequency ranges
 - High pressure levels
 - Under extreme environmental conditions
- Development and calibration of:
 - Smaller transducers and sensors
 - New generation of ultrasonic hydrophones.
 - Standards for acoustic emissions
- Research relating to ultra-sound in the medical and surgical fields.
- Establish and validate acoustic interferometer.

3.2 Electricity and Magnetism

- DC & LF Standards:
 - Development of fully programmable Josephson standards in the range -10V to $+10\text{V}$
 - Realisation of capacitance standard and development of high sensitive detectors based on SET.
 - Research to improve HF Impedance calibration.
- RF:
 - Development of specific technologies for high frequency up to the terahertz region
 - Development of reference electromagnetic fields up to 18GHz
 - Development of cryogenic, quantum & digital standards.

3.3 Flow

- Development of standards for warm water, including improving uncertainty of ‘Laser Doppler Velocimetry’
- Analysis of ‘Coriolis’ meters for mass, volume & density of liquids other than water
- Ultrasonic Technology - development of standards and methods for low gas flow rate
- Multiple & multicomponent measurements
- Computer modelling of fluid flow phenomena in systems & measuring instruments.
- Research in improving measurement of air speed.

3.4 Ionising Radiation

- Measurement of ‘Tritium’ (water & organically bound)
- Standardisation of radionuclides for radiopharmaceuticals
- Industrial low energy electron dosimetry
- Research in the field of medical dosimetry
- Cosmic ray dosimetry.

3.5 Length

- Primary Standards Research:
 - Femtosecond combs
 - Comparison of microwave frequency standards & optical frequency standards.
- Metrology for 3D structures in meso-scale to micro-scale region
- Flatness interferometry / super-smooth surfaces.

3.6 Mass & Related Quantities

3.6.1 Pressure

- Improving performance of pressure transducers
 - More stable
 - Low pressure
 - Robust
 - High pressure / high temperature operations.
- High pressure interfaces
- Improved Standards below a few kPa.

3.6.2 Density

- Development of equipment linking secondary to primary density standards
- Improved uncertainty of liquid density (≤ 3 ppm).

3.6.3 Force and Torque

- Dynamic force and torque measurement – development of improved instrumentation with smaller uncertainty
- Multi-component force measurement.

3.6.4 Viscosity

- Viscosity standards and measurements in the range –40oC to +150oC.

3.7 Photometry/ Radiometry

- Realisation of primary spectral scales in Air UV, visible & mid IR
- Radiometric & photometric application of display technology
- Research in fibre optic communication.
- Research on:
 - Band gap materials
 - Light emitting materials
 - Novel photonic materials.
- Improvement of uncertainty in a range of photometric / radiometric parameters.

3.8 Thermometry & Humidity

- Implementation of new temperature scale:
 - Radiometry thermometry lower temperature
 - Implementation of low temperature extension PLTS-2000.
- Improved uncertainty for surface temperature measurements
- Humidity:
 - Improved uncertainty for humidity calibration
 - Low vapour pressure extensions.

3.9 Time & Frequency

- Improved uncertainty for time scale
- Development of new and improved frequency standards.

4. RESEARCH TRENDS – LONG TERM UNDERPINNING RESEARCH

While much of the metrological research work can be classified as market driven research, which results from a demand from users of metrological services to improve measuring range, measurement uncertainty or flexibility of measurement instrumentation, it is also vital that basic, underpinning Research and Development in metrology should be undertaken. The following is a list of long term, underpinning R&D topics, which were identified during this analysis work package:

- Redefinition of the kilogram
- Research to link S.I. unit of electric current to the fundamental constants
- Research on clocks and pulses:

- Trapped ions or cold atoms
- Fountains
- Short pulse technology.
- Research on Fundamental Constants:
 - Planck
 - Avogadro
 - Boltzmann.
- Temperature scale
 - Development of new/ improved fixed points
 - Research to link S.I. unit of temperature to the fundamental constants.
- Particle Physics
 - Single electron
 - Single photon.
- Quantum physics
 - Quantum magnetometers
 - SQUIDS.

5. RESEARCH TRENDS – NEW RESEARCH AREAS

5.1 Nanometrology

- Development of nanometrology tools in dimensional metrology:
 - Development of scientific instrumentation
 - Development of validated measurement procedures
 - Development of traceable measurement standards
 - Development of written standards.
- Research in chemical analysis in the nano range
- Research in nano force measurement:
 - New instrumentation and sensors
 - Measurement standards in the nN area.
- Use of Nano dimensional measurements in bio-molecular technology:
 - Surface morphology of blood gas sensor membranes
 - Surface structure of hypodermic needles
 - Surface and sub-surface structure of catheters and skin adhesives (block co-polymers)

- Distribution of active sites (recipient molecules) in diagnostic testers (bioassays, biosensors).

5.2 Metrology in Chemistry

- In the Metrology in Chemistry field there are two distinct groupings:
 - Countries who have yet to develop a Metrology in Chemistry Infrastructure. Many countries have a requirement to develop measurement standards and instrumentation for the common areas of measurement. Some cooperative initiatives, in conjunction with NMIs that already have an existing Metrology in Chemistry infrastructure, would be beneficial in allowing NMIs set their priorities in these areas and also facilitates sharing of facilities.
 - NMIs who have a Metrology in Chemistry infrastructure in place and wish to undertake cooperative research. The research priorities include the development of:
 - Pure substances for metrological applications
 - Certification of reference materials
 - Isotope labelled compound
 - High-level reference standards in new areas, linked to working level reference materials.
 - Traceable reference materials and procedures in the field of clinical chemistry.
- There is also a desire to share large, expensive facilities between NMIs. Sharing of trans-national facilities have been identified for:
 - High resolution NMR
 - Adiabatic calorimetry
 - Primary mass spectrometry.

5.3 Metrology in Biotechnology

- New concepts / standards for the structure & validation of databases for biotechnology, molecular, biology and medicine
- Standard procedures and traceable reference materials.
- Bio-electric and bio-magnetic measurements
- Measurement and screening techniques based on DNA.

5.4 I.T and Software in Metrology

- Internet calibration – increased applications and measurement fields
- Uncertainty evaluation
- Software validation – development of standard methods and tools

- Development and sharing of metrology software libraries.

6. COLLABORATIVE POTENTIAL

A key element in the second survey undertaken by the NMIs was to identify existing areas where they have significant research capability and also those areas where there was a strong willingness to collaborate with other NMIs. The NMIs were requested to do this by nine of the existing ten EUROMET subject Fields (Metrology in Chemistry was included in the emerging fields) and those emerging fields of Nanometrology, Metrology in Chemistry, Metrology in Biotechnology, It and software in Metrology.

The result of this survey indicated that many NMIs have significant capability across a number of subject fields. They also indicate a strong willingness to collaborate with other NMIs in many of these fields. Other countries have limited research capability but have expressed a willingness to collaborate in research activity in the future. Figures One and Two below indicate the results obtained.

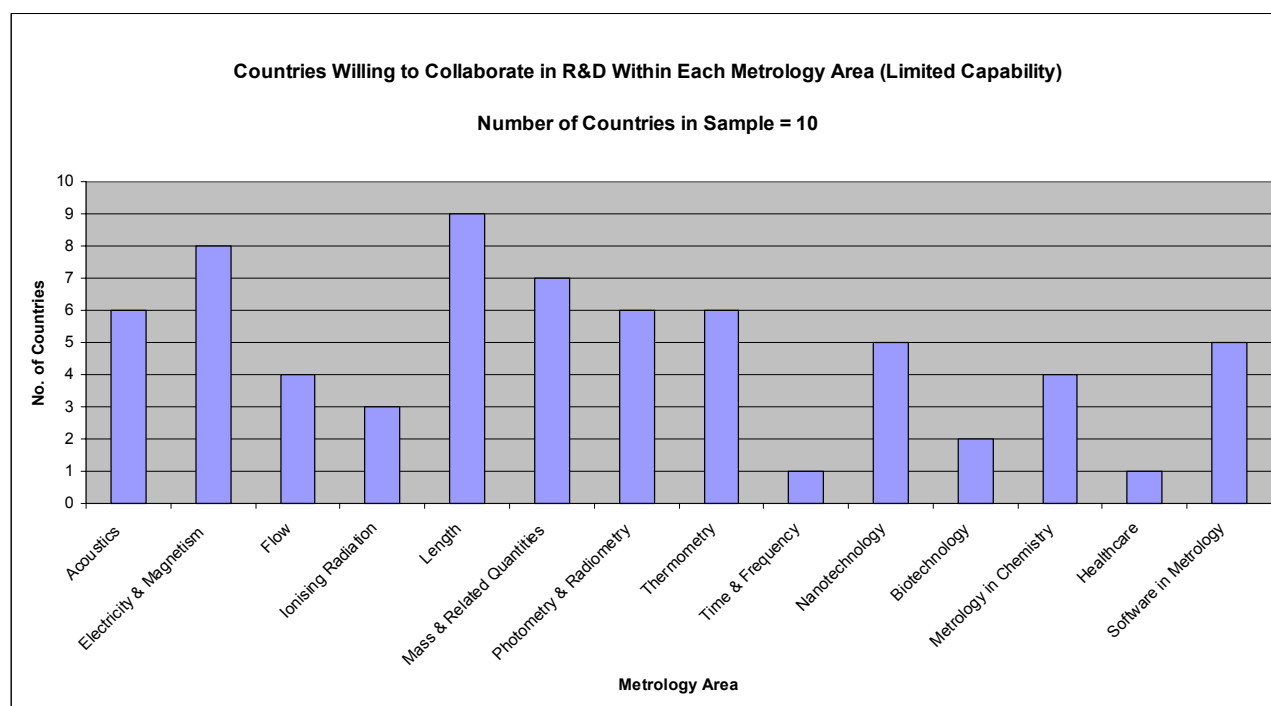
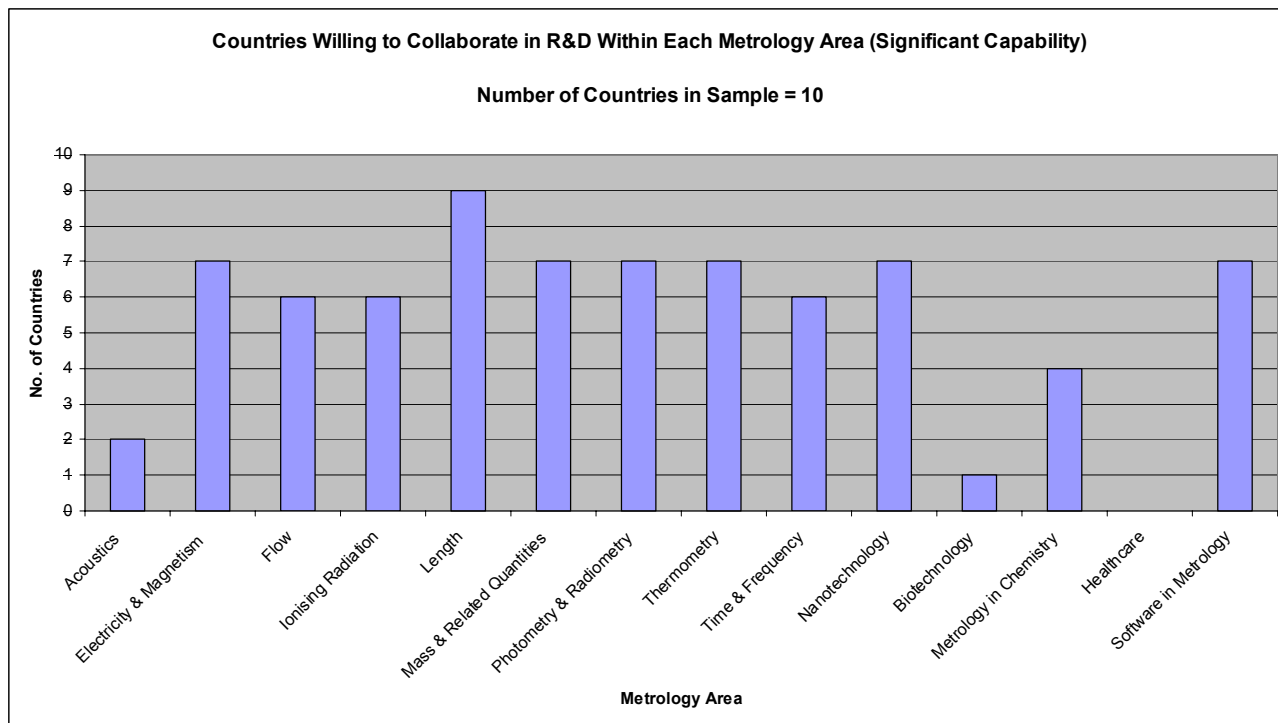


Figure B1: Countries willingness to collaborative – Limited Capability



7. SUMMARY

The list of research topics presented in this document represents a summary of the key topics identified during the analysis. The topics have been identified by those experts working in EUROMET NMIs, NMIs outside of Europe in addition to BIPM and the ‘High Level Expert Group’ of the EU. The topics identified fall into three distinct categories:

- Metrology research in areas where NMIs currently have capability – market driven research
- Metrology research – long term, underpinning research – not market driven
- Metrology research in new and emerging areas.

From the data collected in the study there is significant existing capability in R&D and a strong willingness to collaborate in the following fields:

- Acoustics
- Electricity & Magnetism
- Length
- Mass & related quantities
- Thermometry
- Photometry & radiometry
- Nanotechnology
- Software in Metrology.

This level of capability and potential for collaboration gives European metrology a sound foundation on which to build its cooperative research in metrology and contribute to a harmonised, more efficient research infrastructure in Europe.

Paul Hetherington

EUROMET Chairman, Dublin – 5th September 2003

ANNEX C – DEVELOPMENT OF A TOOL FOR THE ASSESSMENT OF EUROPEAN NATIONAL MEASUREMENT SYSTEMS

1. INTRODUCTION

Workpackage 3 of the MERA project requires the development of a tool to enable European NMIs who consider the issue sufficiently complex to analytically carry out a national assessment of the needs of the National Measurement System (NMS) of their country, seeking to identify priorities areas. One of the purposes of these assessments was to provide input to the planning of a Metrological European Research Area, making it possible to consider rationalisation of provision across Europe, based around NMI specialising in fields for which there is a national priority, and devolving work to other NMI, where there was still a national need but one that is less pressing. Such an approach works well where different countries have different national priorities, but it was also important to identify fields in which all NMI might withdraw leaving Europe dangerously exposed, so that these can be planned for and are covered by at least one European NMI.

Rationalisation of the capability of European NMI is becoming increasingly important because of the increasing demands being made by industry, science and government on the NMS of European countries, both from the increasing complexity of requirement from established technologies and from new requirements to support emerging technologies, e.g. biotechnology and nanotechnology.

NPL was asked to develop this tool, which could be made available to all European NMI, to assist in the national assessments. The tool was specifically targeted at providing a better understanding of the issues constraining countries from a greater specialisation, and a greater devolution, of capability. **Specialisation** is defined as the establishment of a European centre of excellence, on which many countries across Europe can depend. **Devolution** is defined as a withdrawal of a national capability and the reliance on a centre of excellence at a foreign NMI. Devolution could be the complete withdrawal of any capability at the NMI, with industry relying directly on standards from a foreign NMI, or might be achieved by the NMI maintaining national, rather than primary standards, the national standards being traceable to primary standards (and the associated R&D that support them) from a foreign NMI.

Smaller NMIs do not connect a national assessment strongly with specialisation and devolution. They may see a national assessment as just identifying those fields in which to develop national capability and those not. However, making such decisions de facto establishes devolutions for all other quantities to other NMI, although not in any formalised way. Therefore, a national assessment can be characterised through an analysis based around issues linked to specialisation and devolution.

Different NMIs and different countries may also choose differing levels of exposure of the results of their analysis, depending on the strategic perspective within the NMI and their Ministries.

A comprehensive review of the national requirements for the whole NMS of a country, and the scope for specialisation and devolution, requires the establishment of common criteria and procedure for the purpose. This is a challenging task, given the broad coverage of an NMS. Therefore, one of the key activities of this study was to develop a suitable tool and procedure for this review.

One of the characteristics of European NMIs is the diversity of the arrangements national governments use to maintain them. Structures range from NMIs that exist as private companies recognised by their government as the NMI, to NMIs that remain fully part of government. Some countries have a single institution that covers most of the NMI, others have a highly dispersed arrangement of a multiple of laboratories making up the NMI. For some aspects of this study it was necessary to make some

assumptions about the relationship that exists between the government that funds the R&D and maintenance work of the NMI, and the NMI itself. It has been assumed that the NMI has some level of autonomy from government, and that it has an interest in earning income from services it provides to third parties, referred to below as third party income. Also that the NMI will receive direct benefit from reductions in running costs, including the costs of servicing the capital investment of facilities. These assumptions may not be justified for a few European NMI that remain very closely tied to their national government, and these NMIs may wish to modify the tool by removing criteria that are not relevant to them.

2. OBJECTIVE OF STUDY

To develop, and make available a tool to assist European NMI to carry out a national assessment of requirements for their NMS, with a particular emphasis on increasing the understanding of constraints on, and opportunities for specialisation and devolution of capability.

Note that it was not the purpose of this study to implement any specialisation or devolution of standards between the NMI of Europe, but the tool should set the context for choices and negotiations for greater specialisation and devolution in the future.

3. ANALYSIS

The assessment of the requirement for a NMS of a country provides a number of challenges:

- The comparison of the requirements for very different measurement quantities, i.e comparing “*chalk and cheese*”;
- The segmentation of the coverage of the NMS into manageable parts for the analysis;
- The identification of the criteria that determine the case for specialisation and devolution;
- The unavailability of data to make an assessment on a common basis across the whole NMS;
- Scepticism from the experts working on an NMS of a country that it is possible to devolve anything to a foreign NMI.

The purpose of this study is, therefore, to identify a suitable methodology for the analysis, and to develop a tool for the purpose that could be made available to all NMI in Europe.

3.1 MCDA Tool

Multi-Criteria Decision Analysis (MCDA) is a well-established technique which provides a suitable methodology for this study. Information about this technique can be found in reference 1, Multi-Criteria Analysis – A Manual, published as DETR Appraisal Guidance. MCDA has been developed specifically for the comparison of options which cannot be evaluated solely on financial attributes; i.e. it has been developed to enable the comparison of “*chalk and cheese*”.

MCDA is carried out through a number of stages:

- a) Establishing the decision context;
- b) Identify the options to be appraised;
- c) Identify objectives and criteria;
- d) “Scoring”. Assess the expected performance of each option against the criteria. Then assess the value associated with the consequences of each option of each criteria;

- e) “Weighting”. Assign weights for each criteria to reflect their relative importance to the decision;
- f) Combine weights and scores for each option to derive an overall value;
- g) Examine results;
- h) Sensitivity analysis.

a) comes directly from the purpose of the study, to assess different parts of the NMS of a country for its suitability for specialisation and devolution. The options to be appraised, stage b), are specialisation, devolution, or something in between. These will be specified more precisely in the next section. The objectives, criteria, scoring and weighting must all be carefully chosen to fully scope the problem whilst giving appropriate importance to all the issues involved. Guidance in the MCA Manual was followed to ensure that best practice was used for this study.

3.2 Utilisation of MCDA – Decision Analysis Tree

It was possible to simplify the MCDA process for this study by grouping the objectives in a “Decision Analysis Tree”. In this implementation, each objective is chosen as a question that can be either answered Yes or No. Figure 1 shows the Decision Analysis Tree developed for this study. Scoring is then carried out against criteria, which affect the answer to the question-objectives. Each criterion is given a weighting, which reflects its importance to that decision.

Decision Analysis Tree

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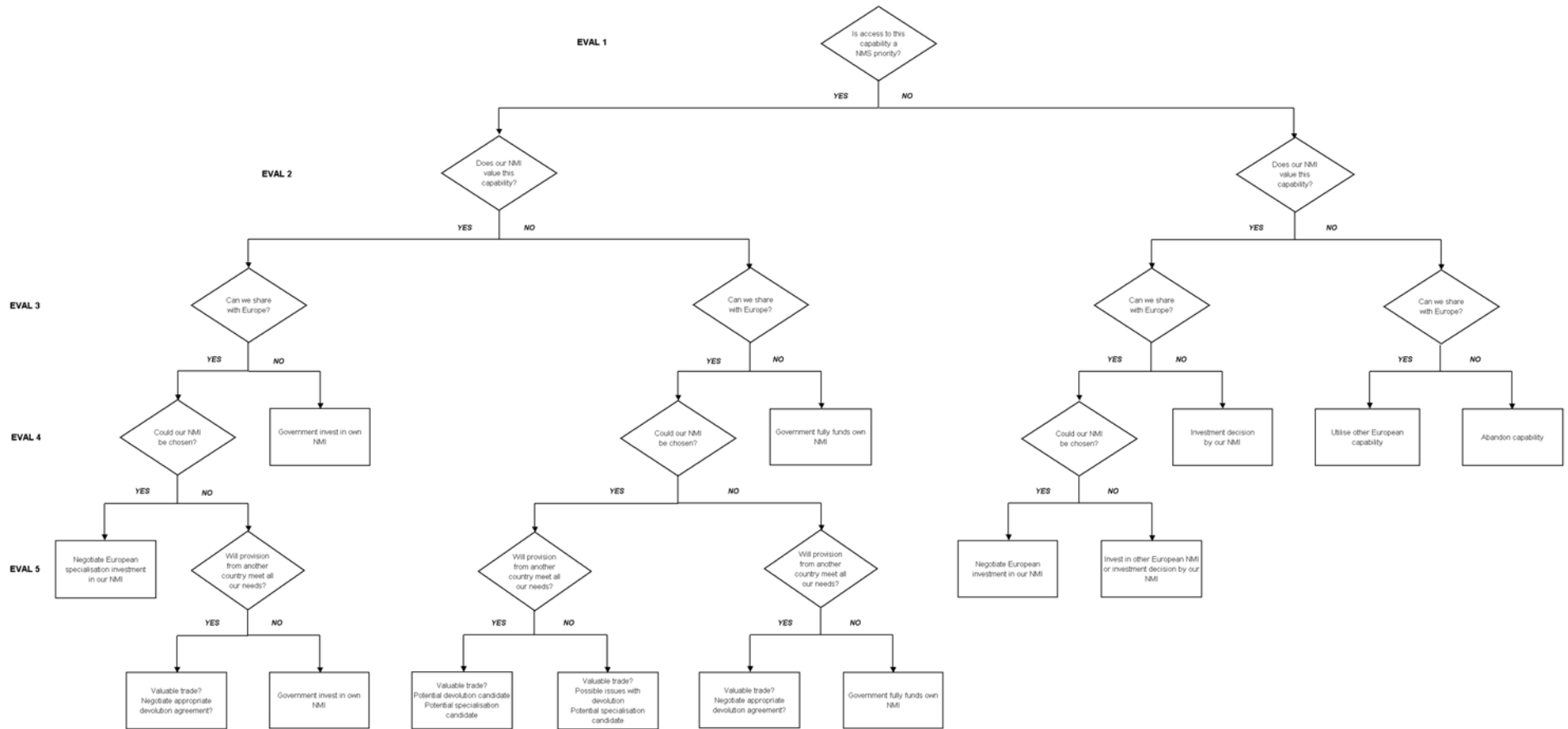


Figure C1: The decision Analysis Tree

The Decision Analysis Tree developed has five levels:

LEVEL 1: REQUIREMENT

This is an obvious starting point. Clearly if a country does not have a priority for a particular measurement standard, its national government is unlikely to support work and, de facto, the work is devolved. However, the NMI in that country may still wish to provide services in this area, see Desirability.

LEVEL 2: DESIRABILITY

There are some measurement standards in which an NMI will see advantage, and others in which it will only remain active because its national government supports it as a national requirement. For example, measurement standards with a small user community which rely on a large capital investment and for which the science used is mature, are unlikely to be attractive to an NMI, but may be essential for national security or key medical services. In contrast, there may be some measurement standards for which the national government sees no reason to provide support, but from which an NMI can provide profitable measurement services. Such a measurement standard is considered attractive to that NMI.

LEVEL 3: SHARABILITY

There are some measurement standards for which it is straightforward to share services across Europe, and others for which it is impracticable. For example, some standards for radioactivity have a half-life of only a few hours, and so the standard must be used very soon after it is calibrated. Clearly these standards require local provision. Devolution and specialisation are likely only to be viable for measurement standards that can be shared.

LEVEL 4: CAPABILITY

The capability of an NMI for a particular measurement standard is likely to be an important factor when deciding whether that NMI will host a European centre of excellence, or whether it might serve that country better to devolve the standard to a foreign NMI with greater capability. Specialisation at an NMI is more likely where its capability is already state-of-the-art, whilst devolution is likely to be more appropriate where its facilities are antiquated and the scientific experts are close to retirement.

LEVEL 5: NATIONAL INTEREST

There is a need to recognise that, even if a country decides to devolve its primary capability to a foreign NMI, there may be a need to retain some expertise to underpin a national interest. For example, if Europe is active in defining a documentary standard related to a particular measurement quantity, the country may wish to be influential on the appropriate CEN committee to ensure its national industry is not disadvantaged by any new European standard. This may require the country to continue to sustain a national expertise in addition to a European centre of excellence maintained by a foreign NMI.

The Decision Analysis Tree leads to one of 12 outcomes, depending on the route through the Tree the answers to the five question-objectives take. These are:

- (1) Negotiate European specialisation, national investment in own NMI;

- (2) Valuable trade? Negotiate appropriate devolution agreement, or national government investment at own NMI;
- (3) Government investment in own NMI;
- (4) Valuable trade? Potential devolution or specialisation candidate, or government fully funds investment at own NMI;
- (5) Possible issues with devolution. Potential specialisation candidate or government fully funds investment at own NMI;
- (6) Trade? Negotiate devolution agreement or national government fully funds own NMI;
- (7) Government fully funds own NMI;
- (8) Negotiate European investment in our NMI or investment decision by own NMI (not national government);
- (9) Invest in other European NMI or investment decision by own NMI (not national government);
- (10) Investment decision by own NMI (not national government);
- (11) Utilise other European capability;
- (12) Abandon capability.

It is likely that most countries will limit their analysis using this tool to current areas of work, which will already be considered a priority by that country. Therefore, it is unlikely that many outcomes above (7) will be found.

“Trade” and “Valuable trade” refer to the fact that any devolution will require negotiation, and any specialisation to achieve a European centre of excellence requires recognition by foreign NMI. It is likely that European NMI will wish to agree *quid pro quo* arrangements for specialisations and devolutions, to share costs and to generate mutual dependence to encourage reliable provision of devolved quantities. If a country agrees to devolve a measurement capability for which it already has a reputation for excellence, it is likely to be seen as a significant sacrifice, which may lead to stronger acceptance of the NMI for that country as a European capability in another area.

Measurement standards which a particular NMI values, but for which its national government does not have a priority requirement, are likely only to be provided if that NMI is prepared to invest its own funds in the capability. These are described by, “Investment decision by own NMI”. However, measurement standards which are a priority for a country but whose provision are unattractive to the NMI, will need to be fully supported by the national government unless devolved. This might include, for example, the NMI seeking funding for the capital investment directly from national government, rather than through an overhead charge on all an NMI’s work. Where an NMI sees value in the provision of particular measurement standards, for example where there is the prospect of significant third party income, the NMI may choose to supplement any investment made by the national government, for example through any internal research funding budgets it may control, and part of the capital cost will be recovered through overhead charges on commercial contracts.

3.3 Criteria for assessing question-objectives

The Decision Analysis Tree will have a number of criteria which influence the decision made at each level of the Tree, i.e. the answer to each question-objective. It is important to identify all the influencing criteria for each question-objective, and to make sure that there is no double counting. This requires careful definition of the criteria.

Some criteria can be evaluated directly from numerical data, for example the third party income associated with a particular measurement quantity, others require a more indirect approach, for example the strength of the reputation of an NMI for that quantity. Wherever possible numerical data are preferable for the scoring but where this is not available or inappropriate, a series of statements is used which range over the scope of that criterion. For example, for Reputation score, statements range from “No team at our NMI” to “Best in Europe and large team for Europe”.

Each criteria is scored with a number between 1 and 5; 1 representing an assessment that the answer to the question-objective is strongly No, and 5 if it is strongly Yes. Numeric data requires scaling to achieve this and this can be quite difficult. The procedure set out below was developed as a pragmatic route to normalisation of numerical data.

SCALING NUMERIC SCORES

The NMS of a particular country has a scope that covers all traceable measurements made in that country. As such it has a size, which is made up of a number of subsystems for measurement for length, electricity, mass, etc. Each of these sub-systems is itself made up of many measurement quantities. But what is the size of that part of the NMS that is electricity, or gauge block interferometry? This is an important question for the Decision Analysis Tree because it is necessary to assess the relative strength of each group of measurement quantities against each criterion. What is a relatively low third party income from electricity, may be considered large for a much smaller part of the NMS like gauge block interferometry. Therefore, it is necessary to normalise numeric values by some measure of the “amount” of the NMS covered by the groups of measurement quantities scored.

There is no completely satisfactory way to calculate this “amount” of the NMS covered by a particular group of measurement quantities, and so a pragmatic approach is proposed. It is reasonable to assume that there is a strong correlation between the size of investment made by the national government in a particular subsystem of the NMS, and the “amount” of the NMS which this represents. Therefore, it is proposed to use the financial size of the national government investment in a particular subsystem of the NMS as an estimate of the “amount” of the NMS it represents. A simple definition can be used; for every € x per year invested by the national government in a particular subsystem of its NMS (e.g. Electricity), 100 points are assigned. “ x ” is chosen as an appropriate number for the level of investment made by that national government. These points are then sub-divided across the subsystem of the NMS being analysed, broadly following with the proportion of funding for each group of measurement quantities scored. The points assigned to each group of measurement quantities scored is defined as the **individual relative scope score** (irss) for that part. Numeric data recorded for that part can be normalised by dividing by the irss so that comparisons can be made across the whole NMS for that country.

The normalised numeric values for each criterion form a distribution covering each part of the NMS, which need to be assigned a score between 1 and 5, 1 for values reflecting a strong No up to 5 for those reflecting a strong Yes. Inspection of these distributions of values has shown that often there are a few outliers, well away from the main distribution. Dividing up the distribution into equal parts, from the lowest to the highest values, would give little discrimination between the majority of the data. Therefore, the assignment of scores 1 to 5 should be chosen by discounting the outliers and equally dividing up the range of data that remained. Outliers are then scored 1 or 5 as appropriate. Figure 2 should clarify this point.

The criteria defined to assess each of the questions-objectives are now described, taking each question-objective in turn.

1. Is access to this capability a government priority?

National governments may have carried out studies to address this issue in some detail. Where this information is not available in a suitable form to answer this question-objective in a consistent way across the NMS, the tool uses a simple scoring approach. Two criteria were identified as relevant to this question-objective:

- a) The annual cost of running the facilities required for this group of measurement standards;
- b) The level of requirement, considering both industry and regulation.

The assumption behind the assessment chosen is that the higher the cost of providing and maintaining the provision of a capability in the country, the stronger the requirement would need to be for the national government to support it.

The annual running cost is calculated to include the cost of accommodation, annual costs associated with capital equipment, maintenance and service costs, plus the costs of staff time to maintain the facilities. The cost is then normalised by the irss and assigned a score between 1 and 5, 1 for a very low running cost and 5 for a very high one. Clearly very low and very high can only be quantified once results for the whole NMS have been collected.

The requirement is assessed using a list of statements ranging from 1 – Marginal, to 5 Essential.

A simple two-dimensional matrix was then defined to combine these scores into a single score for this question-objective. For example a very low cost facility, which meets an essential requirement is scored 5 overall, i.e. strongly Yes this is a government priority, whilst a very high cost facility with a marginal requirement is scored 1, i.e. strongly No this is not a government requirement.

2. Does our NMI have inherent reasons (other than just government funding) for providing this capability?

Six criteria were identified as relevant to this question-objective:

- a) The level of third party income, the more income the higher the score;
- b) The replacement cost of the associated facilities, the lower the cost the higher the score;
- c) The balance between existing capital investment, and investment required in facilities over the next 10 years. The greater the current value of existing assets and the less investment required into the future, the higher the score;
- d) The match with a NMI strategic objectives, the better the match the higher the score (this reflects the fact that most NMI have chosen particular scientific areas in which to specialise);
- e) The strength and reputation of the existing science team, the larger and better regarded the team in Europe, the higher the score;
- f) The degree of dependence of other parts of the NMS on this part, the greater the dependence the higher the score.

Remember that a higher score, i.e. a score nearer 5, indicates a stronger Yes answer to the question-objective.

The first three criteria can be scored with numeric data collected for the study and are normalised by the irss, whilst the final three criteria are assessed against a series of statements scoping the range of each criterion. Criterion c) requires the application of a two dimensional matrix to judge the balance between the existing capital investment and that required over the next ten years.

3. Can our NMI and Europe Share?

Eight criteria were identified for this question-objective:

- a) The amount of spare capacity Europe has for this group of measurement quantities, the more spare capacity the greater the prospect for sharing;
- b) The importance for an independent national capability for NMI across Europe, the less the importance the greater the prospect for sharing. (NB. This requires a judgement of the likely European collective view for the need of an independent capability, not an individual national one – the national perspective being captured in a later question);
- c) The degree of difficulty in managing practical difficulties to sharing, the less the practical difficulties the greater the prospect for sharing;
- d) The change in cost to the users of services for this group of measurement quantities, a reduction in cost would be a benefit for sharing;
- e) The level of savings to the national government if the national capability was devolved to a foreign NMI, the greater the saving the more attractive sharing;
- f) The commonality of requirement for this group of measurement quantities across Europe, the greater the commonality the greater the prospect for sharing;
- g) The strength of requirement for a national expertise for knowledge transfer, the less the requirement for a national expertise the greater the prospect for sharing;
- h) The importance of collaborative R&D to support this group of measurement quantities, the greater the importance the greater the prospect of sharing.

Only one of these criteria can be assessed using numeric data, that is criterion e). In this case the saving is not normalised by the irss before translating to a score between 1 and 5, as this would be inappropriate. All the other criteria are scored using a list of statements that scoped the range of the criterion.

For criterion f) a two dimensional matrix is required for the scoring. This allows two issues to be separated, the degree of commonality of approach to measurements, and the uniqueness of a national requirement, perhaps driven by a regulation particular to that country. A trivial example of the latter might be the requirement in the UK to calibrate speedometers in miles per hour. However, the methodology for carrying out such a calibration would be in common with the rest of Europe, similar to that used for the calibration of speedometers in kilometres per hour.

4. Could our NMI be credible as a European centre of excellence?

Six criteria were identified for this question-objective:

- a) The excellence of capability at our NMI, the greater the capability at our NMI the more likely the it would be established as a European centre of excellence;
- b) The spread of users for the services from this group of measurement quantities, the stronger the user base is in our country, the greater the prospect of our NMI being established as a European centre of excellence;

- c) The number of customers from other countries already using services from our NMI, the more dominant our NMI already is in the provision of services outside our country the greater the prospect of it being established as a European centre of excellence;
- d) The political attractiveness of a particular country to provide European services, recent political events may affect the prospects, favourably or unfavourably, for our country to establish a European centre of excellence in this area. For example, recent food scares in the UK would make it unlikely that the UK NMI would be favoured for food related measurement quantities at present.
- e) The modernity of facilities at our NMI compared with other, similar facilities in Europe. The more up-to-date our facilities the greater the prospect of our NMI being established as a European centre of excellence;
- f) The amount of spare capacity at our NMI for this group of measurement quantities. The greater the spare capacity the greater the prospect of our NMI being established as a European centre of excellence. (NB. This criterion is specific to national capacity, whilst criterion a) in the “Can our NMI and Europe Share?” question-objective assessed the spare capacity across Europe);

None of these criteria can be based on numeric data and all but criterion a) are scored against a list of statements that scope the range of each criterion.

Criterion a), an assessment of the excellence of our NMI capability, is scored against two factors: how close the UK capability is to state-of-the-art, and how comprehensive the range of services are compared with other NMI. The score is taken from a two dimensional matrix. Assessments of capability can be made more objective when informed by NMI Calibration and Measurement Capability (CMC) data presented on the BIPM Key Comparison Database.

5. If a country other than ours is chosen as a European centre of excellence, could the we rely on it alone?

Six criteria were identified for this question-objective:

- a) There is a significant national interest not met by Europe sharing;
- b) There is a very high demand for services for this group of measurement quantities in our country;
- c) It is important that our country maintains an independent expertise for this group of measurement quantities. (NB. This is a judgement of the particular national view, which may not necessarily be the same for other European countries);
- d) Government policy requires that our NMI pump primes new technology which relies on this capability;
- e) It is important for our country to keep some capability to facilitate re-entry of our NMI if requirements change;
- f) There are no, or virtually no savings to be made in the investment cost provided by the national government, for example by retaining a national rather than primary capability in our country.

These criteria, unlike those for the other question-objectives, are scored with either a direct Yes or No. If any is answered Yes, then the answer to this question-objective is No. However, some of the criteria, particularly c), might be met with a small, strategic investment which enables a country to sustain independent expertise, without necessarily investing in a full primary capability.

WEIGHTING OF CRITERIA

It is important for the MDCA process that assessments are made taking account of the full range of views of all the stakeholders in the decision to be made. The criteria were chosen to cover all the issues of importance to the various stakeholders in a particular NMS. The MCDA process has provision for adding weights to each of the criteria, to reflect their relative importance to the various objectives to the stakeholders.

National stakeholders in an NMS are:

- (i) The NMI, i.e. the laboratory or laboratories funded by government to support the NMS of the country
- (ii) The government through its funding department;
- (iii) National users of the NMS, i.e. industry, government and science.

The views of users of the NMS are often canvassed through some form of advisory committee established by the national government or NMI.

It is likely that views of the weightings of the criteria will be different for the different stakeholders. Arguably, it is the view of the user community of the NMS that is the most important, and for this reason it is probably best to ask the advisory committee, where it exists, to provide the weightings for the criteria used for the Decision Analysis Tree. However, it is straightforward to vary the weightings to those chosen by a different stakeholder group, and investigate the consequences to the selected outcomes. This would be part of the sensitivity analysis anyway, see later.

SHOW STOPPERS

Some of the criteria in each question-objective may become dominant, or show stoppers, if an extreme score of 1 or 5 is recorded. Dominance means that all other criteria become irrelevant to the score for the question-objective, and the dominant criterion provides the decision for that question-objective. For example, for the “Can our NMI and Europe Share?” question-objective, if the practical barriers to sharing are impossible to manage, then clearly sharing is impossible no matter what other advantages might accrue.

3.4 Segmenting the NMS Portfolio for analysis

The Decision Analysis Tree requires segmenting the NMS into manageable groups of related measurement quantities. The term “chunk” was chosen to describe a chosen group of measurement quantities for scoring. A number of factors needed to be considered to decide on the content of a chunk:

- (i) The availability of data for scoring the criteria for the chunk;
- (ii) A level of uniformity of the contents of the chunk that made it possible to score the whole chunk as a single entity;
- (iii) A manageable number of chunks, i.e. not so many that the data collection and analysis process became unwieldy;

Some of these factors work against each other, and so a careful balance has to be found.

Suitably qualified staff from an NMI should be asked to segment the work of each subsystem of the NMS, under the guidance of a facilitator for the Decision Tree Analysis. In order to overcome some of the conflicting requirements of the factors set out above, the tool allows segmentation at up to three tiers of division. However, it is not necessary to use all three tiers, and it is possible to mix the number of tiers used within a subsystem. This flexibility makes it possible to consider chunks of quite different size. It also makes it possible to separate out a small part of a chunk and score it separately, where this small part scores significantly differently for one or more criteria. The tool allows each subsystem to be segmented into up to 15 chunks. Where the analysis requires greater segmentation, for example this may be necessary for a large subsystem like electrical measurements, the subsystem can be considered as two separate subsystems, e.g. for Electrical one for DC/LF and one for RF/MW. Limiting the number of chunks also had the benefit of keeping the data collection process down to manageable time periods for each NMS subsystem. An example of a possible segmentation for the Mass and related quantities subsystem is given in figure 2.

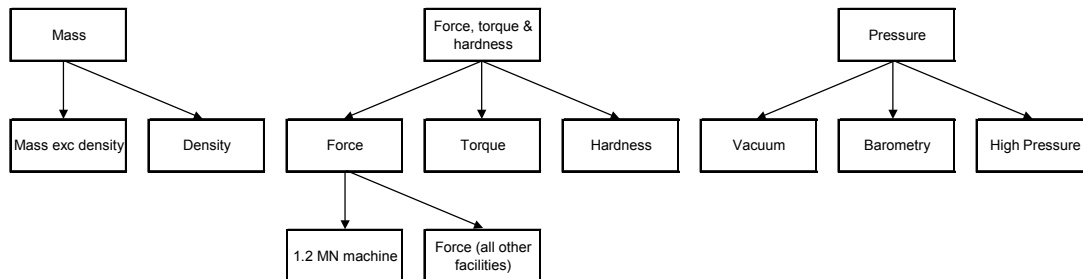


Figure C2: Example of a possible fragmentation for Mass and Related Quantities

The flexibility of considering chunks of quite different size is only made possible by the use of normalisation through the individual relative scope score, the irss described above. The experts from the NMI participating in the use of the Decision Analysis Tree tool are not able to manipulate the numeric scores by judicious segmentation, as the total number of points assigned for the irss for a particular subsystem is set by the annual national government investment in that subsystem. The experts only have the flexibility to assign these points between the chunks they chose.

3.5 Collection of data

The Decision Analysis Tree requires the collection of a great deal of data in a common format. It also requires comparisons to be made right across the NMS of a country. For example, it is important to assess third party income not only within a NMS subsystem, between chunks, but with chunks from other subsystems. To achieve this, an extensive interactive Excel spreadsheet was developed to collect the data. This spread sheet had a separate worksheet for each NMS subsystem. These worksheets were linked so that data could be compared between them.

A separate spreadsheet was developed, to record the various inputs to the running costs of facilities in a particular chunk. The total running costs could then be transferred to the master spreadsheet as an entry for the Level 1 question-objective.

Data is collected from NMI experts for each NMS subsystem in two Phases. Phase I introduces the Decision Analysis Tree procedure, and collects numeric data for one particular subsystem. In addition one chunk is provisionally scored completely so that the full range of issues are introduced to the NMS experts. The scores for Phase I cannot be completed until data from all the NMS Subsystems have been collected, because it is only after the full range of numeric scores are known, that final scores can be assigned. Completion of Phase I for all subsystems defines what is high and what is low. Typically Phase I requires a half-day meeting to complete for each subsystem for a large NMI.

NMI experts are asked to prepare for the Phase I meetings. Firstly, they are asked to segment the particular NMS subsystem into tiered chunks. This information is provided to the developer of the Decision Analysis Tree master spreadsheet so that a template can be prepared for that subsystem. The NMI experts are also asked to collate the required numeric data for the criteria for each chunk, and bring it to the Phase I meeting. Those running the Decision Analysis Tree also collected some high level numeric data, where this is available, to validate the NMI experts input.

The facilitator of the Phase I meeting has the responsibility of challenging the data provided by the NMI experts, and ensuring that the data for all subsystems is collected to a common standard. However, at all times the data entered is that which is agreed with the NMI experts. Where some interpretation is necessary to decide what data should be input, a record of the basis of the decision is kept on the spreadsheet.

Once all the data for Phase I has been collected, the scores for criteria dependent upon numeric data can be set. NMI experts are then invited to a Phase II meeting, half-day for each subsystem for a large NMI, to score the other criteria. Once again the meeting facilitator is responsible for challenging the input provided, and ensuring a common standard is achieved. But once again, all data entered is agreed with the NMI experts, and where some interpretation is necessary, a record is kept of the basis of the decision. Scoring of criteria based on non-numeric data is much more challenging and, therefore, the need to record explanatory comments from the experts much more important. These recorded comments will be a valuable mine of information to assist the consideration of candidates for specialisation and devolution later. They should be studied before taking forward any broad-brush view to which the outcomes from the Decision Analysis Tree may point.

Once all the data is entered for a chunk, it is possible to review the selected outcome from the Decision Analysis Tree with the NMI experts. Where the experts express concerns at the output, these are recorded on the spreadsheet. A blank sample extract from the interactive spreadsheet is shown in Figure 3 below.

PROGRAMME NAME:				
Programme short name:				
Names of team operating this tool				
Dates of data entry:				
Currency in which answers are given (if not euro)				
DATA				
Total programme value (million euro)		see assumptions		
Lifetime of programme (months)				
Annual programme value (million euro)				
Overall relative scope score (r _{ss})				
Division of technical areas or capabilities or facilities				
Top tier technical area				
Second tier technical area				
Third tier technical area				
Maximum, minimum and totals across this worksheet	Maximum	Minimum	Total	
Allocation of individual relative scope scores				
Top tier technical area				
Second tier technical area				
Third tier technical area				
Individual relative scope score used (ir _{ss})				
Annual cost of facility (euro)				
Top tier technical area				
Second tier technical area				
Third tier technical area				
Annual cost of facility used (euro)				
Annual third party income (euro)				
Top tier technical area				
Second tier technical area				
Third tier technical area				
Annual third party income used (euro)				
Replacement cost of facility of similar capability at today's prices (euro)				
Top tier technical area				
Second tier technical area				
Third tier technical area				
Replacement cost of facility used (euro)				
Capital investment required over next 10 years (euro)				
Top tier technical area				
Second tier technical area				
Third tier technical area				
Capital investment used (euro)				
Current asset value of equipment (euro)				
Top tier technical area				
Second tier technical area				
Third tier technical area				
Current asset value of equipment used (euro)				
DECISION TREE QUESTIONS				
	Maximum	Minimum	Total	
Q1 Is national access to this capability a government priority?				
Annual facility cost / ir _{ss}			0	
Annual facility cost score				
Annual facility cost score category				
Importance of facility for measurement infrastructure				
Score for Q1				
Q2 Does our NMI have inherent reasons (other than just NMS funding) for providing this capability?				
a) Size of 3rd part business				
Annual third party income / ir _{ss}			0	
b) Replacement facility cost score				
Replacement facility cost / ir _{ss}			0	
c) Capital investment versus asset value				
Capital investment required over next 10 years / ir _{ss}			0	
Capital investment score				
Current asset value / ir _{ss}			0	
Current asset value score				
d) Alignment with our science strategy				
e) Size and international reputation of our NMI's team				
f) Importance of this area for other areas of the NMS				
Weighted score for Q2				

4 RESULTS

The results from the Decision Analysis Tree can be grouped into different types.

One group of chunks will be those for which there is not a national priority and for which most likely the NMI can abandon its capability in. It might be necessary to issue some guidance to the few national users of this capability as to alternative foreign NMI from whom they can obtain services.

A second group of chunks will be those for which it is very difficult to share. If these are a national priority, then the NMI will have to sustain or develop a capability. Devolution and specialisation are not options for these chunks.

A third group of chunks will be those that can be shared across Europe. One of the major conclusions of running the tool is that the majority of the capability of a NMI falls into this category. This group can be further sub-divided to discriminate between those that are desirable or undesirable to an NMI, and those for which an NMI has a state-of-the-art or more ordinary capability. The chunks can be plotted on a chart, see figure 4. Chunks falling into a particular quadrant can be identified as candidates for particular action: specialisation, devolution, negotiation or investment. The NMI can use this categorisation as a starting point for planning how it might participate in a Metrological European Research Area.

	State-of-the art capability
<i>Seek government support</i>	<i>Specialise</i>
Undesirable	Desirable
<i>Devolve or government investment</i>	<i>Negotiate or invest</i>
	Ordinary capability

Figure C4: Plot of capability against desirability for chunks which can be shared

5 MAKING THE TOOL AVAILABLE TO NMI

Two workshops were run as part of the MERA project. The MCDA technique was presented to other NMI at the first workshop, and the tool in the form of an Excel spreadsheet and guidance notes was provided to each NMI on a CD. In addition, a workshop was run at NPL to train staff from other NMI to use the tool.

The results from the national assessments made by each NMI were provided to NPL on a standard template, and were collated, summarised and presented at the second MERA workshop. It was clear at the second workshop that NMI preferred an approach to specialisation and devolution for the delivery of services that was based on bi-lateral discussions rather than the development of a single, pan-European plan. It was also clear that a good deal of devolution and specialisation of capability around national priorities had already taken place, particularly by the smaller NMI.

6 CONCLUSION

A tool has been developed suitable for use by European NMI to support their national assessment of the NMS for their country. Use of this tool leads to an understanding of the constraints and opportunities for greater interdependence of NMI across Europe. This will facilitate rationalisation of capability across Europe to release resource to meet the increasing demands on NMS of established technology, and the extension of the scope of NMS to meet the new requirements of emerging technologies, e.g. biotechnology and nanotechnology. It enables this rationalisation to take place based around centres of excellence developed in countries to meet their particular national priorities. It is likely that for most chunks a number of European centre of excellences will be required to meet European needs, both to cope with demand and to provide security of supply.

Another important conclusion of this study is that there is far more scope for sharing of capability between NMI than had been anticipated. This means that national governments have a great deal of choice for the capability of their NMI, once a reliable arrangement for devolution of service provision between countries has been established, and as long as the process is planned so that gaps in provision do not develop in Europe. Therefore, metrology is a field for which the development of a European Research Area should bring significant benefits, both to the nation states of European and to Europe as a whole.

7 REFERENCES

1. Multi-Criteria Analysis – A Manual. DETR Appraisal Guidance. Published by the Department of the Environment, Transport and the Regions: London. December 2000. ISBN 1 85112 454 3

ANNEX D – THE MERA NMIs WORKSHOP

D1. The programme of the NMIs workshop

D2. List of participants of the NMIs WORKSHOP

D3. Workshops reports

D1. The programme of the NMIs workshop

Monday 16 December		
09:00	Welcome to the project Ed de Leer (NMi VSL)	
09:05	Overview of the EUROMET strategy and introduction to the MERA project Paul Hetherington (NML)	
09:30	Current level of EUROMET collaboration Luc Erard (BNM)	
09:50	The different scenarios for metrology in the European Research Area Seton Bennett (NPL)	
10: 20	Setting priorities in small and distributed NMIs Kim Carneiro (DFM)	
10:50	Coffee Break	
11:20	The development of a Multi Criteria Decision Tool to aid priority setting in NMIs Andy Henson (NPL)	
12:10	An example of EUROMET collaboration in the field of Quantum Standards Helko van der Brom (NMi VSL)	
LUNCH (12:30 – 13.45)		
Evaluating the scenarios (Seton Bennett)		
	Scenarios Workshop I	Scenarios Workshop II
		Scenarios Workshop III
15:15	Tea Break	
15:45	Presentation of conclusions (3 rapporteurs) and general discussion	
17:15	Closure	
WORKSHOP DINNER		

Tuesday 17 December		
9:00	Future Trends and the impact for Research in Metrology Paul Hetherington	
9:30	International co-operation in metrology research, the BESSY example Michael Kühne (PTB)	
9:50	Stakeholder consultation on European metrology scenarios Leslie Pendrill (SP)	
10:10	The NAS perspective of the future metrology infrastructure scenarios Pavel Klenovsky (CMI)	
10:30	Coffee Break	
11:00	responding to the challenge; metrological needs verses budgets – an approach to priority setting Andy Henson/David Nettleton (NPL)	
LUNCH (12:30 – 13:45)		
14:00	What metrological capability will Europe need? (Paul Hetherington)	
	Future Trends (Nano) Workshop I	Future Trends (Physics) Workshop II
		Future Trends (Chemistry) Workshop III
15:00	Tea Break	
15:30	Presentation of conclusions (3 rapporteurs)	
16:15	“The next steps” in the MERA project	
16:30	Summary and conclusions	
17:00	Closure	
END OF WORKSHOP		

D2. List of participants of the NMIs WORKSHOP

Mr T. Fairley	DG Research	
Mr R. Kaarls	CIPM	
Mr A. Wallard	BIPM	
Mr R. Edelmaier	BEV	Austria
Mr A. Leitner	BEV	Austria
Mrs P. Hristova	State Agency for Standardisation and Metrology	Bulgaria
Mrs A. Todorova	State Agency for Standardisation and Metrology	Bulgaria
Mr Ph. Taylor	EC-DG JRC	Commission of the EC
Ms S. Havrlantova	CMi	Czech Republic
Mr F. Jelinek	CMi	Czech Republic
Mr P. Klenovsky	CMi	Czech Republic
Mr K. Bryder	Danish Technological Institute	Denmark
Mr K. Carneiro	DFM	Denmark
Mr G. Ostergaard	FORCE Technology	Denmark
Mr T. Kübarsepp	Metrosert ltd	Estonia
Mr E. Ikonen	Helsinki University of Technology	Finland
Mr H. Isotalo	MIKES	Finland
Mrs T. Weckström	MIKES	Finland
Mr M. Chambon	BNM	France
Mr L. Erard	BNM	France
Mr W. Hässelbarth	BAM	Germany
Mr M. Kühne	PTB	Germany
Mr T. Lederer	PTB	Germany
Mr P. Pataki	OMH	Hungary
Mr A. Pozsgai	OMH	Hungary
Mrs N. Szilagyi Zsofia	OMH	Hungary
Mr P. Hetherington	NML	Ireland
Mr B. Sheridan	NML	Ireland
Mr S. D'Emilio	IEN	Italy
Mr A. Sacconi	IMGC	Italy
Mr O. Staugatis	VMT	Lithuania
Mr V. Zabolotnas	VMT	Lithuania
Mr J.A. Bartolo	MSA	Malta
Mr H.A. Froystein	Justervesenet	Norway
Mr L. Halbo	Justervesenet	Norway
Mr H. Kildal	Justervesenet	Norway
Mr R. Broda	POLATOM	Poland
Mrs B. Lisowska	GUM	Poland
Mrs A. Szmyrka-Grzebyk	INTiBS Pan	Poland
Mr L. Cortez	IPQ	Portugal
Mr I. Urdea Marcus	INM	Romania
Mr S. Duris	SMU	Slovakia

Mr S. Musil	SMU	Slovakia
Mr R. Spurny	SMU	Slovakia
Mr J. Drnovsek	MIRS	Slovenia
Mr M. Grum	MIRS	Slovenia
Mr R. Lapuh	MIRS	Slovenia
Mr H. Nilsson	SP	Sweden
Mr L. Pendrill	SP	Sweden
Mr B. Jeckelmann	METAS	Switzerland
Mr R. Thalmann	METAS	Switzerland
Mr A.H.L. Aalbers	NMi VSL	The Netherlands
Mr H.E. van den Brom	NMi VSL	The Netherlands
Mr M. Charité	NMi VSL	The Netherlands
Mr E. de Leer	NMi VSL	The Netherlands
Mr J.J. Schmit	NMi VSL	The Netherlands
Mr E. Sadikoglu	UME	Turkey
Mr T. Yandayan	UME	Turkey
Mr Y. Machekhin	Institute of Metrology	Ukraine
Mrs D. Beauvais	NPL	United Kingdom
Mr S. Bennett	NPL	United Kingdom
Mr A. Henson	NPL	United Kingdom
Mr Nettleton	NPL	United Kingdom
Mr R. Paton	NEL	United Kingdom
Mrs C. Wolff Briche	LGC	United Kingdom
Mr D. Milosevic	Fed. Bureau of Measures and Precious Materials	Yugoslavia

D3. Workshops reports

D3.1 Workshop I: Future Trends In Nanometrology

1. Identified nano needs

Needs for nanometrology were identified and the urgency for development (years to full availability) was discussed.

Within a period of one year there is a need for research in:

- Dimensional nano metrology
- Force metrology
- Electrical metrology
- Nanodosimetry
- Validated measurement procedures
- Measurement standards

Within a period of three years the following needs were identified:

- Written standards
- Scientific instrumentation (incl. Knowledge transfer)
- Chemical analysis

Within a period of 10 years the need for nanometrology in Biology was identified.

The different needs with years and scenario of implementation (A, B, C, or D) are given in the table:

	Written Standards	Scientific instrumentation	Validated procedures	Measurement standards
Chemical analysis	10	?	3	1 (B-C)
Biology	10	?	3	3
Dimensional	1 (A)	1 (C)	1 (B)	1 (B-C)
Force	10	3	3	3 (D)
Electrical	10	1 (B-C)	3	1 (B-C)
Dosimetry	10	10 (C)	3 (C)	10 (C)

2. Registered needs in nanometrology

An inventory among the participants of the workshop gave the following research subjects for nanometrology:

- Roughness and flatness standards for optics and sheet metal
- Thickness standards for coating and painting
- Methods for thickness measurement of thin layers from molecular scale
- Characterization blood or tissue compatible surfaces

- X,Y,Z standards microelectronics, precision engineering, biochemistry
- Standards applicable in micro-hardness
- Particle size standards
- Accurate force standards for measurements in the nN-range
- Soft gauges for surface texture and similar software checks for other instrumentation and 3D structures for calibrating micro-/nano-CMMs
- Electrical standards based on single electron nanodevices (such as SET)
- New thermometers based on coulomb blockade
- Pore size distributions and porosity in filtration membranes
- Nano dosimetry

The workshop concluded that an integrated infrastructure for nanometrology in the ERA is desirable and possible, since nanometrology is not an exclusive exercise for only the few big NMIs. For example, in a recently announced EUROMET initiative on nanotechnology, the following countries are involved:

EU	DK, IT, PT, FR, FI, NL, UK, DE
EFTA	CH
NAS	CZ, PL, SI
Other	TR

D3.2 Workshop II: Future Trends In Physics

General Remarks:

- Difficult area to discuss. General feeling among the participants, we are lacking expertise and have not enough background (e.g. in the field of Biotechnology).
- First part of the discussion devoted to identification of some application areas using the approach of the 6th FP
- Followed by discussion on future R&D topics in Physics.

Application areas:

- ICT
- New materials and new production methods (also in Nanotechnology)
- Health and Safety
- Environment
- Space applications
- Transport

Future Research Topics in Physics:

- Software in Metrology (short term and long term program needed, should have high priority, this topic is already covered by ongoing project in 5th FP)
- Photonics (short term and long term)
- Dynamic Mechanical Metrology (short term and long term)
- Quantum Electrical Devices

Collaboration by:

- Funding from 6th FP or other International funded Programs
- Co-operation with EUROMET
- National funded programs

D3.3 Workshop III: Future Trends for Research in Metrology in Chemistry

1. Inventory of present situation

What research is done at NMIs in different countries?

IRMM (EU, approximately 90 scientists)

Reference materials and method development in environmental, food and clinical areas

IPQ (Portugal, approximately 10 scientists)

Continuation of metrology work in field of gas analysis and physical chemical properties. Will work on the establishment of a network of laboratories for clinical, environmental and food analysis, which can act as the designated NMI.

BAM (Germany, approximately 35 scientists in a unit of ~130 persons)

The development of reference materials for industrial materials and in the environmental area. Gas metrology. Will establish in Germany a network of national laboratories in the food and clinical area.

LGC (UK, about 25 persons involved in metrology out of a group of 40)

LGC is the national reference laboratory for organic and inorganic analysis. NPL is responsible for gas analysis and has growing interests in clinical, environmental and food analysis.

JV (Norway, no activities in the field of chemistry)

JV follows the developments for metrology in chemistry with interest and has an interest to start work in environmental, clinical and/or food analysis.

Lithuania, about 5 scientists and a national network

Lithuania is starting in the field of metrology in chemistry. The State Measurement Laboratory is now about 3 years in operation and has activities in the field of environmental, food, clinical and forensic analysis.

OMH (Hungary, 5 scientists + start of new areas)

Present work involves spectroscopic solutions, breathanalysis, humidity, gas analysis, and electrochemistry (pH, conductivity). There is an interest to start new work in the field of environmental analysis and in air quality analysis (dioxins).

CMI (Czech Republic, 2 scientists + the METROCHEM network of designated chemistry institutes)

Small group with activities in physical chemistry and in gas analysis. The reference network (METROCHEM) has activities in the field of environmental, food and clinical analysis.

SMU (Slovak Republic, 18 scientists)

Large group on metrology in chemistry with activities in inorganic analysis, coulometry, conductivity, UV-spectroscopy, gas analysis, humidity, breath analysers, primary reference materials and certification of matrix reference materials.

GUM (Poland, approximately 20 + 5 scientists in two groups)

Work area: Gas metrology, humidity, physical chemical quantities, breath analysers, certification of GUM produced reference materials. Knowledge is applied in the field of environmental, food and safety analysis.

Serbia and Montenegro (about 7 scientists)

Work area: legal applications (breath analysis, etc.), pH, certification and production of reference materials for the petrochemical and copper industries.

The group has an interest in the development of a group involved in environmental and food analysis.

Bulgaria (6-8 scientists)

Work area: electrochemistry, limited production of reference materials for e.g. pH and electrochemical conductivity.

Interest in the development of matrix reference materials for food and environmental analysis in order to support the export to Russia. Wants to set up primary lab facilities for isotope dilution mass spectrometry and for gas analysis.

BIPM (3-5+ scientists)

Global role for the calibration of ozone analysers. Plans are under development for setting up activities in organic and/or biotechnological analysis using NMR and cavity ring-down spectroscopy techniques.

NPL (UK, 25 scientists out of a group of 45)

The present work area involves work on gas standards for application in environmental, natural gas and breath analysis. Ultra low humidity analysis (low ppb area), pH and conductivity standards, research in IDMS.

Before 2004, NPL will set up a lab for biotechnology with a team of 9 scientists. The lab will become complementary to the biotechnology lab of LGC and will probably work at first in the field of protein structure.

NMi VSL (Netherlands, approximately 20 scientists).

The group has a strong focus on gas analysis with applications in industrial, environmental and legal analysis. Research in the field of IDMS, ICP-MS, cavity ring-down spectroscopy and electrolytic conductivity.

A short inventory about the capabilities for metrology in chemistry groups in NMIs that were not present, gave the following summary:

Country	Institute(s)	Scientists	Work area
Germany	PTB + UBA	~20	Air quality, clinical analysis, pH, conductivity, IDMS
Italy	IMGC	~5	Gas analysis
Spain	CEM	~5	Gas analysis
Finland		~5	Air quality
Sweden	SP	?	
Ireland	State Lab	2	Food analysis
France	LNE	~ 30	Gas analysis, IDMS, ICP-MS, etc.
Greece		?	No activities known

Turkey	UME	~5	
Denmark			Distributed system
Romania	INM	5-10	Gas analysis, reference materials
Ukraine		~ 15	Gas analysis, physical chemistry

2. Future Collaborative Research Topics

Many Central and Eastern Europe metrology institutes indicated that at first national programs in support to the implementation of EU-requirements must be set up. Gas analysis for breath and automotive exhaust analysis is of primary importance.

A general need was seen for large trans-national facilities such as high resolution NMR, adiabatic calorimetry and a (virtual) primary mass spectroscopy centre. Facilities should be established in one or two places, but must become available to all metrology institutes.

It was concluded that collaborative research could focus on:

- the development of pure substances for metrological applications
- a sectorial approach for the certification of reference materials
- the development of special compounds (isotope labelled compound)
- the development of calibration standards in all fields (sectors)

3. How to proceed?

Scenario A was thought to be perfect for applications in legal metrology. Since local regulations may differ from country to country, a country-wise approach is necessary.

For more future oriented research, a sectorial approach in scenario B or C was preferred.

ANNEX E – NATIONAL ANALYSIS - UK QUESTIONNAIRE**1 Calibration, measurement, and testing****1.1 Do you have a need for or interest in calibrations, measurements or tests?**

	Yes	No
Choose One:		

1.2 For any calibration, measurement or test service you receive, how do you rate the relative importance of the following?:

	(Very Important) 1	2	3	(Less Important) 4
Advice in English				
General Customer Care				
Physical proximity				
Price				
Quality of Advice				
Technical competence				
Timeliness				

1.3 Do you have (or have you had) calibrations, measurements or tests provided by NPL?

	Yes	No
Choose One:		

1.4 Would it be acceptable to you if you had to go to another NMI in Europe for a service currently provided by NPL?:

	Yes	No	Don't Know
Choose one:			

1.4a Please rate the relative importance of the issues that led you to answer no to the previous question:

Concerned about..	(Very Concerned) 1	2	3	(Not Concerned) 4
Communication				
General Customer Care				
Distance				
Price				

Quality of Advice				
Technical competence				
Timeliness				
Other:				

1.5 In what areas do you think NPL should be offering new services in the future, and when do you think the services will be required?:

Areas	Requirement for Services			
	Now	In 2-5 Years	In 5-10 Years	Don't Know

1.6 Have you heard of the Key Comparison Database (KCDB) from the International Bureau of Weights and Measures (BIPM)?

	Yes	No
Choose One:		

1.7 Do you use the BIPM Key Comparison Database to access:

	Yes	No
Comparison Results:		
Calibration and Measurements Capabilities from different NMIs:		

2. Research and development (R&D)

2.1 Have you undertaken or are you planning to undertake collaborative research and development with other partners?

	Yes	No
Already have:		
Planning to:		

2.2 When you are planning a collaborative R&D project, how do you rate the relative importance of the following qualities in your partner?:

	(Very Important) 1	2	3	(Less Important) 4
English Speaking Partner				
Physical Proximity				
Technical competence				
Timeliness				

2.3 Have you already collaborated with NPL on R&D projects?:

	Yes	No
Choose One:		

2.4 Are you (or would you be) in principle comfortable collaborating with an overseas NMI?:

	Yes	No	Don't Know
Choose One:			

2.4a Please rate the relative importance of the issues that led you to answer no to the previous question:

Concerned about..	(Very Concerned) 1	2	3	(Not Concerned) 4
Communication				
Distance				
Technical competence				
Timeliness				
Other:				

2.5 In what new areas (if any) do you think NPL should be carrying out research in the future? Is the R&D output needed in the long term, medium term, or short term?:

Areas	Output required in the...			
	Short Term (Less than 5 years)	Medium Term (5-10 Years)	Long Term (More than 10 Years)	Don't Know

3. Consultancy

3.1 Do you have a need for, or interest in, technical advice on a consultancy basis?

	Yes	No
Choose One:		

3.2 In general terms, when you receive technical advice how do you rate the relative importance of the following?:

	(Very Important) 1	2	3	(Less Important) 4
Advice in English				
General Customer Care				
Physical Proximity				
Price				
Technical competence				
Timeliness				

3.3 Have you received technical advice on a consultancy basis from NPL?

	Yes	No
Choose One:		

3.4 Would it be acceptable to you if you had to go to another NMI in Europe for consultancy currently provided by NPL?

	Yes	No	Don't Know
Choose One:			

3.4a Please rate the relative importance of the issues that led you to answer no to the previous question:

Concerned about...	(Very Concerned) 1	2	3	(Not Concerned) 4
Communication				
General Customer Care				
Distance				
Price				

Technical competence				
Timeliness				

Other:

3.5 In what new areas (if any) do you think NPL should be providing consultancy in the future, and when do you think this service will be required?:

Areas	Requirement for Consultancy...			
	Now	In 2-5 Years	In 5-10 Years	Don't Know

4. Other Questions

4.1 Are you interested in receiving training in metrology?:

	Yes	No
Choose One:		

4.2 What method(s) of training would best meet your needs?

Please choose between the following:

- Seminar at NPL
- In-house Seminar
- Tailored training at NPL

4.3 Have you already taken some training at NPL?

	Yes	No
Choose One:		

4.4 What do you think of the NPL website? Please rate the following:

	(Good) 1	2	3	4	(Poor) 5	Don't Know
Clarity						
Breadth/Depth of Information						
Up to date Information						

5 Your Company

5.1 What type of organisation do you represent?

Choose up to 2 from the following list that best describe your organisation:

- Industrial
- Service
- University
- Public funded R&D institute
- UKAS Accredited Laboratory
- Calibration and/or Test Laboratory
- Other (Please specify: _____)

5.2 What are your main areas of scientific work?

Choose as many as are appropriate from the following list:

- Mechanical
- Materials
- Acoustics
- Electrical
- Thermodynamic/Temperature
- Magnetism
- Analytical Chemistry
- Radiometry/Photometry
- Ionising Radiation
- Information Technology
- Time and Frequency
- Optics
- Other (Please specify: _____)

5.3 How many people does your organisation employ?

Choose one only from the following:

- Less than 10 Employees
- 10-50 Employees
- 51-250 Employees
- 251-500 Employees
- 501-1000 Employees
- More than 1000 Employees

5.4 As an organisation, roughly how much do you spend on measurement technology/facilities per year as a percentage of your yearly technical investment?

Choose one only from the following:

- More than 50% of your yearly investment
- 20%-50% of your yearly investment
- 5%-20% of your yearly investment
- 2%-5% of your yearly investment
- Less than 2% of your yearly investment
- Don't Know

5.5 Do you consider yourself a Small or Medium-sized Enterprise (SME)?

An SME is usually a company with less than 250 employees and/or a turnover of under £40 million.

	Yes	No	Don't Know
Choose One:			

5.6 Are you a manufacturer of:

Choose as many as are appropriate from the following list

- Measurement equipment
- Accessories for measurement equipment
- Test equipment for measurement equipment
- Measurement related software
- Other (Please specify: _____)
- Not a manufacturer

ANNEX F – N-MERA

NORDIC METROLOGY RESEARCH AREA – REPORT 2003

Modern society requires reliable measurements that give the same answer wherever they are made. As an essential part of a global technological infrastructure enabling free trade and innovation, metrological traceability 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) as well as all derived units. The development of international metrology is stimulated by new demands for traceability from industry and society and is based on and needed in continual and long-term research in fundamental science and technology.

A new Nordic project, “*N-MERA – Nordic Metrology Research Area*”, aims to make a strategy for the future of Nordic metrology. This is a satellite project to corresponding European projects (such as MERA [2003]) and share the same aim of solving the dilemma facing Nordic and European Metrology in that the burgeoning needs for traceable measurement (in both recognised areas, such as physical metrology in manufacturing industry, as well as new areas such as metrology in chemistry) have to be tackled on a substantially fixed budget. N-MERA includes as participants representatives of the National Metrology Organisations (NMO) of the Nordic and Baltic countries (Denmark, Estonia, Finland, Iceland, Latvia, Lithuania, Norway and Sweden) and important stakeholders (industry, universities, funding agencies, politicians) in Nordic metrology. The project is partially financed by NORDTEST [N-MERA 2003].

A first Nordic workshop “Nordic Metrology Research Area – Stakeholders’ Views”, was held at SP in Borås, 14th May 2003. The workshop aimed at presenting and debating Nordic (including Baltic) ideas and opinions about what needs to be done to sustain and develop further national and international metrology.

Amongst the recommendations made so far in N-MERA are:

- Increased co-operation among the National Metrology Organisations (NMO) of the Nordic countries in activities such as metrological R&D, knowledge transfer, intercomparisons, etc, helped by geographical closeness and cultural similarities and to increase Nordic influence in European and global metrology initiatives and research.
- Co-operation in EUROMET is a cornerstone for the development of even the Nordic NMOs. This should remain so in the future, and the Nordic countries must remain active participants and contributors in EUROMET activities.
- Wider NMO service to industry, more involvement, local competence
- Stronger ties between NMO and academic research
- NMO and the Government: Metrology is important for innovation, sustainable growth and national strategies
-

REFERENCES

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

N-MERA 2003 “*Nordic Metrology Research Area 2003 – 2004*”, NORDTEST project
http://www.sp.se/metrology/dokument/SP_NMERA_Berlin_June_03_MERA.ppt

ANNEX G – EUROPEAN STAKEHOLDER CONSULTATION REPORT

Leslie Pendrill

European Metrology Stakeholders Consultation

SP Report 2003:13
Measurement Technology
Borås 2003

The image shows a screenshot of the EUROMET website. On the left, there is a navigation menu with the following items:

- EUROMET** logo
- NERA** logo
- [MERA Introduction](#)
- General Documentation**
- [Link to MERA WP6 International Stakeholder Enquiry](#)

Two arrows point from the 'MERA Introduction' and 'Link to MERA WP6 International Stakeholder Enquiry' items to a larger screenshot on the right. This larger screenshot shows the 'Metrology in the European Research Area - MERA' page, which includes the following text:

Metrology in the European Research Area - MERA

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 national manufacturing and industrial, regulatory and scientific customers. To ensure that the rapidly growing and the increasingly wide range of the NMIs capabilities is supported by the European R&D, the leading edge capability is a main priority. The main objective of the MERA is to provide the European metrology infrastructure with a **continuous** of increasing competence.

Current and future challenges for Europe's measurement related R&D are:

- The emergence of new areas of science and technology such as nanotechnology and biotechnology
- Increased recognition of the value of metrology in meeting societal needs, food safety, etc.
- The need to support traditional small enterprises and start-ups which are often metrology in many cases is becoming more complex.

Current issues faced, according to several NMIs and other partners, are:

- The cost of the metrology infrastructure in relation to the R&D, the development of R&D and the cost of the infrastructure for the small and medium sized companies in the European landscape. Their resources are often not sufficient to finance the increasing scientific and technical needs across Europe and thereby work.

Final vision is to have: European metrology team.

- Low or virtual cost metrology R&D
- Foster additional services
- Low or leading measurement capital flow in Europe that enables leading edge R&D in other areas

The MERA project is exploring different options aimed at creating and developing further Europe-wide metrology resources in Europe in a way of solving the above.

It is now time to have the metrological backbone of Europe defined in the infrastructure, going forward, as a principal member of European metrology and its future development. A detailed background information on the metrology project in Europe and the MERA project is available on the last page of this folder for those interested in the work on the issue in greater depth.

<http://www.euromet.org/pages/projects/proj.htm>

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

Thanks are due firstly to all those organisations who took time and thought to answer the MERA questionnaire. The encouragement and assistance of the other members of the MERA [2003] project group* with formulating this questionnaire were appreciated. Finally, the support of the European Commission, SP Swedish National Testing & Research Institute and the Ministry of Industry, Employment and Communications (grant 38:10, Maintenance of National Metrology) is gratefully acknowledged.

*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 (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.

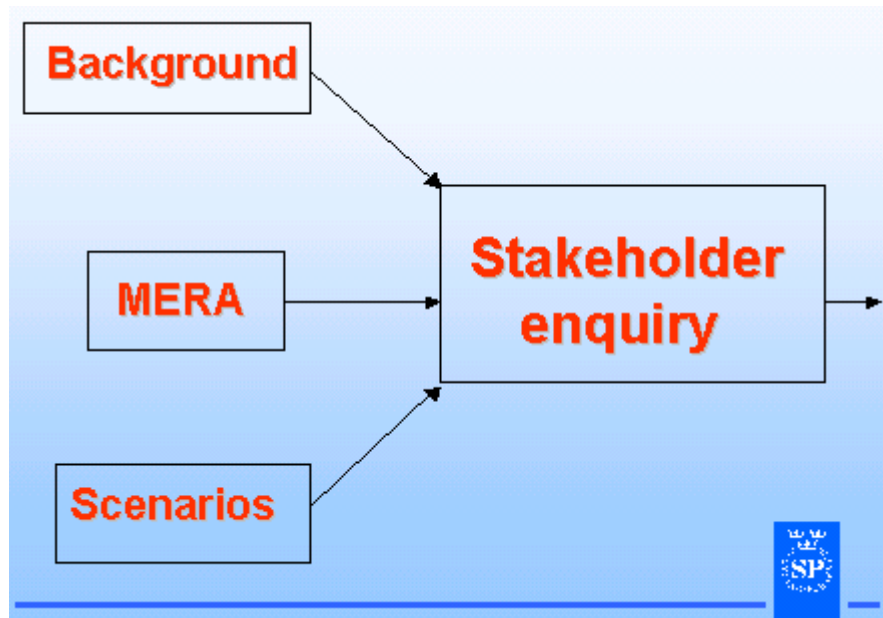


Figure G1: Stakeholder enquiry in relation to MERA project

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) Appendix A contains a copy of the background description provided for the stakeholder together with the questionnaire.

2.2 Distribution of the questionnaire

Two means of circulating the questionnaire were used:

- “glossy print” folder sent by post or handed directly to stakeholder, together with a self-addressed envelope
- e-mail directly to the stakeholder, together with a pdf file version of the questionnaire as well as an editable MS Word file of the questions

Both means of circulation contained also a link to the web-site (via the MERA homepage on the EUROMET web-site) , where the background to the MERA project and questionnaire were given in hyper-linked form, together with a downloadable pdf file version of the questionnaire.



<http://www.euromet.org/pages/projects/proj.htm>

Most questionnaires were distributed to stakeholders during April and early May 2003. The deadline for reply was set to 16th May 2003, although some replies were accepted until the end of May, in order to prepare this report as input to the second MERA workshop in Berlin on 16th June 2003.

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 G2: 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.

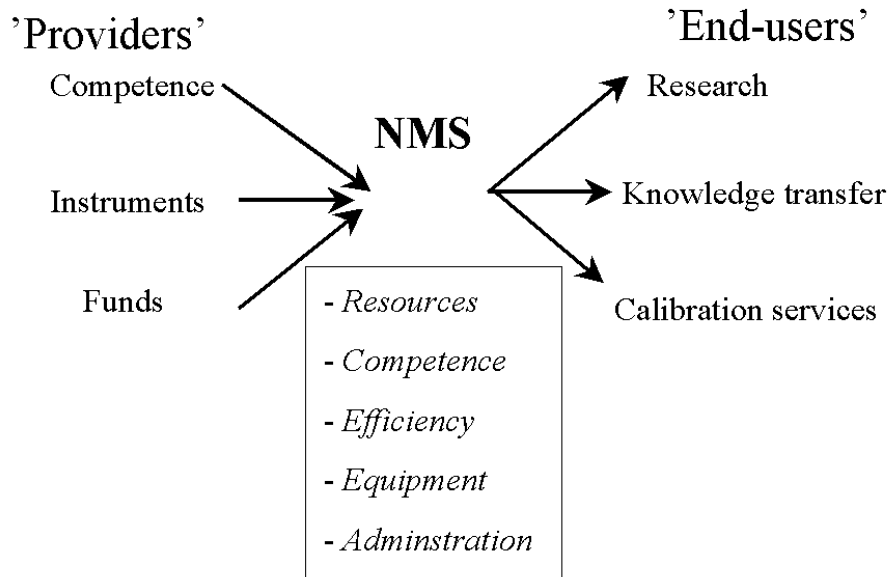


Figure G3: Classes of stakeholders in relation to the different NMS activities and competences

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.

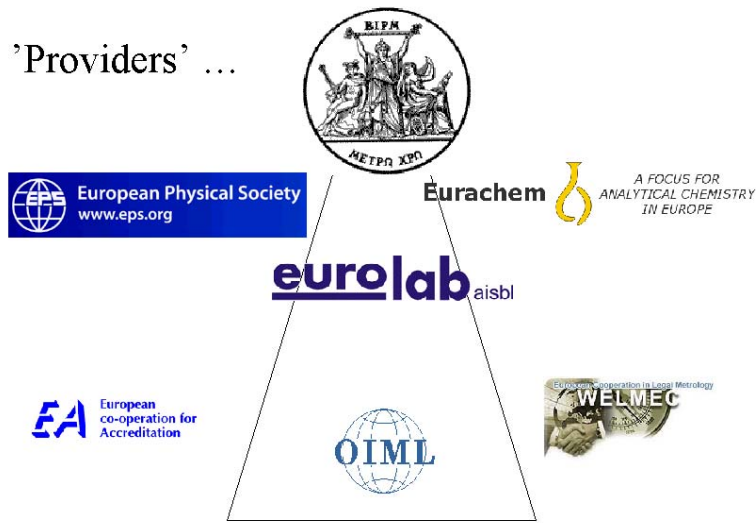


Figure G4: Provider stakeholders – examples

3.2.2 End-users

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

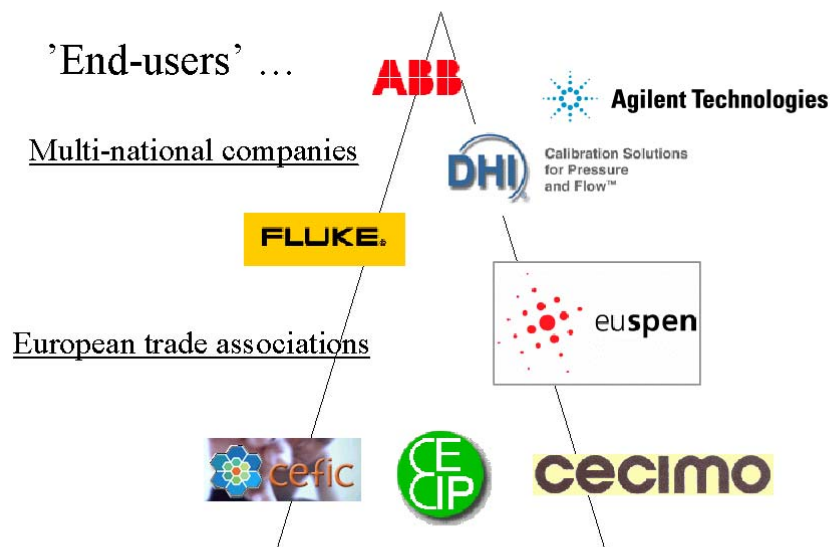


Figure G5: Examples of “End-user” stakeholders in metrology

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 that 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:

4.1.2 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.

4.1.2.1 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.”

4.1.2.2 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"/>

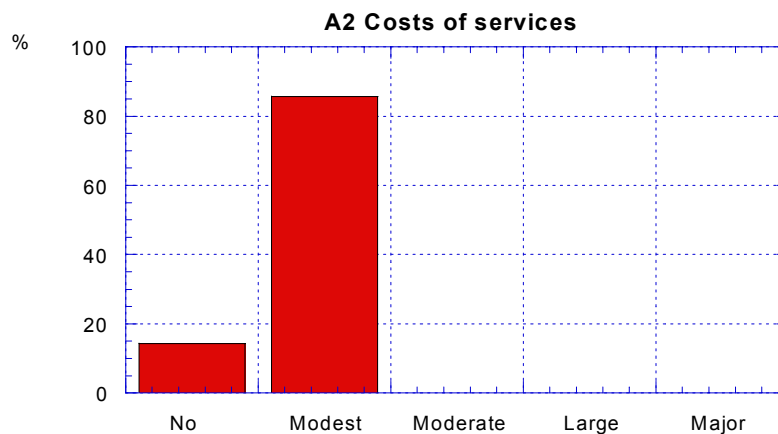


Figure G6: Question A2 Costs of services

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)

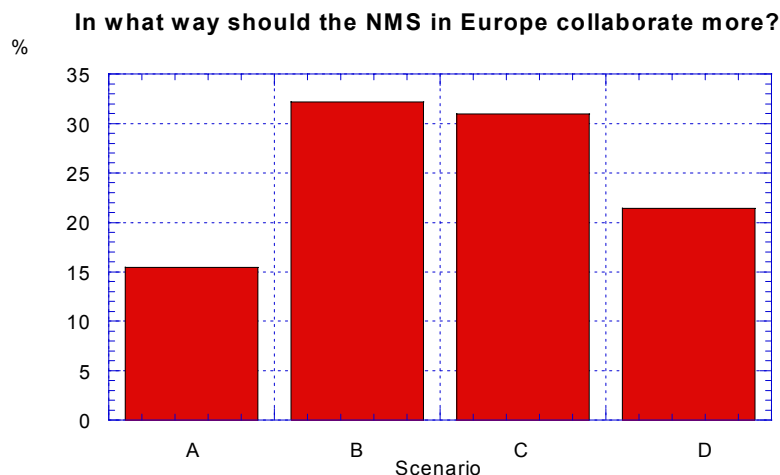


Figure G7: Question B1 In what way should the NMS in Europe collaborate more

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 NMIs to become a competence and research centre 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 NMIs (people can move from one NMI to the other!)

III: Assignment of other NMIs (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 travelling 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 centre (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 Centres 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 NMIs.

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 centres, 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

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

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(<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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WP 6: European Metrology Stakeholders consultation***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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WP 6: European Metrology Stakeholders consultation***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)]

ANNEX H – THE NAS PERSPECTIVE

H1. NAS Position towards ERA

H2. NAS Country Responses

H1. NAS Position towards ERA

Mr. Pavel Klenovsky, CMI, Czech Republic

The aim of the MERA project is to intensify current EUROMET research cooperation and lay the foundations for an integrated European Research Area (ERA) in metrology. Greater collaboration in research, shared use of facilities increased mobility of researchers as well as more effective exploitation of research will all be explored. Whilst increasing collaboration the National Metrology Institutes (NMIs) are enhancing competition in the service delivery by improving access to information on their capability and services via a common database. The opportunity exists to directly contribute to European competitiveness and enhance access to unique facilities for a greater number of EU and Accession countries and companies.

The EUROMET strategy identifies the need to meet new demands from emerging areas like nanotechnology and biotechnology whilst still supporting traditional areas of work within a budget that is not increasing in real terms. Therefore increasing the impact from the available resources is essential for the future of European metrology and the wide range of users that benefit from it. In broad terms the project will lay the foundations for a coordinated approach to meeting these metrology needs in Europe by optimising impact. However whilst MERA can plan the future, implementing it successfully will require the support of not only the NMIs, but also their funding agents and the European Commission, and of course the user community - an exciting challenge for the coming years.

In the special case of NAS countries the thrust has been to establish independent national metrological capability in many of the NAS as part of the accession process managed by the European Commission. However this is now somewhat contradictory with the ERA concept, and to a degree, with the EUROMET strategy. Consequently it is important that NAS perspective of the concept of an interdependent ERA in metrology is properly examined and the implications analysed. The views of the NAS countries have been collected by means of a questionnaire providing a basic input to formulate a NAS position. The questionnaire was distributed, after a presentation during the NMI workshop, on January 10, 2003 to NMIs of the following countries: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, the Slovak Republic, Slovenia and Turkey (Cyprus is not an EUROMET member). The filled-in questionnaires are enclosed. Pursuing the approved implementation plan a draft NAS position paper summarizing the input was prepared and subsequently discussed with directors of the NMIs involved.

To have a clear view of the underlying background it has to be pointed out that the overall development in some of these countries has been, after the collapse of socialism, rather turbulent with metrology not being very high on the list of priorities. A considerable fragmentation has taken place generating as a result a number of new and relatively small countries with limited resources and infrastructure in metrology, bringing the development many years back. In majority of countries, the authorities have had to come to terms with the legacy of the former GOSSTANDARD-type structures and to decide upon their transformation to adapt them to new challenges. After a number of organizational changes a stabilized structure of organizations has emerged recently with dedicated bodies for individual standardization activities (metrology, accreditation, testing, normalization), as recommended by the European Commission.

In metrology area itself, the national metrology institutes (NMIs) are now various mixtures of the basic sectors of metrology (fundamental, industrial and legal metrology) being in a very wide range of situations: with only a very few facilities in small economies over to NMIs trying to catch up with the demand after splits of their original countries up to more or less intact structures being developed

continuously in a historical perspective (Hungary, Poland, Slovakia). Under the auspices of the EU, a continuous shift of emphasis from legal metrology, as conceived in the socialist economy, to industrial applications of metrology is being implemented in the NMIs concerned. The organizational structures available in relation to physical metrology vary widely between distributed systems (Slovenia) up to highly integrated systems (Poland, Hungary, Czech Republic) benefiting from synergies between various sectors of metrology. In the area of metrology in chemistry all the NMIs are now trying to find the way to cope with the demands, predominantly addressing the problem by means of a system of associated laboratories as foreseen by the CIPM MRA.

In every case, any development on the part of those NMIs has had to be based on some form of foresight studies analysing the demand of local economies for metrological services, obviously from the national perspective. These exercises have led to identification of new areas of development being subsequently brought to an implementation phase, frequently with the assistance of foreign aid (EU PHARE, G 24 of Switzerland, PSO of the Netherlands, PTB of Germany, BNM of France, EU JRC IRMM). Apart from historically well-developed subject fields these new areas of activity have now reached a stabilized status with an established technical competence (e.g. based on CIPM MRA, participation in EUROMET projects) but only with very limited capacities assigned to that job.

The analysis of the data from the questionnaires indicates that ca 70 – 90 % of capacities are now devoted to various kinds of metrological services (calibration, verification, testing) – only in Bulgaria and Slovakia the percentage is considerably lower. Apart from the area of metrological services, in the area of R&D in a broader sense, the decisive part of capacities is assigned to maintenance and development of national standards (10 to 20 % of the total), whatever they are, which have the character, at maximum, of applied research only. Independently assessed, dedicated research projects form only a fraction of the capacities available (0 to 10 % of the total) being in most cases in an infant stage of development. At any rate, these projects are not set up and operated along the lines of the ERA principles. Also the very low share of contract research and of international R&D funding clearly demonstrate a negligible experience with the ERA principles in practice. This international funding comes now mostly from EUROMET EU-funded projects like MetroTrade, RegMet, Initiation which therefore play a crucial role in the process of adaptation to ERA-based research in the NAS NMIs. The EU funding rules in earlier stages of the accession process (PHARE) were drawn strictly along the national lines, not encouraging a built-up of any regional capabilities, and the funding has gone, to a large extent, to purchase of equipment so that a relatively high percentage of equipment in the NAS NMIs (10 to 40 % in average) is now of this international origin. In small countries founded as a result of a split the share is logically higher (Lithuania, Latvia) and Turkey has gone the bold path of a Government-guaranteed credit from the World Bank.

As far as the legislative background is concerned, there is no major problem to pool non-investment funds to finance ERA-based research projects – they are capital investments where the problem lies. For any effective ERA-based projects and resulting devolutions the corresponding change in the legislation of the NAS countries (and probably not only of those) related to Government bodies (most of the NMIs) will have to be accomplished.

Generally from the perspective of the NAS countries, the ERA concept of research in metrology is very welcome idea that potentially can unleash a great potential in research on the part of participating NMIs and could lead to more effective use of current resources and capacities. It is beneficial for all the European NMIs, small and large, in a way that it might amplify the results achieved, partially even to overcome the reductions in capacities in some current member states (employing young researchers from NAS countries etc.). The NAS NMIs are more or less keen to take part in the ERA-based research had not been for severe limitations given by scarce resources, capacities, language skills etc. – the capacities assigned within the NAS NMIs to dedicated research

are currently very low. Actions that would facilitate participation in ERA-based projects can be summarised from the viewpoint of the NAS countries as follows:

- to establish a funding line from a single source (e.g. the EC) for such type of integrated projects (as is the case elsewhere in a similar situation);
- greater participation in bilateral, regional and EUROMET projects;
- greater involvement in common projects with R&D bodies on a national level.

What has been mentioned above is largely applicable to classical physical metrology – in the new areas (metrology in chemistry - MiC, biology etc.) the situation is different: the capacities assigned to these areas are in early stages of development. The problem here is that demand for traceability is not yet fully established with the exceptions of traditional electrochemistry and of gas mixtures as driven by legal metrology requirements (calibration of exhaust gas analysers, of alcohol breath analysers). This demand is now being mapped with full use of local expertise of other bodies on national levels. If any areas of future development are identified in MiC they surely will have to be addressed by the advanced ERA-based approach (scenario C). In this context, the NAS NMIs appreciate very much the assistance provided by EU JRC IRMM concentrated mainly on training of experts from chemical labs at large (www.trainmic.org) – the program should be extended and expanded, if possible.

Whereas the strategy is to participate in research projects based on the ERA approach to a maximum extent the NAS countries are presently not prepared to devolve any subject field currently made available to (predominantly national) customers – it is basically nothing here to devolve from. Furthermore, the experience shows that national stakeholders are not very enthusiastic about any devolution. There is also an apprehension in most countries that a hasty embarkation on the ERA concept including devolutions can potentially lead to terminal loss of expertise on national levels. In accordance with the above, any major thrust into MiC in traceability issues will have to be financed using national budgetary resources at this stage, either through NMIs or through a network of associated labs.

In conclusion, the thrust of the NAS NMIs into dedicated research along the ERA concept should surely be strengthened in future for a number of reasons, among others to enhance the level of expertise of the staff members in the individual subject fields. This development might be accompanied by a transformation of the NMIs in various subject fields into service centres (centres of excellence) in sub-regions. On the other hand, any major devolutions cannot be realistically expected in the NAS NMIs in near future and if any, they might be a part of the above mentioned transformation into a local service centre in some subject fields in a given sub-region – simply, the scenario B under the MERA concept is currently widely preferred among the NAS NMIs.

H2. NAS Country Responses

Questionnaire

NMI:	NCM
Country:	BULGARIA
Contact person:	STEFKA HRISTOVA
Email:	ncmdiv@sasm.orbitel.bg

1.	The structure of activities of your NMI (give a fraction of the total):	
	a)	dedicated R&D (projects eligible to be officially registered as basic or applied R&D nationally)
		5 %
	b)	contract research for other Government departments (ministries) or agencies and private bodies
		0
	c)	development and maintenance of national standards (including comparisons, traceability agreements)
		40 %
	d)	calibration and other services in non-regulated area
		55 %
	e)	legal metrology activities
		0
	f)	other non-metrology services (testing etc.)
		0

2.						
	a)	Which sources of R&D funding are now available nationally and have been used by your institute:				
		available			being used	
	- funding of research in industry	yes		no	yes	no
				no		no
	- national science foundation (grants)	yes		no	yes	no
				no		no
	- special funding from your ministry	yes		no	yes	no
		yes			yes	

- international science foundations	yes	no	yes	no
		no		no
- 5 th Framework program of the EU	yes	no	yes	no
	yes			no
- other (specify which ones)	yes	no	yes	no
Estimate the % of R&D funding from all sources which is international in origin:				
				0

2.					
b)	Which international sources (if any) of equipment/infrastructure funding are available to you?				
	available		being used		
- EU non-Framework Programme	yes	no	yes	no	
	yes		yes		
- World Bank	yes	no	yes	no	
	yes		no		
-Other (specify which ones)	yes	no	yes	no	
	IRMM, BIPM		IRMM		
If you receive any of the above:					
Would the funding rules allow for the provision of regional (i.e. more than one country) capability rather than solely national capability, (please identify for each international body that funds you)?					
All international sources used are directed to establishment of national capabilities.					
Estimate the % of equipment/infrastructure funding from all sources available to your laboratory, which is international in origin:					
				40 %	

3.	Is it a part of your future strategy to participate in ERA-based coordinated approach to research in metrology with subsequent possible devolutions in the scope of your current activities in some fields and expansions to new fields ?
	Yes
4.	As regards the activity 1a) and b), have the elements of the ERA concept been already applied in research carried out nationally (work in international teams etc.) ? If yes, please, specify the fraction of the total.
	No
5.	Have you recently made a foresight project to analyse the future metrological needs of your economy ? If yes, please will you send a short synopsis or a final report.
	Yes, according to the Law on Measurements from 2002 development of national measurement standards is based on study and analysis of economy needs on traceability of measurements. First study is elaborated under the PHARE 2000 project BG0003.02.02. The final report will be available at the end of the year.
6.	Are there capacities available in your sector of fundamental metrology at present enabling you a participation in ERA-based projects?
	Yes, in limited areas.
7.	It is at all permitted by your national legislation:
	- to share funds for R&D projects
	No
	- to share investment funds to establish and recurrent funds to operate common facilities ?
	No
8.	Are there any other reasons that could prevent a participation of your NMI in ERA-based projects or a wider concept of an ERA in metrology? Please, specify which ones if applicable.
	No

9.	Are there any actions you can identify that would facilitate participation in ERA based projects or a wider concept of an ERA in metrology?
	<p>In cases of countries with developing economies where national metrology institutes implement primary methods and techniques in narrow areas it is necessary to establish close regional cooperation and even specialization.</p> <p>Participation in ERA based project could be achieved through cooperation with national research institutes and universities.</p>
10.	General comments to the ERA concept in metrology from the perspective of your NMI:
	ERA concept should not prevent availability of metrology expertise that should facilitate national economy to be competitive at EU market.

Questionnaire

NMI:	Czech Metrology Institute
Country:	Czech Republic
Contact person:	Pavel Klenovsky
Email:	pklenovsky@cmi.cz

1.	The structure of activities of your NMI (give a fraction of the total):	
	a)	dedicated R&D (projects eligible to be officially registered as basic or applied R&D nationally)
		0 (2,5 % 2003)
	b)	contract research for other Government departments (ministries) or agencies and private bodies
		0
	c)	development and maintenance of national standards (including comparisons, traceability agreements)
		20 %
	d)	calibration and other services in non-regulated area
		38 %
	e)	legal metrology activities
		38 %
	f)	other non-metrology services (testing etc.)
		4 %

2.						
	a)	Which sources of R&D funding are now available nationally and have been used by your institute:				
		available			being used	
	- funding of research in industry	yes		no	Yes	no
		x				x
	- national science foundation (grants)	yes		no	Yes	no
		x			x	
	- special funding from your ministry	yes		no	yes	no
		x			x	

	- international science foundations	yes	no	yes	no
		x			x
	- 5 th Framework program of the EU	yes	no	yes	no
		x		x	
	- other (specify which ones)	yes	no	yes	no
			x		x
Estimate the % of R&D funding from all sources which is international in origin:					
				5,8 %	

2.					
b)	Which international sources (if any) of equipment/infrastructure funding are available to you?				
		available		being used	
	- EU non-Framework Programme	yes	no	yes	no
			x		x
	- World Bank	yes	no	yes	no
		x			x
	-Other (specify which ones)	yes	no	yes	no
	G 24, PSO (Netherlands)		x		x
If you receive any of the above:					
Would the funding rules allow for the provision of regional (i.e. more than one country) capability rather than solely national capability, (please identify for each international body that funds you)?					
No. Pre-accession funds have been made available to allow the necessary capacity building for the quality infrastructure.					
Estimate the % of equipment /infrastructure funding from all sources available to your laboratory, which is international in origin:					
Infrastructure : 100% National Funding				Equip: 16 %	

3.	Is it a part of your future strategy to participate in ERA-based coordinated approach to research in metrology with subsequent possible devolutions in the scope of your current activities in some fields and expansions to new fields ?
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	Our strategy is to participate in research projects based on the ERA approach to a maximum extent but we are not prepared at the moment to devolve any subject field currently made available by CMI + associated labs.
4.	As regards the activity 1a) and b), have the elements of the ERA concept been already applied in research carried out nationally (work in international teams etc.) ? If yes, please, specify the fraction of the total.
	No.
5.	Have you recently made a foresight project to analyse the future metrological needs of your economy ? If yes, please will you send a short synopsis or a final report.
	A foresight project aimed at metrology in the CR was made in 2000 - 2001 and since then it has been regularly updated.
6.	Are there capacities available in your sector of fundamental metrology at present enabling you a participation in ERA-based projects ?
	Yes, to a very limited amount.
7.	It is at all permitted by your national legislation:
	- to share funds for R&D projects
	Yes.
	- to share investment funds to establish and recurrent funds to operate common facilities ?
	No, against the current legislation for Government bodies.
8.	Are there any other reasons that could prevent a participation of your NMI in ERA-based projects or a wider concept of an ERA in metrology? Please, specify which ones if applicable.
	Capabilities available, language skills (somewhere).
9.	Are there any actions you can identify that would facilitate participation in ERA based projects or a wider concept of an ERA in metrology?
	Establishing a funding line from a single source (e.g. the EC) for such type of integrated projects.
10.	General comments to the ERA concept in metrology from the perspective of your NMI:

	<p>Very welcome idea that potentially can unleash a great potential in research on the part of NMIs and could lead to more effective use of current resources and capacities. It is beneficial for all the European NMIs, small and large, in a way that it might amplify the results achieved, partially to overcome the reductions in capacities in some current member states (employing young researchers from NAS countries etc.).</p>
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Questionnaire

NMI:	National Office of Measures (OMH)
Country:	Hungary
Contact person:	Dr. Peter Pataki
Email:	ppataki@omh.hu

1.	The structure of activities of your NMI (give a fraction of the total):	
	a)	dedicated R&D (projects eligible to be officially registered as basic or applied R&D nationally)
		0
	b)	contract research for other Government departments (ministries) or agencies and private bodies
		0
	c)	development and maintenance of national standards (including comparisons, traceability agreements)
		20%
	d)	calibration and other services in non-regulated area
		28%
	e)	legal metrology activities
		50%
	f)	other non-metrology services (testing etc.)
		2%

2.						
	a)	Which sources of R&D funding are now available nationally and have been used by your institute:				
		available			being used	
	- funding of research in industry	yes	no	yes	no	
		x				x
	- national science foundation (grants)	yes	no	yes	no	
		x		x		
	- special funding from your ministry	yes	no	yes	no	
		x				x

	- international science foundations	yes	no	yes	no
		x			x
	- 5 th Framework program of the EU	yes	no	yes	no
		x			x
	- other (specify which ones)	yes	no	yes	no
			x		
Estimate the % of R&D funding from all sources which is international in origin:					
				0	

2.					
b)		Which international sources (if any) of equipment/infrastructure funding are available to you?			
	<i>equipments</i>	available		being used	
	- EU non-Framework Programme	yes	no	yes	no
	- PHARE	x		x	
	- World Bank	yes	no	yes	no
			x		
	-Other (specify which ones)	yes	no	yes	no
			x		
If you receive any of the above:					
Would the funding rules allow for the provision of regional (i.e. more than one country) capability rather than solely national capability, (please identify for each international body that funds you)?					
Estimate the % of equipment /infrastructure funding from all sources available to your laboratory, which is international in origin:					
				10%	

3.	Is it a part of your future strategy to participate in ERA-based coordinated approach to research in metrology with subsequent possible devolutions in the scope of your current activities in some fields and expansions to new fields ?
	<i>NO</i>
4.	As regards the activity 1a) and b), have the elements of the ERA concept been already applied in research carried out nationally (work in international teams etc.) ? If yes, please, specify the fraction of the total.
	<i>NO</i>
5.	Have you recently made a foresight project to analyse the future metrological needs of your economy ? If yes, please will you send a short synopsis or a final report.
	We are not ready yet.
6.	Are there capacities available in your sector of fundamental metrology at present enabling you a participation in ERA-based projects ?
	<i>NOT REALLY</i>
7.	It is at all permitted by your national legislation:
	- to share funds for R&D projects
	<i>YES</i>
	- to share investment funds to establish and recurrent funds to operate common facilities ?
	<i>NO</i>
8.	Are there any other reasons that could prevent a participation of your NMI in ERA-based projects or a wider concept of an ERA in metrology? Please, specify which ones if applicable.
	The limited resources, capacities and abilities.

9.	Are there any actions you can identify that would facilitate participation in ERA based projects or a wider concept of an ERA in metrology?
10.	General comments to the ERA concept in metrology from the perspective of your NMI:
	ERA is a concept of the so called “primer” NMIs. We work mainly in the “secondary” field, so we are interested in the traceability agreements.

Questionnaire

NMI:	Latvian National Metrology Centre (LNMC)
Country:	Latvia
Contact person:	Māris Dāvis
Email:	maris@lnmc.lv

1.	The structure of activities of your NMI (give a fraction of the total):	
	a)	dedicated R&D (projects eligible to be officially registered as basic or applied R&D nationally)
		10 %
	b)	contract research for other Government departments (ministries) or agencies and private bodies
		-
	c)	development and maintenance of national standards (including comparisons, traceability agreements)
		10 %
	d)	calibration and other services in non-regulated area
		20 %
	e)	legal metrology activities
		55 %
	f)	other non-metrology services (testing etc.)
		5 %

2.						
	a)	Which sources of R&D funding are now available nationally and have been used by your institute:				
		available			being used	
	- funding of research in industry	yes	no		yes	no
			+			+
	- national science foundation (grants)	yes	no		yes	no
			+			+
	- special funding from your ministry	yes	no		yes	no
			+			+

- international science foundations	yes	no	yes	no
		+		+
- 5 th Framework program of the EU	yes	no	yes	no
	+			+
- other (specify which ones)	yes	no	yes	no
		+		+
Estimate the % of R&D funding from all sources which is international in origin:				
				40 %

2.				
b)	Which international sources (if any) of equipment/infrastructure funding are available to you?			
	available		being used	
- EU non-Framework Programme	yes	no	yes	no
		+		+
- World Bank	yes	no	yes	no
		+		+
-Other (specify which ones)	yes	no	yes	no
	PHARE		+	
If you receive any of the above:				
Would the funding rules allow for the provision of regional (i.e. more than one country) capability rather than solely national capability, (please identify for each international body that funds you)?				
This PHARE funding will allow for the provision of national capability (only PHARE is funding us)				
Estimate the % of equipment/infrastructure funding from all sources available to your laboratory, which is international in origin:				
				60 %

3.	Is it a part of your future strategy to participate in ERA-based coordinated approach to research in metrology with subsequent possible devolutions in the scope of your current activities in some fields and expansions to new fields ?
	Yes
4.	As regards the activity 1a) and b), have the elements of the ERA concept been already applied in research carried out nationally (work in international teams etc.) ? If yes, please, specify the fraction of the total.
	No
5.	Have you recently made a foresight project to analyse the future metrological needs of your economy ? If yes, please will you send a short synopsis or a final report.
	Research project “Development of the conception of scientific metrology in Latvia” set policy for the development of metrology, which should be oriented towards increasing accuracy of national base units of measurement standards and formulated the key tasks in scientific metrology.
6.	Are there capacities available in your sector of fundamental metrology at present enabling you a participation in ERA-based projects ?
	No
7.	It is at all permitted by your national legislation:
	- to share funds for R&D projects
	Yes
	- to share investment funds to establish and recurrent funds to operate common facilities ?
	No
8.	Are there any other reasons that could prevent a participation of your NMI in ERA-based projects or a wider concept of an ERA in metrology? Please, specify which ones if applicable.
	No

9.	Are there any actions you can identify that would facilitate participation in ERA based projects or a wider concept of an ERA in metrology?
	-
10.	General comments to the ERA concept in metrology from the perspective of your NMI:
	<p>-..LNMC will focus on the needs of scientific metrology, i.e., development and maintenance of national measurement standards (including comparisons, traceability agreements).</p> <ul style="list-style-type: none"> - Research cooperation among NMIs will be increased. - Future perspective vision – metrological infrastructure in the country with EUROMET strategy.

Questionnaire

NMI:	State Metrology Service (VMT) VMT/LEI, VMT/PFI, VMT/VMC)
Country:	Lithuania
Contact person:	Osvaldas Staugaitis
Email:	info@lvmt.lt

1.	The structure of activities of your NMI (give a fraction of the total):	
	a)	Dedicated R&D (projects eligible to be officially registered as basic or applied R&D nationally)
		<p>1. Developing the air flow rate and volume standard based on weighing method. Nr. 2-12-113-1.3, 2001-2003 (national).</p> <p>2. Investigation of liquid flow in pursuance to improve the reproducing the values of liquid flow rate and volume. Nr. 2-12-121-1.2, 2001-2003 (national)</p> <p>3. NAS-BioNorm Project No. NNE5-2001-00874.</p> <p>4. MID-Procedures. Registration No. GTC1-2001-43011.</p> <p>5. Project INTAS–01-0257 “Smart sensors in environment protection”</p>
	b)	contract research for other Government departments (ministries) or agencies and private bodies
		<p>1. Preparation of technical regulation according to EC directives 90/396/EEC, 92/42/EEC and 78/170/EEC (82/885/EEC), 2001-2003</p> <p>2. Implementation of measures of the national program “Development of Infrastructure (Testing Laboratories and Certification Bodies) in Conformity Assessment” approved by the Government, 2002-2003.</p> <p>3. Investigation of natural gas supply/consumption balance in Lithuania according to contract with national company “Lithuanian Gas”. 2002.</p>
	c)	development and maintenance of national standards (including comparisons, traceability agreements)
		<p>1. EUROMET intercomparisons: projects 445, 473, 496, 510, 592, 594, 600, 601, 552.</p> <p>2. Other intercomparisons: NORDTEST NT 1610-02-2, EA E127.</p>
	d)	calibration and other services in non-regulated area
		Calibration of various measuring instruments, etc.
	e)	legal metrology activities

Verification of measurement equipment. Validation of test facilities in the legal metrology field.	Up to 70%
f) other non-metrology services (testing etc.)	
Authorized and accredited activity (to ISO 17025) in the field of testing the gas appliances, hot water boilers, wood-fired boilers. Training activities in training of specialists for industry.	Up to 10 %

2.					
a)	Which sources of R&D funding are now available nationally and have been used by your institute:				
		available		being used	
	- funding of research in industry	yes		yes	
		x		x	
	- national science foundation (grants)	yes		yes	
		x		x	
	- special funding from your ministry	yes		yes	
		x		x	
	- international science foundations	yes	no	yes	no
		x		x	
	- 5 th Framework program of the EU	yes		yes	
		x		x	
	- other (specify which ones)	yes		yes	
		x		x	
	<i>Other: Program of Lithuania-Ukraine science-technical cooperation 2002-2004.</i>				
	Estimate the % of R&D funding from all sources which is international in origin:				
					Up to 5 %

2.					
b)	Which international sources (if any) of equipment/infrastructure funding are available to you?				
		available		being used	
	- EU non-Framework Programme	yes		yes	
		x		x	
	- World Bank		no		no

				x			x
	-Other (specify which ones)	yes			yes		
		x			x		
	<p><i>Equipment – PHARE program, Swiss Government, IAEA.</i></p> <p><i>Infrastructure –Project No. LIT 0127, 2001-2003, Denmark; CEN PHARE (PRAQ I-III; Phare twinning project LI 0003-01, 2002-2003 (on-going); FEU LIT 0168 with DFM (to start in March); co-operation agreement with PTB; LIT06/15 PHARE project.</i></p>						
	If you receive any of the above:						
	Would the funding rules allow for the provision of regional (i.e. more than one country) capability rather than solely national capability, (please identify for each international body that funds you)?						
	<p><i>In practice, funding and collaboration enable to strengthen regional capability, especially in order to ensure the free movement of goods on the market and harmonize procedures in the metrology and certification fields. Nevertheless, if it is specified in the agreement (contract) that certain equipment provided by an external body would go to one, two or more countries, there is no problem. As an example, there was IAEA funded regional project and some equipment was supplied to all three Baltic countries (Lithuania, Latvia and Estonia).</i></p>						
	Estimate the % of equipment/infrastructure funding from all sources available to your laboratory, which is international in origin:						
							Up to 60%
3.	Is it a part of your future strategy to participate in ERA-based coordinated approach to research in metrology with subsequent possible devolutions in the scope of your current activities in some fields and expansions to new fields ?						
	Yes						
4.	As regards the activity 1a) and b), have the elements of the ERA concept been already applied in research carried out nationally (work in international teams etc.) ? If yes, please, specify the fraction of the total.						
	<p><i>1. Improvement of measurement methods and techniques.</i></p> <p><i>2. Harmonization of requirements for measurement and testing the efficiency of heat generators.</i></p> <p><i>3. Development of standard test procedures of heat generators firing the various types of biofuels.</i></p>						
5.	Have you recently made a foresight project to analyse the future metrological needs of your economy ? If yes, please will you send a short synopsis or a final report.						
	<p><i>Such an analysis was performed by State Metrology Service, research institutes, industrial bodies and universities several years ago. It is planned to review the</i></p>						

	<i>analysis in the near future.</i>
6.	Are there capacities available in your sector of fundamental metrology at present enabling you a participation in ERA-based projects ?
	<i>Yes.</i>
7.	It is at all permitted by your national legislation:
	- to share funds for R&D projects
	<i>There are no specific barriers.</i>
	- to share investment funds to establish and recurrent funds to operate common facilities ?
	<i>There are no specific barriers, but no experience as well.</i>
8.	Are there any other reasons that could prevent a participation of your NMI in ERA-based projects or a wider concept of an ERA in metrology? Please, specify which ones if applicable.
	<i>Financial problems.</i>
9.	Are there any actions you can identify that would facilitate participation in ERA based projects or a wider concept of an ERA in metrology?
	<i>No</i>
10.	General comments to the ERA concept in metrology from the perspective of your NMI:
	<i>Interesting and promising concept.</i>

Questionnaire

NMI:	Malta Standards Authority
Country:	Malta
Contact person:	Joseph A.Bartolo
Email:	joseph.Bartolo@msa.org.mt

1.	The structure of activities of your NMI (give a fraction of the total):	
	a)	dedicated R&D (projects eligible to be officially registered as basic or applied R&D nationally)
		0
	b)	contract research for other Government departments (ministries) or agencies and private bodies
		0
	c)	development and maintenance of national standards (including comparisons, traceability agreements)
		60
	d)	calibration and other services in non-regulated area
		25
	e)	legal metrology activities
		15
	f)	other non-metrology services (testing etc.)
		0

2.						
	a)	Which sources of R&D funding are now available nationally and have been used by your institute:				
		available			being used	
	- funding of research in industry	yes		no	Yes	no
				x		x
	- national science foundation (grants)	yes		no	Yes	no
				x		x
	- special funding from your ministry	yes		no	yes	no
				x		x

	- international science foundations	yes	no	yes	no
			x		x
	- 5 th Framework program of the EU	yes	no	yes	no
			x		x
	- other (specify which ones)	yes	no	yes	no
			x		x
Estimate the % of R&D funding from all sources which is international in origin:					
				0	

2.					
b)	Which international sources (if any) of equipment/infrastructure funding are available to you?				
		available		being used	
	- EU non-Framework Programme	yes	no	yes	no
		y		y	
	- World Bank	yes	no	yes	no
			x		x
	-Other (specify which ones)	yes	no	yes	no
			x		x
If you receive any of the above:					
Would the funding rules allow for the provision of regional (i.e. more than one country) capability rather than solely national capability, (please identify for each international body that funds you)?					
No. Pre-accession funds have been made available to allow the necessary capacity building for the quality infrastructure.					
Estimate the % of equipment/infrastructure funding from all sources available to your laboratory, which is international in origin:					
Infrastructure : 100% National Funding				Equip: 100%	

3.	Is it a part of your future strategy to participate in ERA-based coordinated approach to research in metrology with subsequent possible devolutions in the scope of your current activities in some fields and expansions to new fields ?
-----------	---

	It is envisaged in our new Metrology Act that should the need and circumstances arise that collaborative work in the fields of metrology not catered for internally may take place with external partners.
4.	As regards the activity 1a) and b), have the elements of the ERA concept been already applied in research carried out nationally (work in international teams etc.) ? If yes, please, specify the fraction of the total.
	NO.
5.	Have you recently made a foresight project to analyse the future metrological needs of your economy ? If yes, please will you send a short synopsis or a final report.
	The startup phase we are currently in stems from two requirements , <ol style="list-style-type: none"> 1) making available the most basic setup to allow the proper dissemination of mass for the legal metrology service which is also just starting up. 2) to assist local industry in having available at hand , some traceable standards and facilitate the needs of traceable measurement for local testing and calibration labs to acquire accreditation.
6.	Are there capacities available in your sector of fundamental metrology at present enabling you a participation in ERA-based projects ?
	No
7.	It is at all permitted by your national legislation:
	- to share funds for R&D projects
	Not contemplated
	- to share investment funds to establish and recurrent funds to operate common facilities ?
	Not contemplated. (NOTE: Buying into a required service is much more the norm since in most circumstances it would be on a one off basis)
8.	Are there any other reasons that could prevent a participation of your NMI in ERA-based projects or a wider concept of an ERA in metrology? Please, specify which ones if applicable.
	Scope and applicability mainly
9.	Are there any actions you can identify that would facilitate participation in ERA based projects or a wider concept of an ERA in metrology?
10.	General comments to the ERA concept in metrology from the perspective of your NMI:

Questionnaire

NMI:	CENTRAL OFFICE OF MEASURES
Country:	POLAND
Contact person:	BARBARA LISOWSKA – VICE PRESIDENT
Email:	vprbl@gum.gov.pl

1.	The structure of activities of your NMI (give a fraction of the total):	
	a)	dedicated R&D (projects eligible to be officially registered as basic or applied R&D nationally)
		0 %
	b)	contract research for other Government departments (ministries) or agencies and private bodies
		0 %
	c)	development and maintenance of national standards (including comparisons, traceability agreements)
		5 %
	d)	calibration and other services in non-regulated area
		0 %
	e)	legal metrology activities
		46 %
	f)	other non-metrology services (testing etc.)
		49 %
		administration activity

2.						
	a)	Which sources of R&D funding are now available nationally and have been used by your institute:				
		available			being used	
		yes	no		yes	no
	- funding of research in industry		X			X
	- national science foundation (grants)	yes	no		yes	no
		X				X
	- special funding from your ministry	yes	no		yes	no
		X			X	

	- international science foundations	yes	no	yes	no
			X		X
	- 5 th Framework program of the EU	yes	no	yes	no
			X		X
	- other (specify which ones)	yes	no	yes	no
	national budget	X		X	
Estimate the % of R&D funding from all sources which is international in origin:					
					0 %

2.					
b)	Which international sources (if any) of equipment/infrastructure funding are available to you?				
		available		being used	
	- EU non-Framework Programme	yes	no	yes	no
			X		X
	- World Bank	yes	no	yes	no
			X		X
	-Other (specify which ones)	yes	no	yes	no
	PHARE Programs	X		X	
If you receive any of the above:					
Would the funding rules allow for the provision of regional (i.e. more than one country) capability rather than solely national capability, (please identify for each international body that funds you)?					
Estimate the % of equipment/infrastructure funding from all sources available to your laboratory, which is international in origin:					
					2 %

3.	Is it a part of your future strategy to participate in ERA-based coordinated approach to research in metrology with subsequent possible devolutions in the scope of your current activities in some fields and expansions to new fields ?
	YES. It is a part of our future strategy.
4.	As regards the activity 1a) and b), have the elements of the ERA concept been already applied in research carried out nationally (work in international teams etc.) ? If yes, please, specify the fraction of the total.
	NO.
5.	Have you recently made a foresight project to analyse the future metrological needs of your economy ? If yes, please will you send a short synopsis or a final report.
	No. GUM has not made such a project.
6.	Are there capacities available in your sector of fundamental metrology at present enabling you a participation in ERA-based projects ?
	There are limited capacities.
7.	It is at all permitted by your national legislation:
	- to share funds for R&D projects
	YES.
	- to share investment funds to establish and recurrent funds to operate common facilities ?
	NO.
8.	Are there any other reasons that could prevent a participation of your NMI in ERA-based projects or a wider concept of an ERA in metrology? Please, specify which ones if applicable.
	NO.
9.	Are there any actions you can identify that would facilitate participation in ERA based projects or a wider concept of an ERA in metrology?

10.	General comments to the ERA concept in metrology from the perspective of your NMI:

Questionnaire

NMI:	NATIONAL INSTITUTE OF METROLOGY
Country:	ROMANIA
Contact person:	Ionel Urdea Marcus
Email:	urdea@inm.ro

1.	The structure of activities of your NMI (give a fraction of the total):		
	a)	dedicated R&D (projects eligible to be officially registered as basic or applied R&D nationally)	
			6 %
	b)	contract research for other Government departments (ministries) or agencies and private bodies	
			0 %
	c)	development and maintenance of national standards (including comparisons, traceability agreements)	
			10 %
	d)	calibration and other services in non-regulated area	
			40 %
	e)	legal metrology activities	
			31 %
	f)	other non-metrology services (testing etc.)	
			13 %

2.					
	a)	Which sources of R&D funding are now available nationally and have been used by your institute:			
		available		Being used	
	- funding of research in industry	yes	no	yes	no
		•		•	
	- national science foundation (grants)	yes	no	yes	no
		•		•	
	- special funding from your ministry	yes	no	yes	no
			•		•

	- international science foundations	yes	no	yes	no
			•		•
	- 5 th Framework program of the EU	yes	no	yes	no
		•			•
	- other (specify which ones)	yes	no	yes	no
	German Government (PTB) French Government (BNM)	•		•	
Estimate the % of R&D funding from all sources which is international in origin:					
				3 %	

2.					
b)	Which international sources (if any) of equipment/infrastructure funding are available to you?				
		available		being used	
	- EU non-Framework Programme	yes	no	yes	no
		•		•	
	- World Bank	yes	no	yes	no
			•		•
	-Other (specify which ones)	yes	no	yes	no
	PHARE Programme German Government (PTB)	•		•	
If you receive any of the above:					
Would the funding rules allow for the provision of regional (i.e. more than one country) capability rather than solely national capability, (please identify for each international body that funds you)?					
NO					
Estimate the % of equipment/infrastructure funding from all sources available to your laboratory, which is international in origin:					

		25 %
3.	Is it a part of your future strategy to participate in ERA-based coordinated approach to research in metrology with subsequent possible devolutions in the scope of your current activities in some fields and expansions to new fields ?	
	YES	
4.	As regards the activity 1a) and b), have the elements of the ERA concept been already applied in research carried out nationally (work in international teams etc.) ? If yes, please, specify the fraction of the total.	
	NO	
5.	Have you recently made a foresight project to analyse the future metrological needs of your economy ? If yes, please will you send a short synopsis or a final report.	
	NO	
6.	Are there capacities available in your sector of fundamental metrology at present enabling you a participation in ERA-based projects ?	
	NO	
7.	It is at all permitted by your national legislation:	
	- to share funds for R&D projects	
	NO	
	- to share investment funds to establish and recurrent funds to operate common facilities ?	
	NO	
8.	Are there any other reasons that could prevent a participation of your NMI in ERA-based projects or a wider concept of an ERA in metrology? Please, specify which ones if applicable.	
	Lack of resources	

9.	Are there any actions you can identify that would facilitate participation in ERA based projects or a wider concept of an ERA in metrology?
	Bilateral co-operation with other NMIs Participation in EUROMET projects Participation in VIRM
10.	General comments to the ERA concept in metrology from the perspective of your NMI:
	Setting priorities within the framework of ERA concept in metrology should allow small NMIs in general and NAS NMIS in particular to promote their own specific priorities.

Questionnaire

NMI:	Slovak Institute of metrology
Country:	Slovakia
Contact person:	Stanislav Musil
Email:	musil@smu.gov.sk

1.	The structure of activities of your NMI (give a fraction of the total):	
	a)	dedicated R&D (projects eligible to be officially registered as basic or applied R&D nationally)
		2
	b)	contract research for other Government departments (ministries) or agencies and private bodies
		2
	c)	development and maintenance of national standards (including comparisons, traceability agreements)
		68
	d)	calibration and other services in non-regulated area
		13
	e)	legal metrology activities
		12
	f)	other non-metrology services (testing etc.)
		3

2.						
	a)	Which sources of R&D funding are now available nationally and have been used by your institute:				
		available			being used	
	- funding of research in industry	yes	no	yes	no	
		X		X		
	- national science foundation (grants)	yes	no	yes	no	
		X			X	
	- special funding from your ministry	yes	no	yes	no	
		X		X		

	- international science foundations	yes	no	yes	no
		X		X	
	- 5 th Framework program of the EU	yes	no	yes	no
		X		X	
	- other (specify which ones)	yes	no	yes	no
			X		X
Estimate the % of R&D funding from all sources which is international in origin:					
					3

2.					
b)	Which international sources (if any) of equipment/infrastructure funding are available to you?				
		available		being used	
	- EU non-Framework Programme	yes	no	yes	no
			X		X
	- World Bank	yes	no	yes	no
			X		X
	-Other (specify which ones)	yes	no	yes	no
	PSO, PHARE, USA funds, IRMM	X		X	
If you receive any of the above:					
Would the funding rules allow for the provision of regional (i.e. more than one country) capability rather than solely national capability, (please identify for each international body that funds you)?					
?					
Estimate the % of <u>equipment/infrastructure</u> funding from all sources available to your laboratory, which is international in origin:					
					5

3.	Is it a part of your future strategy to participate in ERA-based coordinated approach to research in metrology with subsequent possible devolutions in the scope of your current activities in some fields and expansions to new fields ?
	YES
4.	As regards the activity 1a) and b), have the elements of the ERA concept been already applied in research carried out nationally (work in international teams etc.) ? If yes, please, specify the fraction of the total.
	No
5.	Have you recently made a foresight project to analyse the future metrological needs of your economy ? If yes, please will you send a short synopsis or a final report.
	No
6.	Are there capacities available in your sector of fundamental metrology at present enabling you a participation in ERA-based projects ?
	Yes, there are any personnel capacities in the SMU for participating in ERA project, but only in the specific quantities.
7.	It is at all permitted by your national legislation:
	- to share funds for R&D projects
	yes
	- to share investment funds to establish and recurrent funds to operate common facilities ?
	no
8.	Are there any other reasons that could prevent a participation of your NMI in ERA-based projects or a wider concept of an ERA in metrology? Please, specify which ones if applicable.
	capacities available language skills

9.	Are there any actions you can identify that would facilitate participation in ERA based projects or a wider concept of an ERA in metrology?
10.	General comments to the ERA concept in metrology from the perspective of your NMI:
	The SMU prefer concept the sharing capacities in the specific areas in all NMIs (model 2 presented in Rotterdam) and do not prefer concept 2-4 big R and D NMIs (model 3 presented in Rotterdam) in EU (as presented PTB and NPL).

ANNEX I – ANALYSIS FOR THE 2ND WORKSHOP

A standard proforma was developed and the NMIs surveyed to identify the areas in which they wish to increase the amount of R&D collaboration, and to identify opportunities for greater collaboration related to the use of facilities and delivery of services. For ease of use a common proforma was circulated with the pre defined topics, additionally NMIs were encouraged to enter topics over and above the pre-defined list where they considered it appropriate.

I1 - Example (for Acoustics, Ultrasound and Vibration) of a blank proforma circulated to establish the degree of interest in increase collaboration.

I2 - Example of a proforma response (for Electricity and Magnetism) from one country

I1 - Example (for Acoustics, Ultrasound and Vibration) of a blank proforma circulated to establish the degree of interest in increase collaboration.

		R&D			
R&D topics identified during MERA		Unable to collaborate on this topic	Limited capability and desire to increase expertise through collaboration	Significant capability and desire to increase R&D collaboration	General Comments
Acoustics Ultrasound and Vibration	Calibration / comparisons of microphones / hydrophones at different frequency ranges				
	Calibration of microphones at high-pressure levels				
	Performance of transducers & hydrophones under extreme environmental conditions				
	Development & calibration of smaller transducers & sensors				
	Measurements related to ultrasound in the medical & surgical field				
	Development of primary standards at various frequency ranges & derived from other measurement functions				
	Development of new generation of ultrasonic hydrophones				
	Development of standards for acoustic emissions				
	Calibration of velocity hydrophones & sensors				
	<i>Others (please specify):</i>				

I2 - Example of a proforma response (for Electricity and Magnetism) from one country

		R&D			
R&D topics identified during MERA		Unable to collaborate on this topic	Limited capability and desire to increase expertise through collaboration	Significant capability and desire to increase R&D collaboration	General Comments
Electricity and Magnetism	Development of fully programmable Josephson standards in the range -10V to + 10V			Development of a 10 V programmable Josephson standard in progress	
	Realisation of capacitance standard and development of high sensitive detectors based on SET			Development of SET based detectors is starting with domestic collaborators.	
	Non – invasive sampling of electromagnetic fields		Possibly development of micromechanical sensors		
	Clarity of electrical power è improved uncertainty in AC – DC transfer for current		yes		
	(RF-) Development of specific technologies for high frequency up to the terahertz region		Possible domestic collaboration in development of 110 - 170 GHz power standards		
	(RF-) Development of cryogenic, quantum & digital standards		yes		
	Use of internet for calibration		yes		
	Development of validation procedures for self-calibration instrumentation		yes		
	<i>Others (please specify):</i>				

I3 – Results – Considering existing EUROMET areas of interest and capabilities

The “forward look” topics were entered into the proforma and the NMIs surveyed to identify where they wish to increase the amount of collaboration.

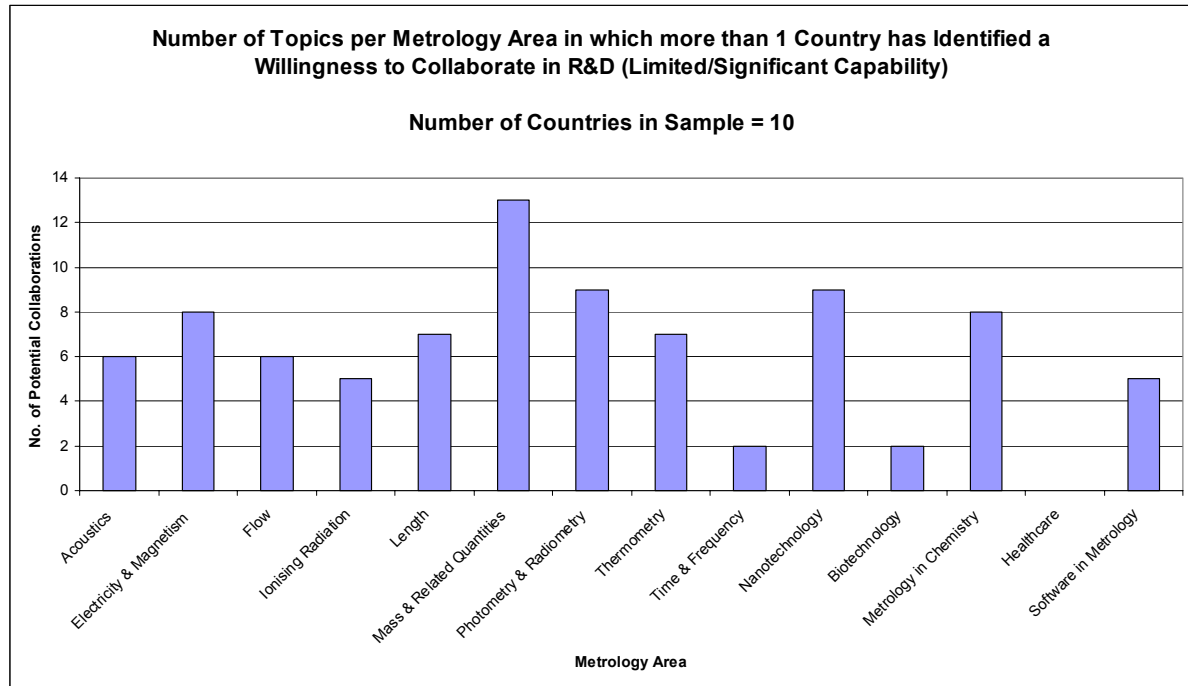


Figure I1: Number of topics per Metrology areas in which more than 1 country has identified a willingness to collaborate in R&D

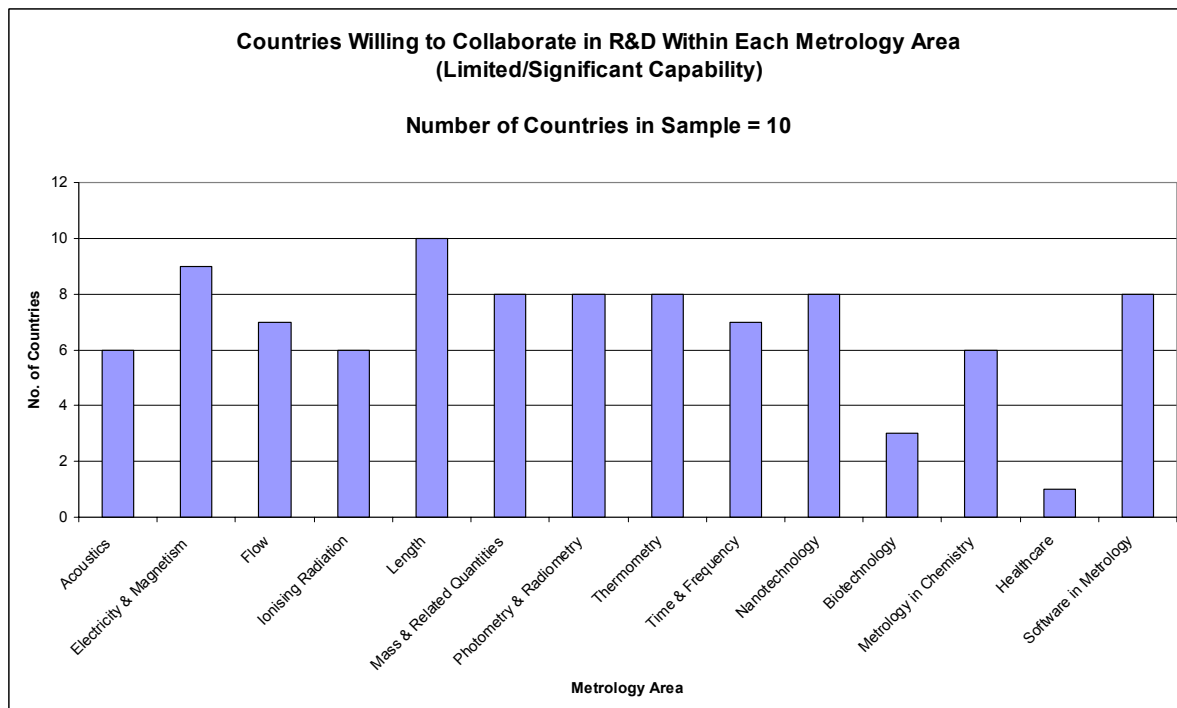


Figure I2: Countries willing to collaborate in R&D within each Metrology area

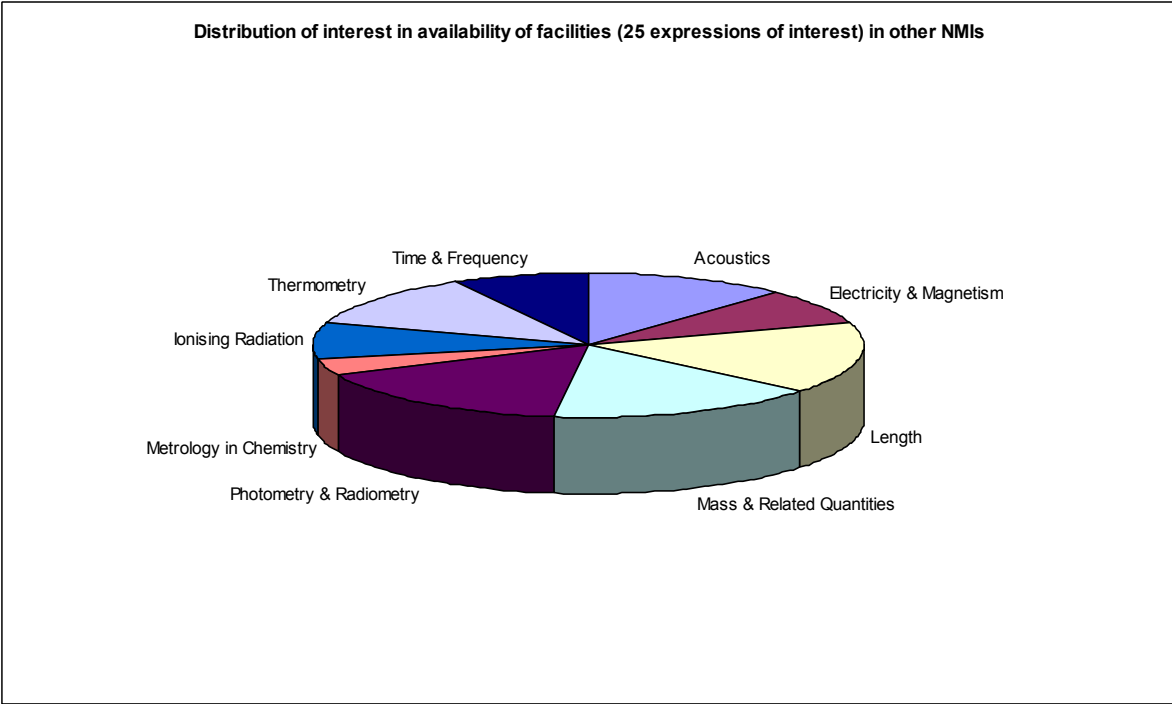


Figure 13: Distribution of interest of facilities

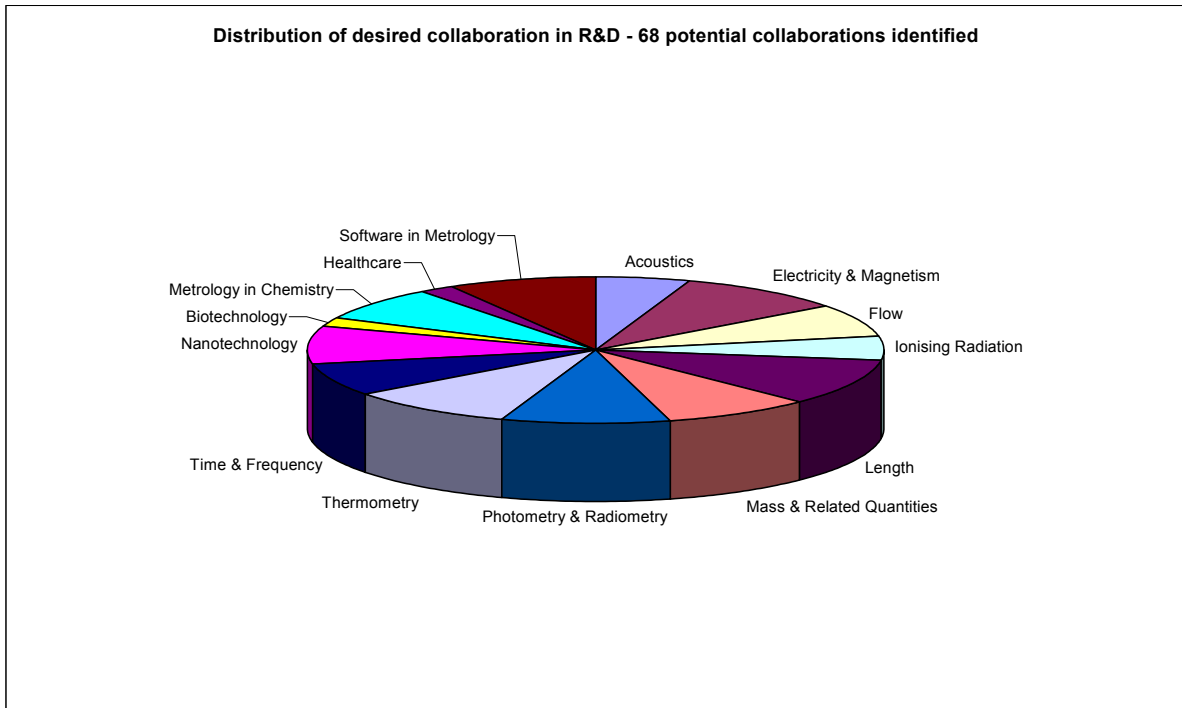


Figure 14: Distribution of desired collaboration in R&D

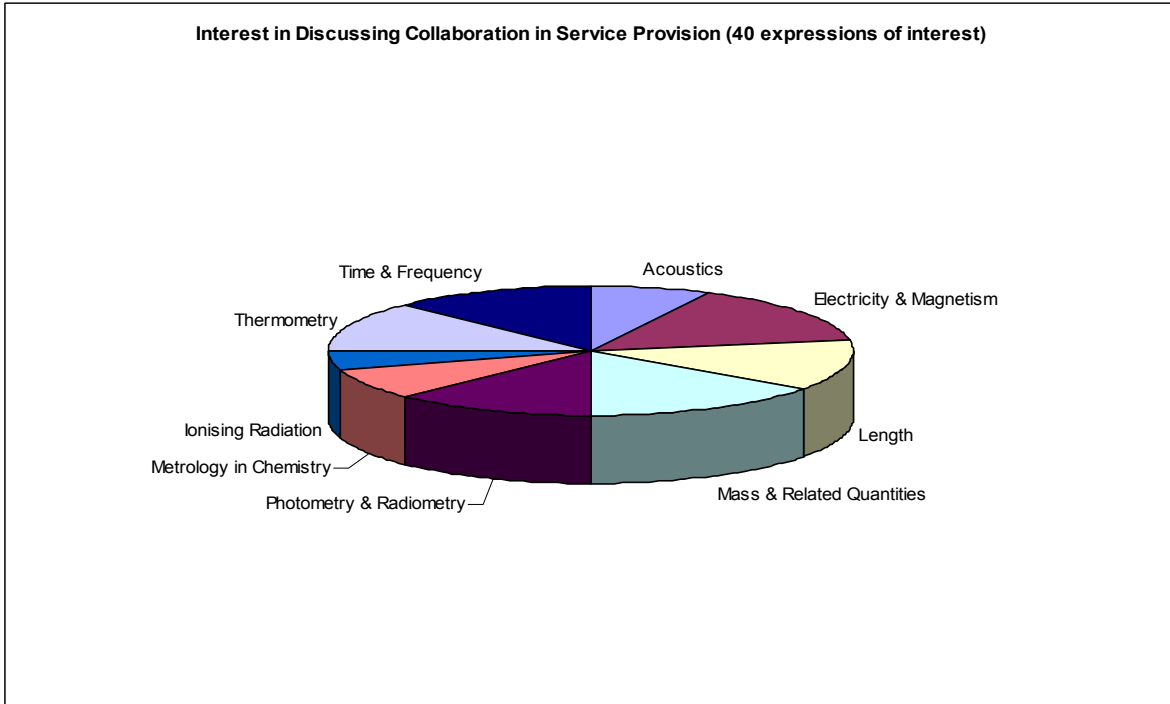


Figure I5: Interest in discussing collaboration in service provision

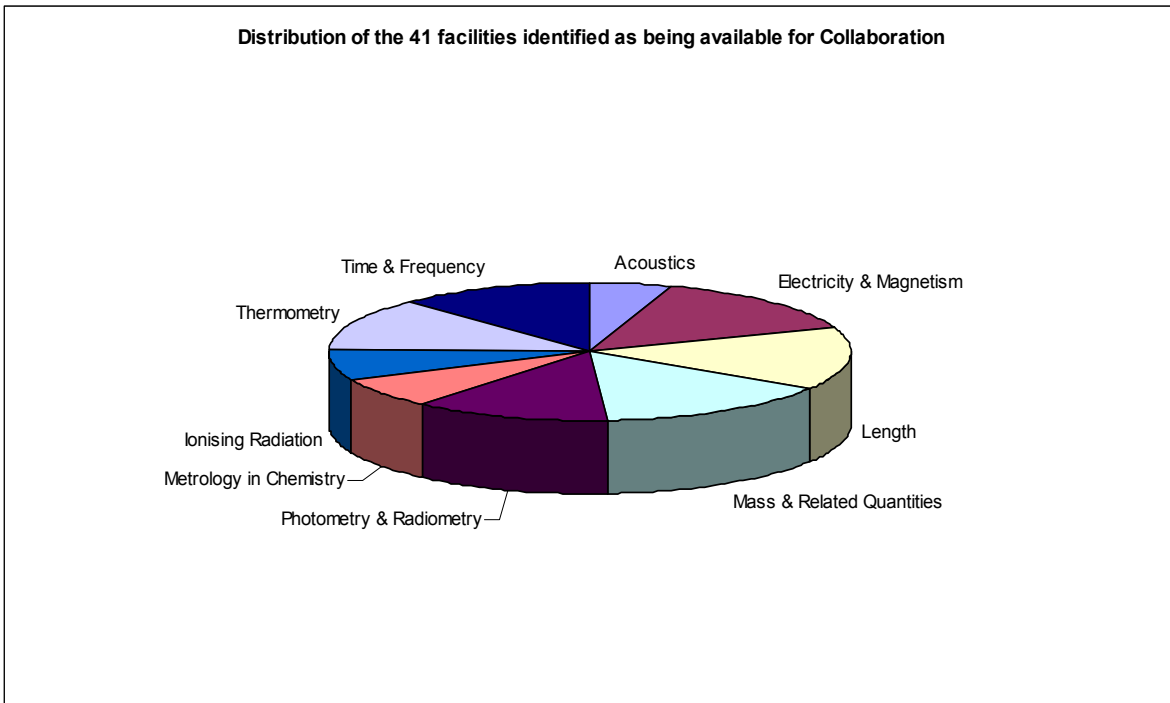


Figure I6: Distribution of the 41 facilities identified as being available for collaboration

I4 – Results – Non standard topics suggested for collaboration

Proposed Topic	
Acoustics	Calibration of ear simulators for new applications
	Develop methods for the specification and testing of free-field rooms in a form suitable for standardisation by ISO/IEC
	Enable the introduction of full uncertainty budgets consistent with the ISO “Guide to the expression of uncertainty in measurement” in ISO sound power standards
	Provide a method for qualifying measurement sites used for machinery noise determination based on criteria that relate to measurement uncertainty
	Investigate the feasibility of rapid methods for assessing radiated acoustic noise from underwater vehicles (e.g. ROVs) and contribute to the development of new standards
	Complete establishment of new interferometer and validate performance beyond 60 MHz
	Establish a measurement facility for determining propagation speed in liquids with an uncertainty of +/- 0.2 m/s or better
	Environmental noise
	Room Acoustics
	Research to support the development of IEC Standards for microphones
	Research to support the development of IEC Standards for ear simulators
	Development of sound sources for testing acoustic fields
	Research in testing hearing aids including those with sophisticated signal processing
Electricity & Magnetism	Generation of reference electromagnetic fields 0Hz to 18GHz
	HF impedance calibration
	Noise measurements
	DC development of cryogenic, quantum
Flow	Air speed
IR	Standards for environmental monitoring using Mass Spectrometry
	Medical Dosimetry
	Radionuclide Metrology
	Proton dosimetry
Length	Geodetic applications: System calibration of digital levelling
	Geodetic applications: Calibration of precise levelling rods
	Geodetic applications: System calibration of trigonometric levelling
	Geodetic applications: Standard and calibration baselines
	Geodetic applications: Calibration of EDM instruments and tacheometers
	Geodetic applications: Metrology and quality in satellite geodetic methods, e.g. GNSS, RTK, VRS
	Various nanometrology
Mass & Related Quantities	Manometric standards
	Dynamic pressure
	Hardness uncertainties
	Improving performance of pressure transducers - Differential pressure/high line pressure
	Improving performance of pressure transducers - Dynamic pressure
	Torque transducers
	Hardness, standard test

	Gravity
	Hardness, Instrument indentation test
	Absolute gravimetry
Photometry & Radiometry	Fibre optic communication
Thermometry	Photothermal methods (e.g Laser Absorption Radiation Thermometry)
	LART
Time & Frequency	Time & frequency transfer via geodetic GPS receivers
Metrology in Chemistry	Analysis of purity of gases
	Primary spectrometry
	Water conductivity
	Aerosol and particles in air (diam >1nm, < 2 µm)
	Uncertainty determination in analytical chemistry
Software in Metrology	Biometrics
	Biometrics
Other Areas	Soft Metrology

ANNEX J – THE MERA ERA WORKSHOP

J1. The programme of the ERA workshop

J2. List of participants of the ERA WORKSHOP

J1. The programme of the ERA workshop

**Location: PTB, Abbestr. 2 - 12,
Hermann-von-Helmholtz-Building, Lecture Hall**

Monday 16 June: Meeting of NMI delegates

Session I: Chairman Luc Erard

- 09:00 Welcome to workshop
Michael Kühne, Member of the Presidential Board of PTB
- 09:10 Introduction to workshop (Henson, NPL and Kühne, PTB)
- 09:25 Review of cooperation in EUROMET (Bennett, NPL)
- 09:50 Evaluation of future trends (summary) (Hetherington, NML)
- 10:30 coffee break

Session II: Chairman Ed de Leer

- 11:00 Results of European Stakeholder Consultations (Pendril, SP)
- 11:40 Newly Associated States perspective (Klenovsky, CMI)
- 12:10 lunch

Session III: Chairman Helge Kildal

- 13:30 Presentations of National Analysis - country results and summary. Presentations from: Nordic countries, France, Germany, Italy, UK. (Summary analysis by Stenger, PTB)
- 15:20 Conclusions for future scenarios (Henson, NPL)
- 16:00 coffee break
- 16:30 Identification of pilot projects (Kühne, PTB)
- 17:00 end of session
- 20:00 Workshop Dinner
Hotel Excelsior, Hardenbergstr. 14

Tuesday 17 June: Meeting of NMI delegates and representatives of funding agencies

- 09:00 Welcome by representative of BMWA
“The importance of Metrology in a technology driven society”
- Session I:** Chairman Wolfgang Schwitz
- 09:15 The future of metrology in Europe – View from a NMI (Göbel, PTB)
- 10:00 The future of metrology in Europe – View of a funding agency
(Walker, DTI)
- 10:45 coffee break
- Session II:** Chairman Kim Carneiro
- 11:15 An introduction to EUROMET (Hetherington, NML)
- 11:45 Summary of results from MERA inquiries (European Stakeholders,
National Analysis, perspective for Newly Associated States)
(Stenger, PTB)
- 12:30 Scenarios for the development of metrology in Europe (Henson, NPL)
- 13:00 lunch
- Session III:** Chairman Attilio Sacconi
- 14:20 Panel discussion with NMI delegates and funding representatives
“What are the difficulties that hinder a closer metrological cooperation in Europe and
how can they be overcome?”
- | | |
|-----|----------------|
| NMI | funding agency |
| CMI | Netherlands |
| IPQ | Slovakia |
| PTB | UK |
- 15:20 Summary of Berlin workshop (Kühne, PTB)
- 15:40 The way forward – IMERA (Bennett, NPL)
- 16:00 End of Workshop

J2. List of participants of the ERA WORKSHOP

Mrs. Ani Todorova Bulgaria

Mr. Heikki Isotalo	Finland
Mr. Pavel Klenovsky	Czech Republic
Mr. Alexander Safarik-Pstrosz	Czech Republic
Mr. Arnold Leitner	Austria
Mr. Dragan Milošević	Yugoslavia
Mr. Matej Bilý	Slovakia
Mr. Stanislav Duriš	Slovakia
Mr. Jaromir Markovič	Slovakia
Mr. Ján Ružička	Slovakia
Mr. Jozef Orlovský	Slovakia
Mr. Carlos Nieto de Castro	Portugal
Mr. Hans Andersson	Sweden
Mr. Leslie Pendrill	Sweden
Mr. Hakan Nilsson	Sweden
Mr. Seton Bennett	United Kingdom
Mr. Dennis Walker	United Kingdom
Mr. Robert Gunn	United Kingdom
Mr. Andy Henson	United Kingdom
Mr. David Nettleton	United Kingdom
Mr. Kim Carneiro	Denmark
Mr. Ionel Urdea Marcus	Romania
Mr. Helge Kildal	Norway
Mr. Joseph Bartolo	Malta
Mr. Peter Pataki	Hungary
Mr. András Pozsgai	Hungary
Mr. Toomas Kübarsepp	Estonia
Mr. Paul Hetherington	Ireland
Mr. Brian Sheridan	Ireland
Mr. Brendan Finucane	Ireland
Mr. Janko Drnovsek	Slovenia
Mr. Ivan Skubic	Slovenia
Mr. Sacconi	Italy
Mr. Ed de Leer	Netherlands
Mr. B.P.Th. Veltman	Netherlands
Mrs. Anneke van Spronssen	Netherlands
Mr. Jacques Nicolas	Belgium
Mr. Wolfgang Schwitz	Switzerland
Mr. Luc Erard	France
Mr. Maris Davis	Latvia
Mrs. Brigita Dragune	Latvia
Mr. Viktoras Zabolotnas	Lithuania
Mr. Enver Sadikoglu	Turkey
Mr. Ernst O. Göbel	Germany

Mr. Michael Kühne	Germany
Mr. Jörn Stenger	Germany
Mr. Thomas Lederer	Germany
Mr. Martin Wasmuß	Germany
Mr. Peter Szent-Iványi	Germany

ANNEX K – PAPERS AND POSTERS PRESENTED AT CONFERENCES.

K1. Poster presented at ‘Towards an integrated infrastructure for measurements’ conference, 18-19 June, Warsaw.


K2. Poster presented at ‘the International ILAC/IAF conference on accreditation in global trade, 23-25 September 2002, Berlin

K3. Paper and poster presented at the XVII IMEKO World Congress, 22–27 June 2003, Dubrovnik, Croatia


K4. Paper presented at the NCSLi conference, 18-21 August 2003, Tampa

K5. Paper presented at Métrologie 2003, 20-23 October2003, Toulon

K1. Poster presented at ‘Towards an integrated infrastructure for measurements’ conference, 18-19 June, Warsaw.


European Commission


Metrology in the European Research Area (MERA)




The EUROMET countries

METROLOGY FOR EUROPE


Innovation in virtually all scientific and technological fields depends on the ability to make leading edge measurements. This project will develop the plans to optimise and increase significantly the impact of the effort to underpin European metrology research and exploitation by strengthening the coherence of national and EU funded activities.

OBJECTIVES

The project will intensify current EUROMET co-operation between National Metrology Institutes (NMIs) and lay foundations for a co-ordinated European Research Area for metrology. Greater collaboration in research, shared use of facilities, and increased mobility of researchers, as well as more effective exploitation of research will all be explored.




Measuring at the leading edge: examining nanotubes with NPL's scanning tunnelling microscope




High value facilities include the anechoic chambers at NPL

IMPACT

The project will identify metrology research priorities and develop decision-making aids to help identify research and services that would be optimised through greater collaboration. Scenarios will be developed and tested with the stakeholders and a road map proposed for developing a co-ordinated pan-European approach to meeting high level metrological needs.






National Physical Laboratory

Andy Henson
Andy.Henson@npl.co.uk


K2. Poster presented at ‘the International ILAC/IAF conference on accreditation in global trade, 23-25 September 2002, Berlin



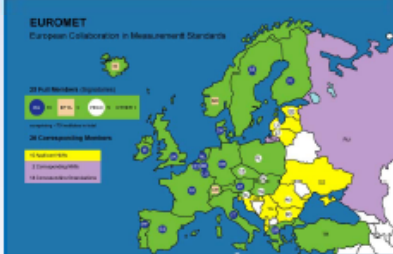
NPL
National Physical Laboratory

Globalisation and the integration of the European Measurement Systems

Metrology in the European Research Area: The MERA Project



Much international trade depends upon effective, consistent measurements and the interoperability of manufactured components. As globalisation becomes a reality, the drive for greater consistency from within the measurement infrastructure has therefore increased. The desire for “measured once accepted everywhere”, the mantra for measurement in trade, is reflected in the huge efforts that have led to the mutual recognition arrangements and multilateral agreements at the highest levels within the trade, measurement and accreditation communities. However the ability to deliver state-of-the-art measurement capability with the confidence necessary to underpin trade, is dependent on the metrology infrastructure being able to meet ever-growing demands with resources that are not increasing at a comparable rate.

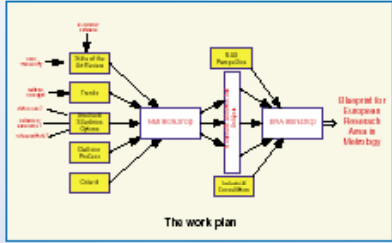


EUROMET
European Collaboration in Measurement Standards

- 20 Full Member Institutions
- 10 Associate Members
- 10 Corresponding Members
- 10 Honorary Members

Objectives:

The project is planning the implementation of the EUROMET strategy, intensifying current EUROMET co-operation between National Metrology Institutes (NMIs) and laying the foundations for a co-ordinated European Research Area for metrology. Greater collaboration in research, shared use of facilities, and increased mobility of researchers, as well as more effective exploitation of research are being examined.



The work plan

The work plan:

Activities include:

- a review of current collaboration
- identification of trends
- examination of scenarios for metrology research
- the development of decision tools
- workshops
- industrial consultation
- accession country studies
- analysis at national level
- a plan for an ERA in Metrology


The Project:

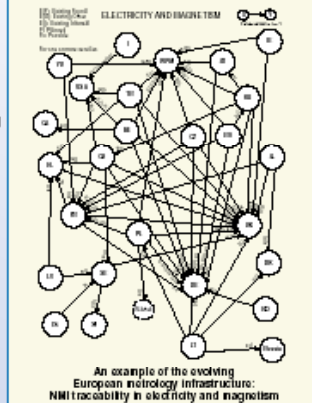
The project started on the 1st September 2002 and will run for 12 months. It is partly funded by the European Commission with the National Metrology Institutes (NMIs) from the UK (NPL, the coordinator), Germany (PTB), Ireland (NMI-EI), Sweden (SP), Czech Republic (CMI), Netherlands (NMI VSL) and Switzerland (METAS-participating with national funding only) as partners. The project is supported by a further 4 NMIs from France (BNM), Denmark (DFM), Italy (IMGC) and Norway (JV).

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ELECTRICITY AND MAGNETISM

An example of the evolving European metrology infrastructure: NMI traceability in electricity and magnetism

MERA will plan the joint use of top-level metrological facilities, such as the anechoic chamber at NPL.



International ILAC/IAF Conference on accreditation in global trade
23 - 25 September 2002



K3. Paper and poster presented at the XVII IMEKO World Congress, 22–27 June 2003, Dubrovnik, Croatia

K3.1 Paper

**GLOBALISATION AND THE INTEGRATION OF
THE EUROPEAN MEASUREMENT SYSTEMS:
THE MERA PROJECT**

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Abstract – Industry, trade and increasingly the quality of life depend on the ability to make leading edge measurements. However, within Europe the ability to deliver state-of-the-art measurement capability with the confidence necessary to underpin research, innovation and development, is dependent on the metrology infrastructure being able to meet ever-growing demands with resources that are not increasing at a comparable rate. A strategy has been developed within EUROMET to address these issues and this paper describes the MERA project, which will plan the implementation of the strategy.

Keywords: MERA, EUROMET, NMIs.

1. INTRODUCTION

Innovation in virtually all scientific and technological fields depends on the ability to make leading edge measurements. Much international trade depends upon effective, consistent measurements and the interoperability of manufactured components and metrological equivalence at the highest level underpins so called legal metrology. As globalisation becomes a reality, the drive for greater consistency from within the measurement infrastructure has therefore increased. The desire for "measured once accepted everywhere", the mantra for measurement in trade, is reflected in the huge efforts that have led to mutual recognition arrangements and multilateral agreements at the highest levels within the measurement, accreditation and trade communities. However the

ability to deliver state-of-the-art measurement capability with the confidence necessary to underpin research, innovation, development and trade, is dependent on the metrology infrastructure being able to meet ever-growing demands with resources that are not increasing at a comparable rate. The drivers behind this pressure can be considered as threefold. Firstly new areas of technology are emerging that require metrological support, for example the desire to move nanotechnology from an interesting scientific phenomena to a new key industrial activity. Likewise measurement science is vital if the potential of the emerging biotechnology opportunities are to be exploited. Secondly there are areas of activity such as clinical medicine and food safety that are not in themselves new, but in which the impact and value of metrology are increasingly being recognised. Finally the traditional areas of industry whilst not necessarily expanding, nor the metrology becoming more widespread, are becoming more complex and placing demands at the leading edge of metrology and measurement science that are ever more costly. One key approach to addressing this dilemma, that is to say the increasing demand with static resources, is to increase the level of cooperation in metrology, both in the research and development effort and in the delivery of the resulting measurement services. EUROMET, the European collaboration between the National Metrology Institutes (NMIs), already has an impressive record of cooperation, with the number of collaborative projects undertaken now numbering in the hundreds.

However to date collaboration has not gone as far as planning either R&D effort or delivery of the resulting measurement services at a strategic level. Over the past few years EUROMET has examined the challenge faced by European metrology and developed a view that a strategic approach is essential for the future. The EUROMET vision was embodied in a project proposal submitted to the European Commissions R&D Framework Programme in 2001. The proposal, addressing metrology in the context of the European Commission's vision for an integrated European Research Area, was selected for funding. The resulting project, "Planning the European Research Area in Metrology ("MERA")" is partly funded by the EC FP5 "GROWTH" Programme¹⁰, with the NMIs providing a significant input from their own resources.

MERA, in effect, is planning the implementation of the EUROMET strategy to address the issues faced by the highest-level metrology community in Europe. The project involves developing the plans to optimise and increase significantly the impact of European metrology research and exploitation by strengthening the coherence of national and EU funded activities.

2. THE MERA PROJECT

The EUROMET strategy identifies the need to meet new demands from emerging areas like nanotechnology and biotechnology whilst still supporting traditional areas of work within a budget that is not increasing in real terms. Therefore increasing the impact from the available resources is essential for the future of European metrology and the wide range of users that benefit from it. In broad terms the MERA project lays the foundations for a coordinated approach to meeting these metrology needs in Europe by optimising impact.

The project commenced in September 2002 and will run for approximately 12 months. The project participants reflect the make up (at the

time of the proposal submission) of the EUROMET Executive Committee, augmented by those NMIs not on the Committee but who were contributing to the strategic planning within EUROMET. The seven project partners are the National Metrology Institutes from:

- | | |
|-------------------|---|
| • UK | NPL (the coordinator) |
| • The Netherlands | NMi-VSL |
| • Germany | PTB |
| • Ireland | NML-EI |
| • Sweden | SP |
| • Czech Republic | CMI |
| • Switzerland | METAS – (who are participating with national funding only). |

The partners are directly supported by a further four NMIs from:

- | | |
|-----------|------|
| • France | BNM |
| • Denmark | DFM |
| • Italy | IMGC |
| • Norway | JV |

who provide expertise and breadth to the project steering committee. However, all 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.

3. THE WORKPLAN

The project divides the work into ten main packages (Fig.1). These are:

- State-of-the-art review of relevant collaborative activity;
- Identification of future trends for metrology research;
- Metrology infrastructure scenarios and decision tool development allowing areas and degree of cooperation to be identified;
- National Metrology Institute Workshop – involving the NMIs from across Europe, addressing issues, elaborating scenarios and presenting models and research trends;
- National review of structures and priorities for collaboration taking due account of national

¹⁰ Contract G6MA-CT-2002-04012

industrial need and issues that hinder greater collaboration;

- A stakeholder consultation at European level to ascertain the end user perspective on potential structural changes in the metrology infrastructure;
- A consultation to ascertain the Newly Associated States (Accession Countries) perspective on potential structural changes in the metrology infrastructure;
- A summary of the findings from the national, stakeholder and Newly Associated States consultations;
- European Research Area Workshop – proposing metrology infrastructure options and research priorities, identifying actions to overcome hurdles;
- Foresight Report and dissemination – summarising and justifying the conclusions of the project, and providing recommendations and roadmap for selected scenarios.

The project is still on-going but has already made significant progress. An evaluation of the current collaboration in European metrology at NMI level has been conducted. Some 80 traceability arrangements are already in place between the NMIs whereby an NMI in one country does not hold a primary standard, but holds a national standard traceable to the primary realisation at another NMI.

Research collaboration remains the strongest element of cooperation, and the EC Framework Programme can clearly be seen historically as a key catalyst in the process. EC support brings not only funds, but also a formal and detailed work programme complete with defined responsibilities, deliverables and of course the discipline of a formal contract with a start and end

date for the research activity. Many EUROMET projects are undertaken and completed without this formal EC support, however the risk of project “drift” is noticeably increased. The new EC Framework Programme, for the first time, does not include a dedicated measurement and testing activity, so the metrology community must face new challenges in integrating with wider research efforts.

The MERA foresight study has identified the key metrological research trends for the future, and will enable cooperation to be planned more effectively. Simplified scenarios have been prepared to illustrate the possible options for the future of the high-level metrology infrastructure in Europe. Every effort was made to ensure all options, popular or otherwise, were considered. Thus scenarios examined ranged from the status quo to a single institute for Europe. It is clear from the first workshop that there is a clear consensus amongst the NMIs that collaboration must be increased, though a single institute for Europe is not considered the most appropriate option for the future. This is not surprising; the knowledge transfer (KT) associated with high-level metrology has been recognised increasingly as one of the major impacts at national level. Even if R&D is concentrated, and facilities shared, local (national) KT capability is likely to remain a prerequisite. Thus there is a strong rationale for the continued existence of an NMI in each country. Whilst it is too early in the project to be definitive it would seem that a mixture of primary and national standards, coordinated research and greater joint use of facilities is likely to be the most successful and widely supported approach.

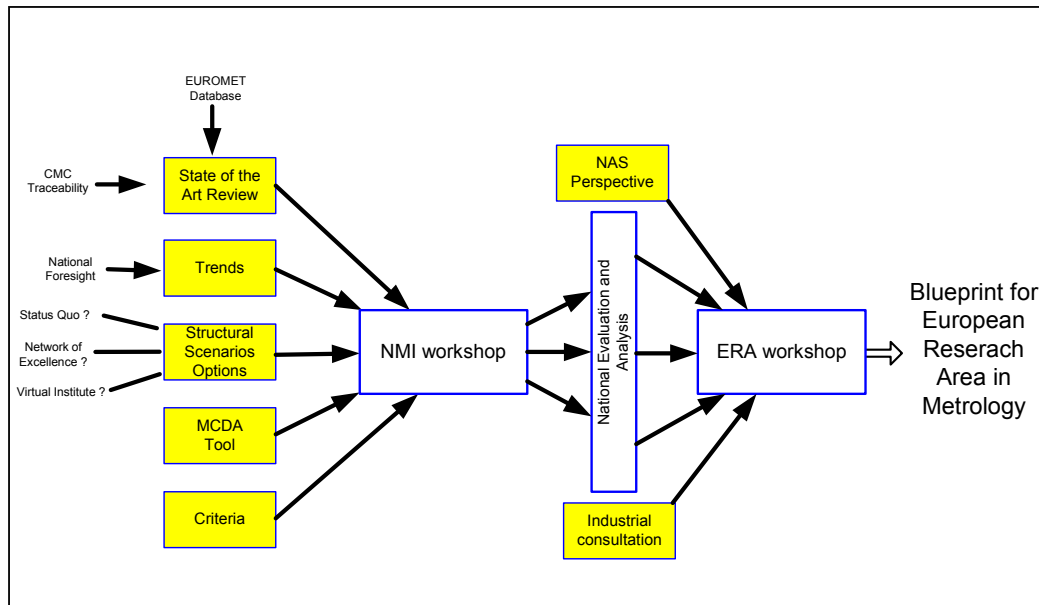


Fig. 1. MERA work plan

The changes implied may impact most dramatically on the larger NMIs. Smaller NMIs in Europe have always focused their resources on the most pressing priorities in their country, relying on the larger NMI capabilities for the balance. In many larger countries the NMIs have historically, by and large, provided a comprehensive range of services and research. The pressure on resources means that this assumption, that all capability must be provided from within the country, is being questioned even in the larger European countries. Whilst smaller countries can identify and concentrate on their priority topics on a unilateral basis, if the larger countries adopt the same approach Europe risks losing vital capability. Thus the larger NMIs either have or are undertaking exercises to develop methodologies to identify their options. The first project workshop, held in Rotterdam in December 2002, was open to all the NMIs in Europe, and representatives of almost all the laboratories that make up the NMIs (almost 70 laboratories across Europe) were briefed on the project and able to contribute to the debate. The preliminary output of the early workpackages were aired and discussed. The NMIs are now (with national funding) conducting analysis of national metrology priorities, identifying those

best addressed collaboratively. Stakeholder consultation and review of the special

Circumstances of the Newly Associated States is under way to ensure appropriate balance.

The second MERA workshop in June 2003 marks a major step forward in planning the strategic planning process. By bringing together the various strands developed in the project, a comprehensive view can be gained of this issue.

For the first time the NMI funding agents from around Europe also have the opportunity to discuss together and alongside the NMIs the issues they face and to review the possible solutions. The involvement of the national funding bodies is crucial for those NMIs who wish to go much beyond the current level of cooperation. Greater collaboration, for example through the establishment of joint facilities, implies that the issue of joint funding must be explored. In the short term such solutions may not be feasible, and joint planning rather than joint funding may be more realistic.


3. CONCLUSIONS

MERA aims to lay the foundations for greater collaboration in research, the shared use of facilities and increased mobility of researchers, as well as more effective exploitation of research. The project is identifying metrology trends and research priorities and has developed decision-making aids to help identify research and services within Europe that would be


optimised through greater collaboration. Scenarios for increased collaboration have been studied and are being tested with the stakeholders. A road map is under development that proposes a co-ordinated pan-European approach to meeting high level metrological needs. The real challenge still lies ahead: that is implementing the output of the project.

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K3.2 Poster



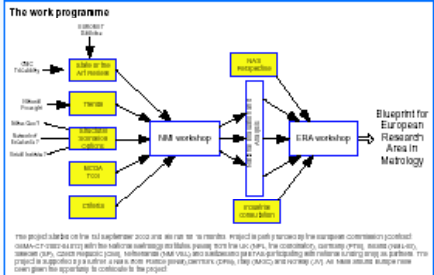
Metrology in the European Research Area: The MERA Project




Much international trade depends upon effective, consistent measurements and the interoperability of manufactured components. As globalisation becomes a reality, the drive for greater consistency from within the measurement infrastructure has therefore increased. The desire for "measured once accepted everywhere", the mantra for measurement in trade, is reflected in the huge efforts that have led to the mutual recognition arrangements and multilateral agreements at the highest levels within the trade, measurement and accreditation communities. However the ability to deliver state-of-the-art measurement capability with the confidence necessary to underpin trade, is dependent on the metrology infrastructure being able to meet ever-growing demands with resources that are not increasing at a comparable rate.

The project is intensifying current EUROMET co-operation between National Metrology Institutes (NMIs) and laying the foundations for a co-ordinated European Research Area for metrology. Greater collaboration in research, shared use of facilities, and increased mobility of researchers, as well as more effective exploitation of research are being examined.

The work programme



This project starts on the 1st September 2002 and will run for 18 months. It is a joint project of the European Commission (contract number 5010-CT-2001-10001) and the National Metrology Institutes (NMIs) of the EU. The Commission, currently acting through the European Commission, is the sponsor of the project. The project is a joint project of the European Commission, currently acting through the European Commission, and the National Metrology Institutes (NMIs) of the EU. The Commission, currently acting through the European Commission, is the sponsor of the project. The project is a joint project of the European Commission, currently acting through the European Commission, and the National Metrology Institutes (NMIs) of the EU. The Commission, currently acting through the European Commission, is the sponsor of the project.

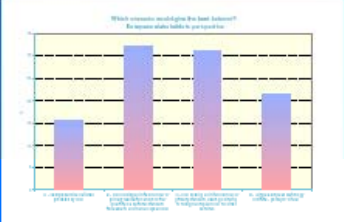


"Technical competence is the most important issue"
(National Analysis)

"The thrust of the NAS NMIs into dedicated research along the ERA concept should surely be strengthened in future"
(Newly Associated States (NAS) perspective)

"Our highest level industry is not requiring us to do all types of research since they take a very international position themselves and are ready to use unique facilities in other countries"
(National Analysis)

"Many would find it acceptable to work with NMIs in other countries, with a suitable framework to ensure confidence"
(National Analysis)




The June 2003 MERA workshop in Berlin marked a milestone in the evolution of top level European metrology. For the first time, NMIs and their funding agents had the opportunity to meet collectively to address the issues identified in the project and accept the challenges for the future.

"We are looking for a European Metrology System/Organization that comprises of competence centres, each performing fundamental research for certain quantities and parameters and providing traceability for the very high-level 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"
(Stakeholders consultation)

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K4. Paper presented at the NCSLi conference, 18-21 August 2003, Tampa

**Globalisation and the Integration of
the European Measurement Systems
The MERA Project**

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ABSTRACT – Industry, trade and increasingly the quality of life depend on leading edge measurements. However, within Europe, as in the USA, the ability to deliver state-of-the-art measurement capability with the confidence necessary to underpin research, innovation and development, is dependent on the metrology infrastructure being able to meet ever-growing demands with resources that are not increasing at a comparable rate. A strategy has been developed within EUROMET to address these issues and this paper describes the MERA project, which will plan the implementation of the strategy.

1 INTRODUCTION

Innovation in virtually all scientific and technological fields depends on the ability to make leading edge measurements. International trade depends on measurements that are trusted by the trading parties and issues such as global warming require data of the highest quality that is also internationally consistent. As globalisation becomes a reality the pressure for greater consistency is increasing. The desire for "*measured once, accepted everywhere*", the mantra for measurement in trade, is reflected in the mutual recognition arrangements and multilateral agreements at the highest levels within the measurement, accreditation and trade communities. The European metrology community must rise to these challenges and meet the growing demand, in both scope and competence, with budgets that are, broadly speaking static. The demand drivers can be considered as threefold. Firstly new areas of technology are emerging that require metrological support, for example the desire to move nano-scale science from an interesting curiosity to a key industrial activity. Likewise measurement science is vital if the potential of the emerging biotechnology opportunities are to be exploited. Secondly there are areas of activity such as clinical medicine and food safety that are not in themselves new, but in which the value of metrology is increasingly being recognised. Finally, the traditional areas of industry whilst not necessarily expanding, nor the metrology becoming more widespread, are nevertheless becoming more complex and the metrology more costly.

One key approach to addressing this dilemma, that is to say the growing demand with static resources, is to increase the level of cooperation in metrology, both in the research and development effort and in the delivery of the resulting measurement services. EUROMET¹¹ already has an impressive record of cooperation, with the number of collaborative projects undertaken now numbering in the hundreds.

¹¹ EUROMET; the European Collaboration in Measurement Standards

- Metrology infrastructure scenarios and decision tool development;
- National Metrology Institute Workshop – involving the NMIs from across Europe, addressing issues, elaborating scenarios and presenting models and research trends;
- National review of structures and priorities for collaboration taking due account of national industrial needs and issues that hinder greater collaboration;
- A stakeholder consultation at European level to ascertain the end user perspective on potential structural changes in the metrology infrastructure;
- A consultation to ascertain the Newly Associated States (Accession Countries) perspective on potential structural changes in the metrology infrastructure;
- A summary of the findings from the national, stakeholder and Newly Associated States consultations;
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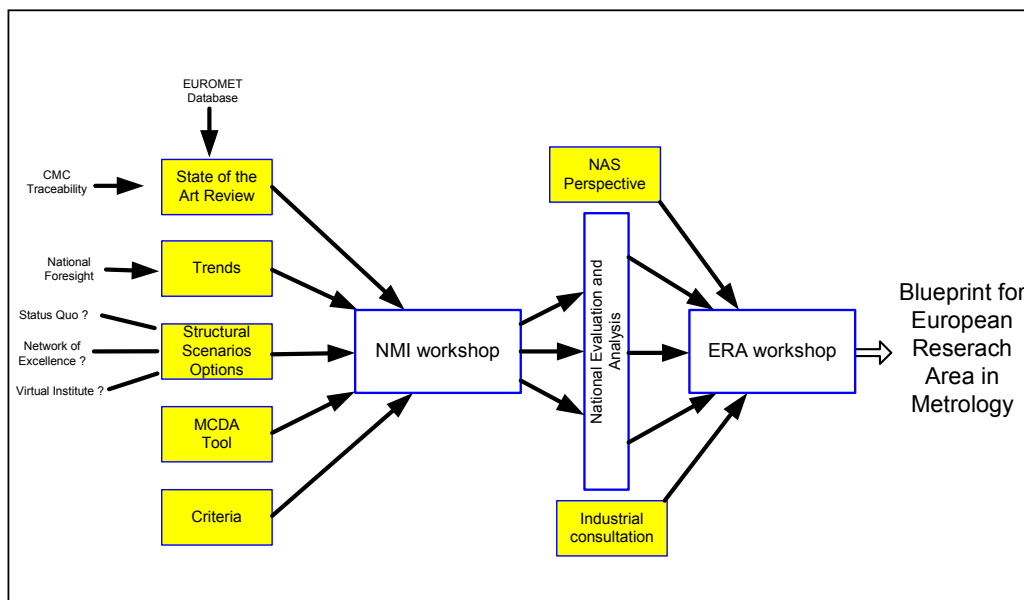


Figure 1. The MERA work plan.

The project is still on-going but has already made significant progress. An evaluation of the current collaboration in European metrology at NMI level has been conducted; most collaboration revolves around joint R&D projects. By the end of 2002 some 275 projects had been recorded as completed in the EUROMET projects database [2], with a further 175 “Agreed” (effectively under way) and 44 with “Proposed” status. Over and above R&D collaboration some 80 traceability arrangements are already in place between the NMIs, whereby an NMI in one country does not hold a primary standard, but holds a national standard traceable to the primary realisation at another NMI. Although limited at present, the joint use by the NMIs of key facilities such as BESSY in Germany, which provides synchrotron radiation to the European metrology community through its accelerators and storage rings, demonstrate the practicality of a more closely integrated infrastructure.

In the research collaboration, the strongest element of cooperation, the EC Framework Programme can clearly be seen historically as a key catalyst in the process. EC support brings not only funds, but also a formal and detailed work programme complete with defined responsibilities, deliverables and of course the discipline of a formal contract with a start and end date for the research activity. Many EUROMET projects are undertaken and completed without this formal EC support, however the risk of project “drift” is noticeably increased. The new EC Framework Programme, for the first time, does not include a dedicated measurement and testing activity, so the metrology community must face new challenges in integrating with wider research efforts in the so-called priority areas such as life science, nanotechnology etc.

The MERA foresight study has identified a number of key metrological research trends for the future, the first step to enable cooperation to be planned more effectively. One key difficulty identified is the different time scales and approaches to R&D priority setting and funding in EUROMET countries. There are instances where particular NMIs would like to collaborate, but differences in the funding cycles are such that in practice it is not practical to do so. Clearly greater coordination in the R&D planning process would help overcome this obstacle.

Simplified “scenarios” have been prepared to illustrate the possible options for the future of the high-level metrology infrastructure in Europe. Every effort was made to ensure all options, popular or otherwise, were considered. Thus scenarios examined ranged from the status quo to a single institute for Europe. It was apparent from the first workshop that there is a clear consensus amongst the NMIs that collaboration must be increased, though a single institute for Europe is not considered the most appropriate option for the future. This is not surprising; the knowledge transfer (KT) associated with high-level metrology has been recognised increasingly as one of the major impacts at national level. A distributed system of European NMIs ensures maximum benefit in KT and allows tailoring of services and expertise to local priorities. Even if R&D is concentrated and facilities shared, local (national) KT capability is likely to remain a prerequisite. Thus there is a strong rationale for the continued existence of an NMI in each country. Whilst it is too early in the project to be definitive, it would seem that a mixture of primary and national standards, coordinated research and greater joint use of facilities is likely to be the most successful and widely supported approach.

The changes implied may impact most dramatically on the larger NMIs. Smaller NMIs in Europe have always focused their resources on the most pressing priorities in their country, relying on the larger NMI capabilities for the balance. In many larger countries the NMIs have historically, by and large, provided a comprehensive range of services [3] [4] and research. The pressure on resources means that this assumption, that all capability must be provided from within the country, is being questioned even in the larger European countries. Whilst smaller countries can identify and concentrate on their priority topics on a unilateral basis, if the larger countries adopt the same approach Europe risks losing vital capability.

In the larger countries the complexity of the current range of activities is such that the NMIs either have or are undertaking exercises to identify their options, in some cases using methodologies such as Multi Criteria Decision Analysis (MCDA) adapted to the issues within the project.

The first project workshop, held in Rotterdam in December 2002, was open to all the NMIs in Europe. Representatives of almost all the laboratories that make up the NMIs (almost 70 laboratories across Europe) were briefed on the project and were able to contribute to the debate. The preliminary output of the early work packages were aired and discussed. The NMIs engaged in an analysis of national metrology priorities (with national funding), identifying those best addressed collaboratively. Stakeholder consultation of the user community and review of the special circumstances of the Newly Associated States has ensured appropriate balance.

The second MERA workshop in June 2003 marks a major step forward in planning the strategic process. Bringing together the various strands developed in the project enables an overall picture to be established. For the first time the NMI funding agents and NMIs from around Europe will have the opportunity to jointly discuss the issues and to review the possible solutions. The involvement of the national funding bodies is crucial for those NMIs who wish to go much beyond the current level of cooperation. Greater collaboration, for example through the establishment of joint facilities, implies that the issue of joint funding must be explored. In the short term such solutions may not be feasible, and joint planning rather than joint funding may be a more realistic outcome.

4. CONCLUSIONS

MERA is laying the foundations for greater collaboration in research, the shared use of facilities and increased mobility of researchers, as well as more effective exploitation of research. The project is identifying metrology trends and research priorities and has developed decision-making aids to help identify research and services within Europe that would be optimised through greater collaboration. Scenarios for increased collaboration have been studied and are being tested with the stakeholders. The final report will include a road map proposing a co-ordinated pan-European approach to meeting high level metrological needs. The real challenge still lies ahead: that is implementing the output of the project.

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K5. Paper presented at Métrologie 2003, 20-23 October 2003, Toulon**METROLOGY IN THE EUROPEAN RESEARCH AREA: THE MERA PROJECT**

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RESUME

Les facilités métrologiques d'avant-garde soutiennent la recherche et l'innovation dans beaucoup de domaines de la science et de l'industrie, non seulement dans le domaine de la métrologie. L'industrie, le commerce et de plus en plus la qualité de vie d'aujourd'hui dépendent de mesures fiables et en lesquelles on a confiance. Les Instituts Nationaux de Métrologie sont des fournisseurs essentiels, réalisant de la Recherche et Développement de haut niveau et disséminant leur connaissance à travers leurs services et expertises. Les instituts étant pour la plupart fondés par les gouvernements donc avec de l'argent public, les ressources ne peuvent pas augmenter de la même façon que la demande. EUROMET a donc développé une stratégie afin d'adresser ce dilemme et le projet MERA aide à faire avancer cette stratégie.

ABSTRACT

State of the art measurement capability underpins research and innovation in many fields of science and industry, not just in metrology. Today's industry, trade and increasingly the quality of life also depend on reliable and trusted measurements. The National Metrology Institutes (NMIs) are key providers, conducting leading edge R&D and disseminating the knowledge they generate to the users through their calibration services and expertise. With the bulk of NMI funding coming from the public purse resources cannot realistically be expected to increase at a rate comparable to the demands. EUROMET has therefore developed a strategy to address this dilemma, and the MERA project is the vehicle that is carrying the strategy forward.

1. INTRODUCTION

The leading edge measurement capabilities, pioneered within the European NMIs, facilitate innovation, vital for tomorrow's prosperity, in virtually all-scientific and technological fields. We also rely today on high quality metrology capability and infrastructure. The regulations that ensure the quality of our lives, industrial competitiveness and international trade depend upon effective, consistent measurements and the interoperability of manufactured components. As globalisation becomes a reality, the drive for greater consistency from within the measurement infrastructure has increased. The desire for "measured once accepted everywhere", the mantra for measurement in trade, is reflected in the huge efforts that have led to mutual recognition arrangements and multilateral agreements at the highest levels within the measurement, accreditation and trade communities.

The ability of the NMIs to continue to deliver state-of-the-art measurement capability is threatened by ever-growing demands that must be met with resources that are not increasing at a comparable rate. The drivers behind this pressure can be considered as threefold:

- New areas of technology are emerging that require metrological support, for example the trend to move nanotechnology from an interesting scientific phenomenon to a key industrial activity. Likewise measurement science is vital if the potential of the emerging biotechnology opportunities are to be exploited.
- Areas of activity such as clinical medicine and food safety that are not in themselves new, but in which the impact and value of the metrology infrastructure are increasingly being recognised.
- Traditional areas of industry, whilst not necessarily expanding, nor the metrology

becoming more widespread, are becoming more complex and placing demands at the leading edge of metrology and measurement science that are ever more costly.

One key approach to addressing the dilemma of demand outstripping resource growth is to increase the level of cooperation in metrology, particularly in the R&D effort but also in the delivery of the resulting measurement services. EUROMET, the European collaboration between the NMIs, already has an impressive record of cooperation, with the number of collaborative projects undertaken now numbering in the hundreds.

To date the collaboration has not gone as far as planning either R&D effort, the facilities that support R&D or delivery of the resulting measurement services at a strategic level. Over the past few years EUROMET has examined the challenge faced by European metrology and developed a view that a strategic approach to these issues is essential for the future.

2. THE MERA PROJECT

The EUROMET vision matched very closely with the then emerging European Commission initiative now known as the “European Research Area” or ERA. Consequently the NMIs proposed, and the European Commission selected, a proposal for support under the R&D Framework Programme. The resulting project, “Planning the European Research Area in Metrology (“MERA”)” is partly funded by the FP5 “GROWTH” Programme¹², with the NMIs providing a significant input from their own resources. The MERA project identifies and addresses the issues associated with the EUROMET strategy with the objective of providing recommendations for action that are supported by consultation, surveys, studies, and analysis. The thrust of both the strategy and the project focuses around closer R&D coordination, joint use of facilities and some rationalisation of services.

The need for increased cohesion in top level European metrology has never been greater. The

European Commission’s 6th Framework Programme (FP6), for the first time, does not include a dedicated measurement and testing activity, so the metrology community must face new challenges in integrating with wider research efforts in FP6 and elsewhere. Therefore increasing the impact from the available resources is essential for the future of European metrology and the wide range of users that benefit from it.

The project commenced in September 2002 and will run for 15 months. The project participants reflect the composition (at the time of the proposal submission) of the EUROMET Executive Committee, augmented by those NMIs not on the Committee but who were contributing to the strategic planning within EUROMET. The seven project partners are the National Metrology Institutes from:

- | | | |
|-------------------|---------|---|
| • UK | NPL | (the coordinator) |
| • The Netherlands | NMi-VSL | |
| • Germany | PTB | |
| • Ireland | NML-EI | |
| • Sweden | SP | |
| • Czech Republic | CMI | |
| • Switzerland | METAS | (who participate with national funding only). |

The partners are directly supported by a further four NMIs from:

- | | |
|-----------|------|
| • France | BNM |
| • Denmark | DFM |
| • Italy | IMGC |
| • Norway | JV |

who provide expertise and breadth to the project steering committee. All 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.

3. THE WORK PLAN

The project divides the work into ten main packages (Fig.1). These are:

¹² Contract G6MA-CT-2002-04012

- State-of-the-art review of relevant collaborative activity;
- Identification of future trends for metrology research;
- Metrology infrastructure scenarios and decision tool development allowing areas and degree of cooperation to be identified;
- National Metrology Institute Workshop – involving the NMIs from across Europe, addressing issues, elaborating scenarios and presenting models and research trends;
- National review of structures and priorities for collaboration taking due account of national industrial need and issues that hinder greater collaboration;
- A stakeholder consultation at European level to ascertain the end user perspective on potential structural changes in the metrology infrastructure;
- A consultation to ascertain the Newly Associated States (Accession Countries) perspective on potential structural changes in the metrology infrastructure;
- A summary of the findings from the national, stakeholder and Newly Associated States consultations;
- European Research Area Workshop – proposing metrology infrastructure options and research priorities, identifying actions to overcome hurdles;
- Foresight Report and dissemination – summarising and justifying the conclusions of the project, and providing recommendations and roadmap for selected scenarios.

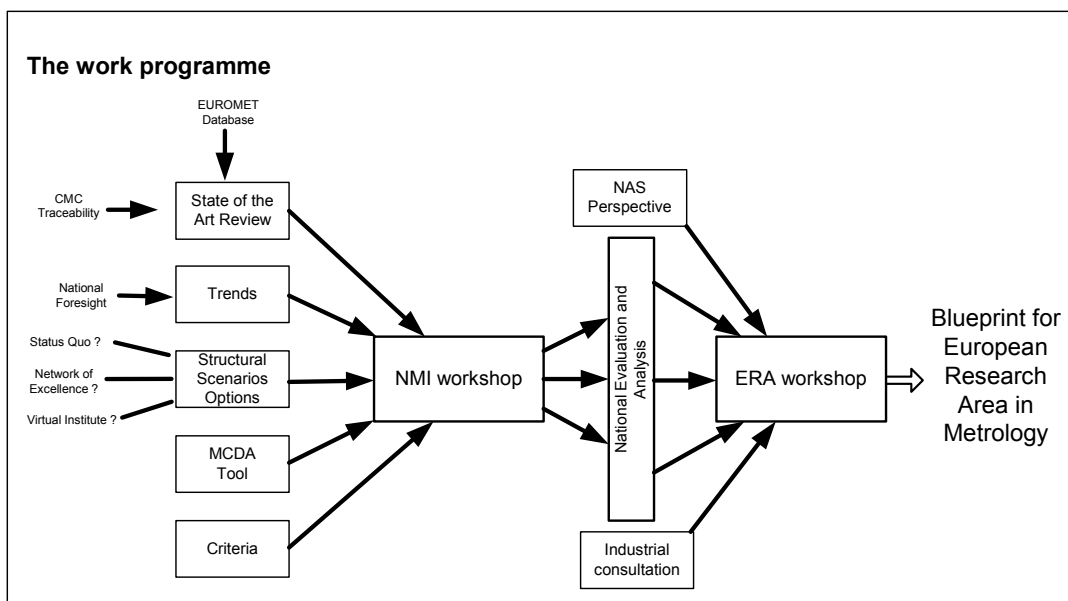


Fig. 1. MERA work plan

The initial phase of the project involved the groundwork necessary to enable the NMIs to get to grips with the complex issues under consideration. This required collating and assessing the “state-of-the-art” in terms of current collaboration between the NMIs, looking at the future trends for metrology, developing analytical methodologies and tools. Simplified and stylised

“scenarios” were developed to illustrate the issues associated with changing the character of the

structure of top-level metrology in Europe. Analytical tools based on multi-criterion decision analysis were developed and shared. The various approaches that would be used during the consultations and surveys with Newly Associated States (as they were then known) and the stakeholders at European level had to be thought through and agreed. As each NMI was free to conduct the national analysis in the way they thought most suitable, collaboration at this stage revolved around jointly thinking through the issues, and later sharing the processes and questionnaires etc.

All these elements were brought together at a workshop in Rotterdam in December 2002. The workshop was open to all the NMIs in Europe; some 70 laboratories across Europe (as many countries have more than one laboratory that comprise the NMI) were briefed on the project and able to contribute to the debate. The preliminary output of the early workpackages were aired and discussed. Every effort was made to ensure that all options, popular or otherwise, were explored. Thus scenarios examined ranged from the status quo to a single institute for Europe. The NMIs left the workshop with a commitment to engage in a national analysis to establish national metrology priorities, identifying those best addressed collaboratively. A number of NMIs surveyed their user communities as part of this process. Stakeholder consultation at European level and review of the special circumstances of the Newly Associated States complemented the

national consultation process and has helped to ensure appropriate balance.

The second MERA workshop at PTB in Berlin held in June 2003 marked a major step forward in planning the strategic planning process. By bringing together the various strands developed in the project, a comprehensive description of the issues and viewpoints underpinned the discussions. For the first time the NMI funding agents from around Europe also had the opportunity to discuss with each other and with the NMIs the issues they are facing and also to review the possible solutions.

4. PRELIMINARY FINDINGS

Indications of the direction of the project findings are emerging. Research collaboration has always been one of the strongest elements of cooperation, and this is likely to be the case in the future. The EC Framework Programme can clearly be seen historically as a key catalyst in the process. EC support brings not only funds, but also a formal and detailed work programme complete with defined responsibilities, deliverables and of course the discipline of a formal contract with a start and end date for the research activity. Many EUROMET projects are undertaken and completed without this formal EC support, however the risk of project “drift” is noticeably increased. EUROMET may well consider the value of initiating a process adopting the best elements that characterise the formal EC projects for EUROMET projects, but of course without the funding support and attendant bureaucracy.

The MERA foresight study has identified many key metrological research topics for the future, and will allow areas of overlapping interest between NMIs to be identified more effectively and at an earlier stage. One of the ideas emerging from the project has been prompted by the recognition that the NMI laboratories have spheres of interest that do not coincide exactly. Longer-term core R&D activity has been identified by the project as one of the activities most suitable for strategic coordinated planning

and collaboration. This R&D is the research supporting development of the *SI Units* and measurement of the fundamental constants. It can be characterised as the R&D undertaken in support of many of tomorrow's standards, supporting the essence of tomorrow's metrology. Because this R&D is likely to be medium to long term, it tends to be far from market. An example would be the work undertaken to replace the current mass artefact. Much of the core research may well be concentrated in a few NMIs, although all NMIs are stakeholders in the process. The core R&D activities lead to tomorrow's "product" for all the NMIs. In a more closely integrated infrastructure a wider circle of NMIs could participate either in certain aspects of the R&D or through staff exchanges, providing additional resource on the one hand and enhanced knowledge transfer on the other. Shorter term R&D collaboration, targeted at the improvement of existing facilities in NMIs, would also be beneficial, but will perhaps occur on a more *ad hoc* basis as opportunities arise.

The evaluation of the current collaboration in European metrology at NMI level has identified some 80 traceability arrangements already in place between the NMIs (whereby an NMI in one country does not hold a primary standard, but holds a national standard traceable to the primary standard at another NMI). Whilst smaller NMIs make extensive use of this mechanism, the larger NMIs have traditionally been able to offer a comprehensive primary capability. It seems likely that the larger laboratories will also begin to specialise rather than stretch their resources ever wider.

The end user analysis show that, not surprisingly, given a free choice most users want their own national NMI to deliver a comprehensive service. This reluctance to take a European perspective was tempered when it was proposed to support non national service provision with a formal agreement to guarantee quality, fair treatment, and continuity. The national analysis has highlighted the importance of the NMIs maintaining excellence; the one characteristic users valued above all others in

the surveys.

From the consultations and workshops a broad consensus emerged amongst the NMIs and their stakeholders: collaboration must be increased, but a single institute for Europe is not the most appropriate option for the future. This is not surprising, the knowledge transfer (KT) associated with high-level metrology has been recognised increasingly as one of its major impacts at national level. Even if R&D is concentrated, and facilities shared, local service delivery and (national) KT capability is likely to remain a prerequisite. Thus there is a strong rationale for the continued existence of an NMI in each country.

In the short term, increased utilisation of existing major national facilities can be pioneered by the NMIs. However the establishment of joint facilities in the future implies that the issue of joint funding must be explored. Thus the involvement of the national funding bodies is crucial for those NMIs who wish to go much beyond the current level of cooperation. In the short term such solutions may not be feasible, and joint planning rather than joint funding may be more realistic.

5. CONCLUSIONS

Many of the likely changes may impact most dramatically on the larger NMIs. Smaller NMIs in Europe have always focused their resources on the most pressing priorities in their country, relying on the larger NMI capabilities for the balance. In many larger countries the NMIs have historically, by and large, provided a comprehensive range of services and research. The pressure on resources means that this assumption, that all capability must be provided from within the country, is being questioned even in the larger European countries. Whilst smaller countries can identify and concentrate on their priority topics on a unilateral basis, if the larger countries adopt the same approach Europe risks losing vital capability.

MERA aims to lay the foundations for greater collaboration in research, the shared use of

facilities and increased mobility of researchers, as well as more effective exploitation of research. The project has identified metrology trends and research priorities and has developed decision-making aids to help identify research and services within Europe that would be optimised through greater collaboration. Scenarios for increased collaboration have been studied and tested with the stakeholders. Detailed recommendations will point the way forward for meeting high level metrological needs in Europe. The emerging conclusions of the project identify:

- The current extensive R&D collaboration in Europe;
- The example set by the traceability interdependencies that have developed over time;
- The likelihood that the number of such arrangements is likely to increase, with larger NMIs using the mechanism to a much greater extent in the future;
- The need for NMIs to maintain excellence, the quality most valued by end users;
- The need to move beyond the current “ad hoc” collaborations to strategically planned

and jointly executed R&D for at least core or spine activities;

- The value (and difficulties to be overcome) associated with shared major facilities;
- The importance of mobility of scientists – and the challenges that mobility in practice brings;
- The value of a local (i.e. national) NMI delivering national calibrations and knowledge transfer and able to tap into the European network;
- The need for long term commitment when providing transnational capabilities;
- The importance of basing acceptance of calibration certificates on the CIPM MRA rather than insisting that the domestic NMI issues the certificate;
- The need to have high-level support to implement the findings.

The process may be illustrated by EUROMET's evolving role: cooperation in the early days, collaboration in more recent years, and coordination of activities in the future. The real challenge still lies ahead: that is implementing the output of the project.

ANNEX L – PARTNERS AND SUBCONTRACTORS CONTRIBUTIONS

- L1. Report on Activities of partner 1 and project coordinator (National Physical laboratory-NPL)**
- L2. Report on Activities of Partner 2 (NMI Van Swinden Laboratorium - NMI VSL)**
- L3. Report on Activities of Partner 3 (Physikalisch-Technische Bundesanstalt - PTB)**
- L4. Report on Activities of Partner 4 (National Metrology Laboratory - NML)**
- L5. Report on Activities of Partner 5 (Swedish National Testing & Research Institute - SP)**
- L6. Report on Activities of Partner 6 (Czech Metrology Institute - CMI)**
- L7. Report on the activities of partner 7 (Swiss Federal Office of Metrology and Accreditation - METAS)**
- L8. Report on Activities of the Subcontractor DFM (Danish Institute of Fundamental Metrology)**
- L9. Report on Activities of the Subcontractor BNM (Bureau National de Métrologie)**
- L10. Report on Activities of the Subcontractor JV (Justervesenet)**
- L11. Report on Activities of the Subcontractor of IMGC (*Istituto di Metrologia G Colonnetti*)**

L1. Report on Activities of partner 1 and project coordinator (National Physical laboratory-NPL)

Reporting period: August 2002 to November 2003 + report preparation

1 INTRODUCTION

As the coordinator NPL was been active in almost of the workpackages, at a minimum taking on board the outcomes and ensuring that workpackage outputs correctly fed into subsequent activities. Other than a coordinating role NPL led WP1, 3, 8, 10 and 11.

The following gives a summary of NPL's activities under each Workpackage heading.

2 WORKPACKAGE 1: STATE-OF –THE-ART REVIEW

NPL led this workpackage, proposing the modus operandi at the kick off meeting, and following discussions carried out the core activities. This involved: Review of the EUROMET project database, analysis of the findings and presentation in easy to follow format, review and analysis of traceability arrangements and generation of the “airline maps”, review of calibration and measurement capability statements (declared by all the European NMIs in the BIPM KCDB database), analyses of the findings and preparation of graphical representations. A review of CORDIS projects was attempted to identify the relevant NMI collaborative projects that had been funded by the EC, however the quality of data available was such that clear conclusions could not be drawn, and this line of enquiry was abandoned. Following initial review of the EUROMET database NPL identified the need for improved quality of data, and NPL interfaced with BNM, METAS and NML who undertook a cleaning up of the data prior to analysis.

Output: data to enable presentation of the level of collaboration in research and summary of airline maps for traceability.

3 WORKPACKAGE 2: TRENDS ANALYSIS

NPL consulted the various technical contacts within the UK NMS to canvas views on future trends and fed the output to NML, the task leader. Following discussions with NML a support review of existing foresight studies was undertaken, confirming the NML view that these studies were of very limited value in determining future metrological needs. NPL collaborated with NML in evaluating the findings, particularly in characterisation of the categories of future R&D.

Output: A list of trends identified as important from the UK perspective.

4 WORKPACKAGE 3: DEVELOPMENT OF PROCESS

NPL led this workpackage, developing three core processes used in the project: The scenarios to look at the issues associated with the future structuring of metrology in Europe, the Multi Criteria Decision Analysis approach to prioritisation of activities that should be delivered nationally and those where foreign provision may provide a suitable alternative, and development of proforma for collection and collation of data associated with R&D, facilities and services which would benefit from greater collaboration. A training workshop was held for the MCDA tool.

Output: Four-scenario model, MCDA concept and working software, standard proforma for data collection

5 WORKPACKAGE 4: NMI WORKSHOP.

Input to and attendance at the 1st workshop in NMI in December 2002 in Rotterdam, including, as project coordinator, detailed monitoring and coordination with NMi VSL, the task leader on issues such as topics for the workshop, speakers and content.

Output:

- Preparation of the list of identified trends of the UK metrology for the workshop
- Preparation of the data concerning the current level of collaboration within EUROMET
- Participation in the brainstorming sessions
- Presentations on MCDA, the background of MERA, Scenarios

6 WORKPACKAGE 5: NATIONAL ANALYSIS

NPL undertook a major survey of UK stakeholders. This involved contacting some 2500 organisations and alerting them to a specifically developed web based questionnaire. Almost 300 detailed and valid responses were received enabling meaningful analysis of the stakeholder views. Additionally all technical contact persons from each of the UK laboratories making up the UK National Measurements System (NMS) were contacted and interviewed to establish which areas were considered most appropriate for R&D collaboration. The MCDA tool, developed under workpackage 3 was used to evaluate the entire UK NMS portfolio, taking into account all the contributing laboratories.

Output: Areas with devolution and research collaboration potential were identified.

7 WORKPACKAGE 6: EUROPEAN STAKEHOLDER CONSULTATION

- Reorientation of the workpackage in conjunction with the task leader (SP) and all partners
- Contribution to the format and detail of the questionnaire used to survey stakeholders. This involved an unscheduled meeting of NPL and SP staff at SP in order that all issues could be resolved.
- Joint review of findings with SP

Output: SP report

8 WORKPACKAGE 9: ERA WORKSHOP

Preparation for and participation in the 2nd MERA workshop in Berlin, June 2003, including:

- Detailed liaising with PTB, task leader (including a preparatory meeting between NPL and PTB at PTB)
- With PTB, joint development of the Programme including identification of speakers, review of presentations
- Preparation and presentation of 3 elements at the workshop

9 WORKPACKAGE 10: DISSEMINATION AND FORESIGHT REPORT

NPL has been particularly active in ensuring all interested parties were aware of the MERA activity. Presentations at conferences (detailed below) were supplemented by information made available on the EUROMET website where a MERA dedicated area was created in conjunction with NML EI, the EUROMET Chair.

Conferences:

- ‘Towards an integrated infrastructure for measurements’ conference, 18-19 June, Warsaw (poster)
- XVII IMEKO World Congress, 22–27 June 2003, Dubrovnik, Croatia (paper and poster)
- The International ILAC/IAF conference on accreditation in global trade, 23-25 September 2002, Berlin (poster)
- NCSLi conference, 18-21 August 2003, Tampa (paper and presentation – not funded by the project)
- Presented at Métrologie 2003, 20-23 October 2003, Toulon (paper and presentation)

Handouts:

Handouts based on the posters were prepared and distributed, including opportunistic distribution at the various events attended by the partners.

Additionally at National level presentations have been made at the International Forum for the NMS stakeholders, and for the DTI, STRD and BSI.

10 WORKPACKAGE 11: MANAGEMENT

NPL was the project manager and coordinator of the project. Management issues preceded smoothly, the main difficulty being that much of the input needed to come directly from the NMI senior managers, in many cases the Directors of the Institutes. Thus it was vital that inputs were carefully followed up. The project held a kick off meeting (originally planned to be held at NPL, but in fact held at JV in Norway (10 and 11th September 2002) to take advantage of a EUROMET meeting already scheduled), a second meeting at BNM in Paris (January 28, 2003), the two workshops (Rotterdam and Berlin) and a final meeting at the Toulon conference (October 23, 2003).

L2. Report on Activities of Partner 2 (NMI Van Swinden Laboratorium-NMI VSL)

Reporting period: August 2002 to October 2003

1 INTRODUCTION

NMI Van Swinden Laboratorium (NMI VSL) has had an input into Workpackages 1, 2, 3, 4, 5, 6, 8, 9, 10 and 11. NMI VSL was also the Leader of Workpackage 4.

The following gives a summary of NMI VSL's activities under each Workpackage heading. A complete report has been presented on WP 4.

2 WORKPACKAGE 1: STATE-OF –THE-ART REVIEW

NMI VSL provided updated information to the “airline” maps showing the traceability arrangements between NMI VSL and other institutes in different fields, and on Dutch participation in collaborative European projects.

3 WORKPACKAGE 2: TRENDS ANALYSIS

NMI VSL provided WP2 leader with ideas on future metrological research topics in physics and chemistry.

4 WORKPACKAGE 3: DEVELOPMENT OF PROCESS

Input to project coordinator on metrology infrastructures in Europe at different working levels, ranging from cooperation in fundamental research, development of new measurement standards, calibration services at the national level, and legal metrology services.

5 WORKPACKAGE 4: NMI VSL WORKSHOP.

NMI VSL organised the first MERA workshop in December 2002 in Rotterdam.

During the workshop, 66 leading experts from 28 National Metrology Institutes (NMIs) in Europe and guests from the BIPM, CIPM and DG Research:

- reviewed the current level of EUROMET cooperation,
- visualized and discussed four different scenarios for the restructuring of European metrology,
- identified the key challenges and discussed the associated risks for the future research in metrology,
- discussed priority setting for research in small and large NMIs using common decision tools,
- reviewed the issues to be addressed during the national activities.

Output:

The workshop resulted in

- a list of metrology structural scenarios, including the risks and challenges identified during plenary discussions

- a list of priority topics in metrological research resulting from workshops on nanotechnology, physics and chemistry
- a full report on the programme and all discussion items

6 WORKPACKAGE 5: NATIONAL ANALYSIS

NMi VSL made an inventory of future services that are required by our major customers. Interviews and questionnaires were used. The greatest demand was identified in the area of chemistry, where the need for reference materials with traceable reference values can be solved through international cooperation. A report in Dutch is available.

Also, the Dutch government started a new approach to planning metrology services in The Netherlands in the next 5-10 years. A report on the new vision will become available in 2004.

7 WORKPACKAGE 6: EUROPEAN AND NATIONAL INDUSTRIAL CONSULTATION

NMi VSL contributed to the format and detail of the questionnaire used to survey major stakeholders. The national consultation is mentioned under WP 5.

8 WORKPACKAGE 8: SUMMARY AND ANALYSIS

Preparation of a paper on the Dutch national analysis for presentation at the MERA workshop in Berlin.

9 WORKPACKAGE 9: ERA WORKSHOP

Participation in the 2nd MERA workshop in Berlin, including the presentation of a paper on the Dutch national analysis and industrial consultation activities.

10 WORKPACKAGE 10: DISSEMINATION AND FORESIGHT REPORT

The results of the MERA project have been discussed mainly with the responsible governmental departments. At present there is a very positive attitude towards European cooperation and the willingness to share research results and calibration activities with other countries.

Ed de Leer

L3. Report on Activities of Partner 3 (Physikalisch-Technische Bundesanstalt - PTB)

Reporting Period: August 2002 to October 2003

1 INTRODUCTION

PTB, the national metrology institute of Germany, has had an input into the workpackages 1, 2, 3, 4, 5, 6, 8, 9, 10 and 11. In addition it was leader for the workpackage 9.

2 WORKPACKAGE 1: STATE-OF –THE-ART REVIEW

This workpackage was led by NPL, UK. PTB provided and updated its data for NPL to be included in the EUROMET database for all technical fields covered by EUROMET committees.

3 WORKPACKAGE 2: TRENDS ANALYSIS

This workpackage was led by NML, Ireland. PTB provided input to NML on its view of the major challenges in metrological research for the time of the next decade. This topic was then further discussed at the first MERA workshop in Rotterdam.

4 WORKPACKAGE 3: DEVELOPMENT OF PROCESS

This was led by NPK, UK. PTB provided input to NPL on the ideas how scenarios for the development of European metrology could be structured. The possible scenarios were then discussed in more detail at the first MERA workshop in Rotterdam.

5 WORKPACKAGE 4: NMI VSL WORKSHOP.

PTB contributed a paper on international cooperation in R&D considering as example the synchrotron radiation facility BESSY II and participated with 2 members in the workshop.

6 WORKPACKAGE 5: NATIONAL ANALYSIS

PTB contacted 2400 of its customers and stakeholders via an internet-based questionnaire. More than 900 responses were received.

Basic questions were:

- - what is important for the stakeholder when they receive a metrological service
- - would the stakeholder agree if the service was provided by another European institution?

These (and other) questions were asked each related to R&D, conformity assessment and calibration services. The answers could be correlated with the characteristics of the respondents (private/publicly funded, technical field of activity, size etc).

The comprehensive overview of the stakeholders' views obtained in that manner was presented at the Berlin workshop, June 2003.

7 WORKPACKAGE 6: EUROPEAN AND NATIONAL INDUSTRIAL CONSULTATION

This workpackage was led by SP, Sweden. PTB put the results of the European stakeholder consultation in context to the various national analyses and the perspectives of the accession countries and presented this summary at the Berlin workshop, June 2003.

8 WORKPACKAGE 8: SUMMARY AND ANALYSIS

This workpackage was led by NPL. PTB gave its input to NPL that was drawn in particular from the results of the German national analysis of metrological needs.

9 WORKPACKAGE 9: ERA WORKSHOP

PTB being the workpackage leader planned and managed the workshop in Berlin, June 2003. PTB presented several papers:

- a summary of the German national analysis
- a concluding summary combining the various national analyses, the European stakeholder consultation and the perspectives of the accession countries
- a paper on the identification of pilot projects
- a paper on the future of metrology in Europe from an NMI's view.

PTB participated in the panel discussion of representatives of NMIs and of the funding agencies.

10 WORKPACKAGE 10: DISSEMINATION AND FORESIGHT REPORT

The final report will include PTB's analyses and contributions to the other workpackages.

Michael Kühne

L4. Report on Activities of Partner 4 (National Metrology Laboratory - NML)

Reporting period: August 2002 to October 2003

1 INTRODUCTION

The National Metrology Laboratory, Enterprise Ireland has had an input into Workpackages 1, 3, 4, 5, 6, 9 and 10. NML are also the Leader of Workpackage 2.

The following gives a summary of NML's activities under each Workpackage heading. A complete report has been presented on WP 2.

2 WORKPACKAGE 1: STATE-OF –THE-ART REVIEW

To develop a clear understanding of the level of cooperation between NMIs in Europe, it was necessary to verify the content and completeness of the EUROMET project database. This task was undertaken by NML through contact with EUROMET Technical Committee Chairmen and project coordinators. The data was verified and uploaded to the database ensuring that all proposed and on-going projects had been correctly registered.

Output: EUROMET project database fully updated and verified thereby ensuring that all information on level of EUROMET cooperation is available and up-to-date.

3 WORKPACKAGE 2: TRENDS ANALYSIS

See dedicated report on this workpackage.

4 WORKPACKAGE 3: DEVELOPMENT OF PROCESS

Input to project coordinator in developing a series of scenarios for the metrology infrastructure in Europe, through a detailed examination of existing national scenarios, traceability interdependences and national requirements.

5 WORKPACKAGE 4: NMI .WORKSHOP.

Input to and attendance at the 1st workshop in NMI in December 2002 in Rotterdam:

- Preparation of the list of identified trends for the workshop
- Presentation of the identified trends (to date) to all attendees (PowerPoint presentation is available on MERA section of EUROMET Website)
- Co-ordination of the three brainstorming sessions, including collation of the outputs from the three groups.

Output: Production of a focussed and prioritised list of metrology research trends to take to the next stage of the process.

6 WORKPACKAGE 5: NATIONAL ANALYSIS

NML undertook discussions and consultation with a number of customers from four specific sectors of industry, Pharmaceuticals, Electronics, Calibration & testing services and Food/drink on preferred structural scenarios for metrology in Ireland. From these consultations a view on the preferred metrology infrastructural scenario for Ireland was reached.

Completion of the pro-forma detailing potential for:

- service devolution
- significant capability and potential to increase work through devolution from other countries
- potential to collaborate in each research area identified.

Output: A view on the preferred metrology infrastructural scenario for Ireland has been reached. Areas with devolution and research collaboration potential were identified.

7 WORKPACKAGE 6: EUROPEAN AND NATIONAL INDUSTRIAL CONSULTATION

- Contribution to the format and detail of the questionnaire used to survey stakeholders.
- Construction of a questionnaire for NML customers. Questionnaire was sent out to over 200 customers to ascertain customer's present and future needs from a metrology infrastructure.

Output: On-going activity, awaiting customers responses.

8 WORKPACKAGE 9: ERA WORKSHOP

Preparation for and participation in the 2nd MERA workshop in Berlin, June 2003, including:

- on-going contact and survey of EUROMET NMIs to ascertain their research capability and potential to collaborate for those fields identified in the 'trends analysis'.
- Taking into account the feedback received from the NMIs, preparation of paper for presentation at workshop.
- Presentation of paper at ERA workshop on research trends and potential collaboration – day 1
- Presentation of paper on EUROMET's role and objectives – day 2.
- Participation on the panel for the 'panel discussions' on day 2.

9 WORKPACKAGE 10: DISSEMINATION AND FORESIGHT REPORT

A final report being prepared on the 'trends analysis', which will include a list of priority metrology research areas over the next decade.

Paul Hetherington

L5. Report on Activities of Partner 5 (Swedish National Testing & Research Institute - SP)

Reporting period: August 2002 to October 2003

Attendance at all MERA project meetings.

1 WORKPACKAGE 2: TRENDS ANALYSIS

Report on Swedish National Technology Foresight project from a measurement point of view submitted to MERA WP2 coordinator.

2 WORKPACKAGE 3: DEVELOPMENT OF PROCESS

Input to MERA WP3 co-ordinator in developing a series of scenarios for the metrology infrastructure in Europe, through a detailed examination of existing national scenarios, traceability interdependences and national requirements.

3 WORKPACKAGE 4: NMI WORKSHOP

Input to and attendance at the 1st workshop in NMI in December 2002 in Rotterdam, including:

- Presentation of the planned European Stakeholder consultation (WP6) to all attendees (PowerPoint presentation is available on MERA section of EUROMET Website)

Output: Important feedback in the formulation of the European Stakeholder consultation (WP6)

4 WORKPACKAGE 5: NATIONAL (AND REGIONAL) ANALYSIS

Discussions and consultation within NMO and with a number of stakeholders in metrology in Sweden. Corresponding Nordic regional (N-MERA) project initiated with support of NORDTEST.

Output: A view on the Swedish national metrology analysis was formulated following the expected deliverables for this WP. Nordic Metrology project list; NORDTEST Position Paper (010); Seminars & Workshops.

5 WORKPACKAGE 6: EUROPEAN STAKEHOLDER CONSULTATION

Output: As lead partner for this WP, see separate report [SP 2003:13] on this. NORDTEST N-MERA Seminar “Stakeholder Interests”, May 2003 organised by SP.

6 WORKPACKAGE 9: ERA WORKSHOP

Preparation for and participation in the 2nd MERA workshop in Berlin, June 2003, including:

- Presentation of paper at ERA workshop on MERA WP6 – day 1
- Presentation of paper on N-MERA Nordic/Nordtest satellite project – day 1

to all attendees (PowerPoint presentations are available on MERA section of EUROMET Website)

7 WORKPACKAGE 10: DISSEMINATION AND FORESIGHT REPORT

Contributions to continued MERA work in EUROMET and N-MERA.

Dr Leslie Pendrill

L6. Report on Activities of Partner 6 (Czech Metrology Institute - CMI)

Reporting period: September 2002 to November 2003

1 INTRODUCTION

The Czech Metrology Institute, Czech Republic, has had an input into Workpackages 3, 4, 5, 7 and 9. CMI was the WP7 Lead Contractor. Representative of the CMI served on the Steering Board of the project.

The following gives a summary of CMI's activities under each Workpackage heading. A complete report has been presented on WP 7.

2 WORKPACKAGE 3: DEVELOPMENT OF PROCESS

Input to the analysis of traceability interdependences and national requirements in preparation of scenarios for the metrology infrastructure in Europe, through a detailed examination of existing national scenarios.

3 WORKPACKAGE 4: NMI WORKSHOP.

Input to and attendance at the 1st workshop in NMI in December 2002 in Rotterdam:

- Preparation and presentation of the implementation plan for the WP7.
- Participation to the three brainstorming sessions.

Output: Implementation plan for the WP7.

4 WORKPACKAGE 5: NATIONAL ANALYSIS

CMI undertook discussions and consultation with a number of customers from specific sectors of industry. Needs of trade and industry were analysed as well as capabilities of CMI fundamental metrology departments which are involved in different metrological fields. Appraisal with respect to given criteria was made by experts at several levels (laboratories, board of directors, scientific council, Metrology Council – advisory board of the Czech Office for Standards, Metrology and Testing). From these consultations a view on the preferred metrology infrastructural scenario for the Czech Republic was formulated.

Output: A view on the preferred metrology infrastructural scenario for the Czech Republic has been reached. Areas with devolution and research collaboration potential were identified. Special national report was presented to the co-ordinator.

5 WORKPACKAGE 7: NAS PERSPECTIVE

CMI was the WP7 Lead Contractor.

Output: See dedicated report on this workpackage.

6 WORKPACKAGE 9: ERA WORKSHOP

Attendance at the 2nd MERA workshop in Berlin, June 2003, including participation on the panel for the ‘panel discussions’ on day 2.

Pavel Klenovsky

L7. Report on the activities of partner 7 (Swiss Federal Office of Metrology and Accreditation - METAS)

Reporting period: August 2002 - October 2003

1 INTRODUCTION

METAS Switzerland has had inputs into workpackages 4, 5, 6 and 9. According to the contract the Swiss contributions were entirely funded nationally.

The following gives a summary of METAS' activities under the mentioned workpackages.

2 WORKPACKAGE 4: NMI WORKSHOP.

Attendance with two experts at the 1st MERA Workshop (State-of-the-Art Review) in December 2002 in Rotterdam. Providing input from METAS as an NMI and the experience gained during a 4-year chairmanship of the EUROMET Technical Committee Length.

Output: Contribution to the prioritised list of metrology research trends to take to the next stage of the process.

3 WORKPACKAGE 5: NATIONAL ANALYSIS

METAS assembled the already available information with regard to the preferred scenarios for metrology in Switzerland, but did not undertake a specific inquiry in view of the regular (every 4 years) wider customer inquiry in October 2003. The latter fully confirmed the already known trend in the country for metrology services.

Completion of the pro-forma detailing potential for:

- service devolution
- significant capability and potential to increase work through devolution from other countries
- potential to collaborate in each research area identified.

Amendment to the regular inquiry for METAS customers with regard to MERA. The corresponding questionnaire was sent out in October 2003 to over 1700 customers and evaluated by an external company in December 2003.

Output: The preferred metrology infrastructural scenario for Switzerland were identified by METAS and later on (October 2003) confirmed by the regular customer inquiry. Areas with devolution and research collaboration potential were identified.

4 WORKPACKAGE 6: EUROPEAN AND NATIONAL INDUSTRIAL CONSULTATION

- Contributions to the format and detail of the questionnaire used to survey European stakeholders.

Output: see report by SP.

5 WORKPACKAGE 9: ERA WORKSHOP

Participation at the 2nd MERA Workshop in Berlin, June 2003, with one METAS representative bringing in his 4 year experience as a EUROMET Chairman Elect, Chairman and Past Chairman.

Wolfgang Schwitz

L8. Report on Activities of the Subcontractor DFM (Danish Institute of Fundamental Metrology)

1 WORKPACKAGE 4: NMI WORKSHOP.

Input to and attendance at the 1st workshop 16-17 December 2002 in Rotterdam:

- Preparation of presentation about the situation in smaller NMIs, including an elaboration of the Bull's eye model as a simplify model for choosing research compared to the Multi Criteria model
- Collecting the results of the voting about scenarios A, B, C, and D.
- Chairing working group on nano metrology

Output:

- Presentation of Setting priorities in small and distributed NMIs
- Presenting the results of the voting about scenarios A, B, C, and D.
- Compiling results for nano-metrology and presenting these in a key-not paper at EURONANOFORUM, Trieste December 2003

2 WORKPACKAGE 9: ERA WORKSHOP

Participation in the 2nd MERA workshop in Berlin, June 2003, including chairing the last session.

3 WORKPACKAGE 5: NATIONAL ANALYSIS

DFM undertook discussion within its Board of directors, and consultation with members of the Danish NMI-organization DANIAMet.

DFM took part in the project N_MERA that dealt with the Nordic aspects of MERA

Output:

- MERA Metrology Research Area National Analysis – Denmark (Report DFM 2004-R2)
- National Enquiry – Denmark (excel spread sheet)
- Contributions to N-MERA output from SP

4 WORKPACKAGE 6: EUROPEAN AND NATIONAL INDUSTRIAL CONSULTATION

Interaction with Danish Federation of Industries DI.

Conclusions:

- Technology and metrology are interrelated and increasingly scientifically based.
- National metrology institutes should priorities areas where local industry is strong and has great potential. For instance acoustics for Denmark.

Output:

- Presentation of the views of Danish Federation of Industries

Kim Carneiro

L9. Report on Activities of the Subcontractor BNM (Bureau National de Métrologie)

Reporting period: August 2002 to October 2003

1 INTRODUCTION

The BNM has had an input into workpackages 1, 2, 4, 5, 6, 9, 10 and 11.

The following gives a summary of BNM's activities under each workpackage heading.

2 WORKPACKAGE 1: STATE-OF –THE-ART REVIEW

To develop a clear understanding of the level of cooperation between NMIs in Europe, it was necessary to verify the content and completeness of the EUROMET collaborative project on research and traceability. Part of this task was undertaken by BNM through contact with EUROMET Executive Committee members and project coordinators. The information were compiled and used for a presentation during the first workshop.

Output: Presentation of the level of collaboration in research and summary of airline maps for traceability.

3 WORKPACKAGE 2: TRENDS ANALYSIS

To identify the main thrust of metrological research for the next decade, BNM sent an enquiry to all calibration and testing accredited laboratories by COFRAC in France. Some managers and scientists were also heard by the BNM Strategic Council in order to give their view on the future of the metrology in France.

Output: A list of four main activities to continue and four new large projects to start.

4 WORKPACKAGE 4: NMI WORKSHOP.

Input to and attendance at the 1st workshop in NMI in December 2002 in Rotterdam:

- Preparation of the list of identified trends of the French metrology for the workshop
- Preparation of the information concerning the current level of collaboration within EUROMET (PowerPoint presentation is available on MERA section of EUROMET Website)
- Participation in the brainstorming sessions.

Output: Presentation of the current level of EUROMET collaboration.

5 WORKPACKAGE 5: NATIONAL ANALYSIS

BNM undertook discussion within its Board of directors, Strategic Council and consultation with all calibration-accredited laboratories.

From these consultations which unfortunately were not very productive, no consensus on the preferred metrology infrastructural scenario for France was reached.

The discussion and enquiry included the following points:

- Possibility of calibration service devolution
- Identification of research area for a better collaboration in Europe.

Output: Areas with devolution and research collaboration potential were identified.

6 WORKPACKAGE 6: EUROPEAN AND NATIONAL INDUSTRIAL CONSULTATION

- Contribution to the format and detail of the questionnaire used to survey stakeholders.
- Construction of a questionnaire for BNM customers. Questionnaire was sent out to over 400 customers to ascertain customer's present and future needs from a metrology infrastructure.

Output: On-going activity, awaiting customers responses.

7 WORKPACKAGE 9: ERA WORKSHOP

Preparation for and participation in the 2nd MERA workshop in Berlin, June 2003, including chairing the first session: Review of the collaboration in EUROMET and future trends.

8 WORKPACKAGE 10: DISSEMINATION AND FORESIGHT REPORT

Participation to the elaboration of a report on the 'trends analysis', which will include a list of priority metrology research areas over the next decade.

9 WORKPACKAGE 11: MANAGEMENT

Participation in the Steering Committee.

Organisation of two meetings in France:

- Paris at BNM: January 28, 2003
- Toulon, Metrology 2003, October 23, 2003.

Luc Erard

L10. Report on Activities of the Subcontractor JV (Justervesenet)

1 INTRODUCTION

The Norwegian Metrology Service (Justervesenet, JV) has been a subcontractor to Partner 2 (Nmi Van Swinden Laboratorium). Justervesenet has made inputs to workpackages 1, 4, 5, 6, 9, and 11. A summary of the contributions to each workpackage is listed below:

2 WORKPACKAGE 1: STATE-OF –THE-ART REVIEW

Provided updated information to the “airline” maps showing the traceabilities in different fields, and on Norwegian participation in collaborative European projects.

3 WORKPACKAGE 4: NMI VSL WORKSHOP.

Participation in the 1st Workshop in Rotterdam December 2002 (three attendees from JV) and chairing one of the workshops on scenarios.

4 WORKPACKAGE 5: NATIONAL ANALYSIS

Carried out the National Analyses for Norway identifying the potential areas for increased collaboration in R&D with other NMIs. Listed the services and facilities available in Norway and identified significant facilities suitable for collaboration. Furthermore, identified services where Norway has an interest in discussing collaborations on providing the services or taking advantage of facilities elsewhere in Europe.

5 WORKPACKAGE 6: EUROPEAN AND NATIONAL INDUSTRIAL CONSULTATION

A stakeholder consultation was performed during March/April 2003. A questionnaire was prepared and presented at a National Metrology Conference in March 2003. It was then distributed to customers and other stakeholders and the responses were analysed and summarised in a report.

6 WORKPACKAGE 9: ERA WORKSHOP

Participation in the 2nd MERA workshop in Berlin, June 2003. Responsible for chairing one of the sessions.

7 WORKPACKAGE 11: MANAGEMENT

Responsible for hosting the MERA kick-off meeting on 10th –11th September 2002 at Justervesenet.

Helge Kildal

L11. Report on Activities of the Subcontractor of IMGC (Istituto di Metrologia G Colonnetti)

Reporting period: August 2002 to October 2003

1 INTRODUCTION

The *Istituto di Metrologia G Colonnetti* has participated in MERA as a subcontractor to PTB (partner 3). Inputs were given with regard to workpackages 1, 4, 5, 9, 10 and 11. The following gives a summary of IMGC's activities under each workpackage heading.

2 WORKPACKAGE 1: STATE-OF –THE-ART REVIEW

IMGC has contributed to the review of the current cooperation between the NMIs in Europe: data analysis and preparatory work.

3 WORKPACKAGE 4: NMI WORKSHOP.

Input to and attendance at the NMI workshop of December 2002 in Rotterdam, together with a representative of another Italian NMI (IEN). Chair of one brainstorming session (Scenarios Workshop II).

4 WORKPACKAGE 5: NATIONAL ANALYSIS

Coordination and completion for Italy (distributed metrological system with 3 NMIs) of the pro-forma prepared by A. Henson. For each technical subject field, details for service devolution, significant capabilities and potential collaborations in research.

In order to reach a view on the preferred metrology structure scenario for Italy, IMGC undertook a stakeholder consultation, mirrored from the European Consultation of WP6, with an additional part addressed to the national stakeholder needs and attitudes, and to the performance evaluation of Italian NMIs in the fields of calibration, R&D and consultancy. A questionnaire was sent to about 200 customers with a reply rate of about 10%.

5 WORKPACKAGE 9: ERA WORKSHOP

Preparation for and participation in the 2nd MERA workshop in Berlin, June 2003, including:

- Presentation of the results from the national questionnaire of WP5 (Power point is available on a CD-Rom compiled by PTB).
- Chair of one panel discussion (session III).

6 WORKPACKAGE 10: DISSEMINATION AND FORESIGHT REPORT

Contributions to the results analysis and conclusions.

7 WORKPACKAGE 11: MANAGEMENT

Participation in the MERA Steering Committee (meetings and work via e-mail).

Attilio Sacconi

ANNEX M – MANAGEMENT AND COORDINATION

M1. Kick-off meeting

M2. 1st Steering Committee meeting

M3. Final Steering Committee meeting

**M1. Kick-off meeting
10-11th September 2002 at Justervesenet**

Attendees:

Andy Henson	NPL
Paul Hetherington	NML-EI (and EUROMET Chairman)
Michael Kühne	PTB
Pavel Klenovsky	CMI
Wolfgang Schwitz	METAS
Ed De Leer	NMi
Leslie Pendrill	SP
Kim Carneiro	DFM
Attilio Sacconi	IMGC
Helge Kildal	JV
Brian Sheridan	NML-EI
Seton Bennett	NPL
Diane Beauvais	NPL

Dr. Seton Bennett was attending the meeting as the EUROMET strategy leader. Brian Sheridan was attending the meeting as the EUROMET secretary.

The meeting began with a welcome to all participants to the MERA kick off meeting by Andy Henson. It was noted that an invitation to attend the meeting had been issued to the director designate of BIPM. Prof. Andrew Wallard has indicated that he couldn't attend the kick off meeting but would like to attend the 1st workshop.

Presentation by Andy Henson of the contractual situation

- The contract started the 1st September 2002 with an end date of 31st August 2003.
- The contract number is G6MA-CT-2002-04012.
- The project is an Accompanying Measure with overheads fixed at 80%.
- The EC contribution is €452 645, NPL has received the advance, a payment of €181056, about 40% of the contract value.
- The participants were reminded that the 'Contract' is in 3 parts:
 - The contract specific part that has been signed by the EC and the Principal Contractors;
 - The technical annex, annex 1;
 - The general terms and conditions, annex ii
- NPL, NML EI, PTB, CMI, METAS, NMI, SP are the Principal Contractors (PCs), with NPL the coordinator of the project.
- IMGC, JV, DFM and BNM are subcontractors (SCs).

- All of the above are participants.
- METAS is a PC but, being Swiss, does not receive any European Commission funding and is national funded to take part in the project.
- NPL and JV will need to switch some fund related to travel expenses, as the kick off meeting was held at Justervesenet, after the EEC meeting and not at NPL as previously planned. This switch was to enable a convenient meeting of the senior personnel involved in the project and to reduce the cost as most of the MERA participants were already at JV.
- ACTION: JV to identify the cost of hosting the meeting (as this cost will not be switched) and provide this information to NPL and to NMi-VSL (to whom JV are subcontract). NMi-VSL will make the appropriate reduction (JV expected travel costs minus host costs) in the JV subcontract (JV, 20th September).

The Time schedule

- Updated charts showing actual dates for the contract were distributed to the participants.
- The participants were informed about the ILAC/IAF conference in Berlin on 23rd-25th September where a MERA poster will be presented and during which the accredited laboratory community will be consulted on the MERA process.
- The draft MERA poster for the ILAC/IAF conference was circulated around the participants and discussed with some suggestion to take into account. Because of the theme of the ILAC/IAF conference (Trade) the changes (to broaden the applicability of the introductory text) will not be made to the ILAC/IAF poster but another version with a broaden context will be issued and circulated for general used by the participants.
- ACTION: NPL to prepare second version of the MERA poster (NPL, 27th September).
- ACTION: NPL to circulate both versions of the poster to the participants (NPL, end September).
- ACTION: NPL to put both versions of the poster on the EUROMET website (NPL, end of September).
- An updated workflow was presented to the participants for use when discussing the project externally. This workflow shows two workpackages (Industrial consultation and NAS perspective) as occurring later in the project (the version in the technical annex indicates when the processes need to be defined rather than when the external consultation takes place).
- A proposal to request an extension (3 months) to the contract was discussed and agreed by all participants in order to cover the Metrology 2003 conference where the MERA project will (subject to acceptance) be presented.

- ACTION: NPL to contact the EC project officer with the request (the project officer has informally stated the extension is likely to be accepted).
- ACTION: Dates to be checked for paper submission to Métrologie 2003 (NPL, end September)

The contract requirements

- In the absence of the EC Project Officer, the Coordinator presented a summary of the key contract requirements. Emphasis was placed on the need to provide information in a timely way to enable reporting obligations and cost statements to be completed in accordance with the contract. The need for appropriate record keeping was also explained.
- Although everyone has the model contract Principal Contractors may wish to download the electronic versions from the web as they contain the cost statement templates. The model contract for Accompanying Measures can be downloaded from CORDIS at: www.cordis.lu/fp5/mod-cont.htm (Download the first Accompanying Measure listed: **Accompanying Measures, 10.09.1999**).
- Information on the exchange rate (needed for non Euro zone only) can be found at the address: <http://www.europa.eu.int/comm/budget/inforeuro/en/index.htm>.
- ACTION: Principal Contractors to advise formally and in writing (e-mail is acceptable) the names and contact details of the “person designated” under Article 2 (1b) (PCs, 20th September).
- ACTION: Principal Contractors to inform the Coordinator (e mail is ok) that they have “started work” to enable Coordinator to so inform Commission under Article 2 (1 b) (PCs, 20th September).
- ACTION: Coordinator to Inform Commission of start of work (NPL, 25th September).
- ACTION: Coordinator to distribute advance in accordance with the Contract (NPL, 20th September).
- ACTION: Coordinator to advise Commission when that has been done Article 2 (1e) (NPL, 20th September).
- Following a discussion it was agreed not to have a Consortium Agreement for this Accompanying Measure.
- ACTION: PCs to issue an appropriate subcontract
 - IMGc to PTB;
 - JV to NMI;
 - DFM and BNM to NPL.

Review of Technical Annex

Workpackage 1: State-of-the-art Review

Led by: NPL

- ACTION: NPL and NML–EI to discuss and agree whether the web version of the EUROMET database or the underlying database is most appropriate for the review of the EUROMET projects (NPL, end September). In order to have as wide a view of current collaboration as possible additional information available (over and above the database information) will be incorporated in the review.
- ACTION: All participants to contact NPL with any other information on relevant collaborations (All, end of October).

Workpackage 2: Trends Analysis

Led by: NML-EI

- ACTION: All participants to forward to NML-EI a summary of metrological and technological trends (All, mid October)

Note: In term of metrological research it needs to be detailed enough (“Nanotechnology” for example is not detailed enough to be useful)

Workpackage 3: Development of Process

Led by: NPL

Scenarios:

- ACTION: NPL to develop the scenarios and circulate them before the 1st workshop (NPL, mid-October). For external use the scenarios should not be too complicated, need not cover every possible combination and should focus on the main issues.

Decision tool:

- Andy Henson presented the early draft ‘decision tool’ to the participant and explained the thinking behind the approach. It was agreed that we should define some common terminology:
 - NMS stand for individual National Measurement Systems;
 - Specialisation: where an NMI is providing a capability (research, facility, team, service...) that is intended to be of use to or provide for other countries;
 - Devolution: where a capability is no longer provided in the country under consideration, but rather by another country.
- NPL will make the ‘Decision tool’ presentation available to the participants. This prompted a discussion that led to the conclusion that a web page for the project would be very useful. As EUROMET Chair NML-EI offered to host this on the EUROMET website.
- ACTION: NML-EI to set up a web site as a working space for the participants (NML-EI, end of September).

- ACTION: NPL to provide the tools to participants as working progress at an early stage (immediately for SP as the basics will be useful for devising the industrial consultation strategy) (NPL, end of September).
- Additionally DFM will provide the methodology used in Denmark for those considering the ‘decision tree’ more sophisticated than is necessary (which may be the case in a number of the smaller EUROMET countries).

Workpackage 4: NMI Workshop

Led by: NMi-VSL

- As previously circulated the dates of the 1st workshop will be the 16 and 17th December 2002 in Rotterdam.
- ACTION: Both workshops leaders to liaise regarding the cost and re-imburement of invited expert (this should be harmonised as much as it is possible), commission funding rules must be respected (NMi -VSL and PTB).
- Invitation will clearly state the basis of re-imburement (budgets is tight because of reduction of the funding from the EC and the increased number of designated European Institutes under the MRA between the proposal and now).
- The content of the workshop and timing were discussed and agreed in broad outline NMi-VSL will circulate a draft programme for the workshop. (NMi-VSL, 17th September).
- ACTION: All Participants to comment on the draft programme by 20th September, if possible as Ed De Leer is out of the laboratory from the 23rd September (All, 20th September).
- It was recommended that NMi distribute the invitation of the workshop as soon as possible, as the dates are close.
- ACTION: NMi-VSL to consider sending a pre-invitation/announcement before a formal invitation unless the formal invitation can be sent very quickly (depend on sorting out the funding regime for invitees) (NMi-VSL).
- Additional invitations should be kept to a minimum but should be made to the BIPM director designate (Prof Andrew Wallard), to the EUROMET strategy leader (Dr Seton Bennett) and to the EC.
- Formal invited will be extended to the EUROMET corresponding applicant NMIs.
- Care must be taken with number, as budget is tight and space limited, it is necessary to have a cap on funding.
- Two dates for the next Steering Committee meeting were discussed. Following the kick off meeting, NPL can now confirm that the next Steering Committee meeting will be before the EEC meeting at BNM (Paris) on the 28th January 2003 and not straight after the Workshop (the

other possibility). This is because a number of partners are not available on the day following the first workshop.

Workpackage 5: National Analysis

- As it is a national activity, it was clarified to all participants (and will be at the workshop for others) that the use of and the depth of application of the tools is at the discretion on the NMIs. Elements such as the weighting factors can be set nationally to enable the tool to adapt to different perspectives and priorities. The obligation is to return the position on the various proposed structural scenarios and a portfolio of collaborative opportunities.

Workpackage 6: European and National Industrial Consultation

Led by: SP

- Workpackage 6: it was agreed to rename WP6 ‘stakeholder consultation’ to broaden the scope to include non-industrial stakeholders.
- Following discussion of the approach to be taken and content, SP will propose a questionnaire, circulate it to NPL for comments and then put it on the web site in the next few weeks. Some participants my wish to carry out the national part of this workpackage with WP5. It was emphasised however that WP6 was aimed at the broad principles of how greater collaboration might be organised, whilst WP5 will delve into the details addressing the topics for collaboration.
- ACTION: All participants to propose to SP appropriate Europeans bodies that should be consulted in the WP (All, 20th September).

Workpackage 7: Newly Associated States perspective

Led by: CMI

- The NAS are Bulgaria, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, the Slovak Republic, Slovenia and Turkey. See http://europa.eu.int/comm/enlargement/intro/index_en.htm
- But Cyprus is not a EUROMET member
- ACTION: CMI to propose, discuss and agree with the co-ordinator an outline of his approach to consult the NAS such that the approach can be agreed and presented at the 1st workshop (CMI, end of October)

Workpackage 8: Summary and analysis

Led by: NPL

- Prepare on time for 2nd workshop

Workpackage 9: ERA workshop

Led by: PTB

- There is a typing error in the Technical annex on page 17; the person months should read 1.9 and not 21.9.
- The second workshop would be in Berlin and provisional dates are the 16th and 17th June 2003.
- If numbers do grow some travel budget would have to be switch towards food etc, because funding is tight and this will have a minor effect on how high the cap on travel and subsistence is set for invitees.
- It was made clear to the Participants (and will be to the other NMIs at the first workshop) that invitation of their government official is not mandatory and should be done only if it is seen as beneficial for the MERA process.

Workpackage 10: Dissemination and Foresight report

Led by: NPL

- There is an error in the terminology in the technical annex on page 18; it should read EUROMET General Assembly and not EUROMET General Conference.
- The 11th international Metrology Congress will be in Toulon on the 20th-23rd October 2003. NPL will approach the Organising Committee/Scientific Committee regarding the submission of a MERA paper and presentation. The approach will be discussed between ASH (co coordinator) and PH (EUROMET Chairman) to see if two papers are needed (one on the broader EUROMET strategy, the other on the MERA planning process)

AoB

- It was agreed that IRMM, although not strictly an NMI, should be invited to the workshops.

M2. 1st Steering Committee meeting**28th January 2003, BNM, Paris****Attendees:**

Andy Henson	NPL
Paul Hetherington	NML-EI
Michael Kühne	PTB
Pavel Klenovsky	CMI
Wolfgang Schwitz	METAS
Ed De Leer	NMi
Leslie Pendrill	SP
Luc Erard	BNM
Attilio Sacconi	IMGC
Helge Kildal	JV
Brian Sheridan	NML-EI
Diane Beauvais	NPL

- The meeting began with a welcome to all participants to the MERA steering Committee meeting by Andy Henson.
- The attendance list and the participants contact details were circulated to the participants for review and updating. This has been updated and is attached with changes highlighted.
- The minutes of the MERA kick off meeting were reviewed. An extension of three months to cover ‘Métrologie 2003’ has been requested and agreed in principal by the European Commission.

Review of the Technical Annex**Workpackage 1: State of the Art review**

Led by NPL

- The work is in principle completed however a list of European collaborative projects would be beneficial.
- ACTION: NPL to identify relevant European collaborative projects and circulate it to the participants for review (NPL, end of March).

Workpackage 2: Trend analysis

Led by: NML-EI

- Paul Hetherington reported that he had received some more information since the workshop. It was suggested to have two documents, a small document with the list of area identified and a bigger document with all the information.
- ACTION: Ed de Leer to send the information collated on the 2nd day of the workshop by the 3 rapporteurs (Nano, physics, Chemistry) (Ed de Leer, 12th February 2003).

- ACTION: Small document with list of identified areas to be circulated to the participants (NML, End of February).
- ACTION: Core document to be circulated to participants (NML, end of March).

Workpackage 3:

Led by: NPL

- Andy Henson reported that the MCDA software had been circulated and that the process of identifying national priorities has started in the UK.

Workpackage 4: NMI workshop

Led by: NMI-VSL

- Ed De Leer reported that the workshop report is not yet finalised. There are some problems to reimburse people who attended the workshop. MERA Partners and subcontractors were reminded that they should not invoice NMI but charge their cost directly to the MERA project. The money left from the first workshop will be transferred to PTB for the 2nd workshop, as it is clear that the interest is such that the number of participants will be greater than originally budgeted.
- ACTION: Ed de Leer to finish and circulate the workshop report (Ed de Leer, end of February).
- ACTION: Ed de Leer to finalise the reimbursement of workshop participants and advise Mickael Kuehne and Andy Henson of the amount of money left. (Ed de Leer, end of February).

Workpackage 5: National analysis

- Michael Kuehne reported that PTB will send a national questionnaire mid February and is hoping to get some response by the end of March as part of his national analysis.
- Luc Erard reported that he would use mechanism already in place to do his national analysis (meeting etc). Paul Hetherington would like to use the stakeholder questionnaire with some changes.

Workpackage 6: Stakeholder consultation

Led by: SP

- Leslie Pendrill run through the work he had done and that can be found at the address: http://www.sp.se/metrology/Mera_0207/MERA_frames.htm.
- The following suggestion were made regarding the details on the draft questionnaire:
 - On the background page, a link to or some information on the EUROMET strategy and the CIPM MRA should be added.

- On the Metrological European Research Area page, ‘to be effective’ should be mentioned somewhere. The emphasis should be on National Measurement System and not just on NMIs.
- On the European Metrology scenario page, Ed de Leer suggested that the scenario B and C be described. It should also give a description of what the difference from the situation today is going to be. Describing all the scenarios might not be suitable as the stakeholder might not be knowledgeable enough.
- On the ‘enquiry’ page, it might be wise to put the organisation identification at the end.
- Any Henson distributed a document that had been prepared at NPL for discussion, emphasising a number of specific points about the questionnaire.
- The questionnaire must be balanced, i.e. it is important to explain the European dilemma (expanding metrological needs, static budgets etc) and ensure the consequences of the choices that are selected are clear.
 - The need to avoid leading questions (such as the one asking about closing an NMI)
 - The need for the questions to focus on the key issues and avoid distractions.
 - The questionnaire should reflect the multinational audience at which it is aimed at (though individual partners may adapt and use something similar for their national consultation if they so choose)
- Paul Hetherington suggested that Leslie Pendrill contacts the stakeholder directly and interviews them by phone. This avoids the need to have a questionnaire that is suitable for all purpose and so long that it puts off those we need answer from. This was generally supported.
- Pavel klenovsky suggested sending the questionnaire to multi-national companies in addition to the multinational organisations already identified. This was generally supported.
- It was agreed that Leslie Pendrill obligation was to consult at multinational level; consultation at national level is the participants’ responsibilities.
- ACTION: Participants to send their view on the stakeholder questionnaire (SP version, NPL version and also the comment from Paul Hetherington) to Leslie (ALL, end of February).
- ACTION: Participants to identify some multi-national companies and sent contact details if known to Leslie Pendrill (ALL, end of February).

Workpackage 7: NAS perspective

Led by: CMI

- Pavel Klenovsky reported that the NAS perspective questionnaire had been amended taking into account the comment from Bulgaria at the NMI workshop in Rotterdam. The questionnaire has been distributed and the results are expected by the 10th February 2003.

Workpackage 8: Summary and analysis

Led by: NPL

- Prepare on time for 2nd workshop
- ACTION: All information from the national analysis to be sent to Andy Henson at least 1 month prior to the second workshop (ALL, 15th May)

Workpackage 9: ERA workshop

Led by: PTB

- The ERA workshop will take place in Berlin on the 16th and 17th June 2003. Michael Kuehne reported that the objective is to have all the participants of that workshop in one hotel. 70 places have been pre-booked. Reservations will have to be made by the 2nd March in order to be able to benefit from the special price of 102 Euros. The workshop should start both days at 9h00. It will finish at 18h00 on the first day and a workshop dinner will follow at 20h00 in the hotel where participants are invited to stay. The second day will finish at 16h00. The first day on the workshop is for the NMIs only and about 35 people should be present. All participants (but not project partners and subcontractors) of the first day will receive support for travel and subsistence. The second day of the workshop is for the NMIs and their funding agencies. There might be some funding left to support the funding agencies (1 participant). PTB will be doing a first announcement of the workshop by the end of February, sending information about the accommodation and a list of what will be discussed. The final programme will be sent by the 16th May. Participants were informed that it could be possible to visit PTB on the Saturday 14th June, as it is the open day for PTB. A discussion identified that the funding agents will need some briefing before the workshop.
- ACTION: PTB to send first announcement to NMIs, asking NMIs if they will be bringing their funding agencies. (PTB, end of February)
- ACTION: NPL and PTB to liaise regarding the organisation and send a draft programme of the workshop to the participants. (NPL and PTB, mid-March)
- ACTION: Participants to send their views on the draft workshop programme. (ALL, end of March)
- ACTION: Andy Henson to speak to the UK Department of Trade and Industry about them making a presentation at the workshop. (NPL, end of February)

- ACTION: Andy Henson and Wolfgang Schwitz to prepare a quick resume (few bullet points) for the funding agents and to circulate it to the participants for review. (Andy Henson and Wolfgang Schwitz, mid March)

The Next steps

- Andy Henson distributed the ‘feedback needed as input to the second workshop’ sheet to the participants. Andy Henson suggested using a table to identify the areas where the NMIs have strength and the areas where they have an interest in other’s strength. Some felt that this should not be too detailed. Also we need to avoid people selecting all the options simply because they are expressing a general interest, it should aim to identify significant capabilities/facilities/teams. Wolfgang Schwitz recommended that we learn from previous experience (existing collaboration projects). Michael Kuehne commented that it would be useful to know, on the first day of the workshop, areas where it would be possible to collaborate. Paul Hetherington suggested that people consult their technical experts so they can come to the workshop with a view.
- ACTION: Participants to send their comments to Andy regarding the table (headings etc) (ALL, end of February).
- ACTION: Participants to send their comments on their experience of existing collaboration to Andy Henson (ALL, end of May).
- ACTION: Andy Henson to prepare a note to circulate to all participants of the first workshop. A draft of the note will be circulated to MERA partners and subcontractors by mid March (Andy Henson, mid March).

M3. Final Steering Committee meeting

23rd October 2003, Toulon

Attendees:

Andy Henson	NPL
Michael Kuehne	PTB
Ed De Leer	NMi
Leslie Pendrill	SP
Frantisek Jelinek	CMI (part of the meeting)
Luc Erard	BNM
Maguelonne Chambon	BNM
Diane Beauvais	NPL

Apologies: Paul Hetherington, Brian Sheridan, Wolfgang Schwitz, Kim Carneiro, Pavel Klenovsky, Helge Kildal.

- All participants were welcomed to the MERA steering Committee meeting by Andy Henson and the attendance list was circulated.
- Frantisek Jelinek was attending the meeting in place of Pavel Klenovsky who was unable to be present.
- Maguelonne Chambon was invited to the meeting, as she would be involved in drafting the next project iMERA.
- The meeting participants were informed that they could charge the travel and hotel cost (2 nights) to the project.

Review of the minutes from last steering committee meeting (BNM)

- Since the Workpackage was completed, under the CIPM MRA a number of new laboratories have been designated. However at the stage it is not practicable to update the Workpackage and the final report should have a note saying they have not been included. The SoA review included a review of the airline maps and it was questioned whether they should be updated. It was mentioned that a review of the maps and a review of the format of the information could be included as a workpackage in the next project iMERA.
- ACTION: NPL to circulate the airline maps to all project participants. 7th November 2003
- Ed de Leer reported that he had nearly finished the report on the first workshop in Rotterdam. He also reported that not all the participants of the workshop had asked for re-imburement and only €38,000 was spent out of the €63,000 planned.

- ACTION: Andy Henson to contact Tom Fairley at the European Commission to discuss what can be done with the money left from the workshop. End of November 2003

Review of the Technical Annex

WP1 – State of the Art review

- ACTION: NNERA is the Nordic spin-off from the MERA project. Leslie Pendrill to send the co-ordinator the information about NNERA for inclusion in the review and the final report. 14th November 2003

WP2 – Trends analysis

- Paul Hetherington has made some changes to the trend analysis report. The report separates the trends for existing capabilities and the trends for long-term research. The report will be used during the preparation of the iMERA proposal. Some of the slides of the presentation made by Paul Hetherington at the Métrologie conference will be included in the final report.
- ACTION: NML to send the final version of the trends report. 14th November 2003
- ACTION: NPL to ask NML to include the trends report on the MERA pages, in the password protected section. 14th November 2003

WP3 – Development of the process

- To insure that the different views to the scenarios are captured for R&D, services and facilities, the data from the ‘pro-forma’ could be presented as the following model:

	Scenario A	Scenario B	Scenario C	Scenario D
R&D				
Facilities				
Services...				

- The detailed data provided by individual laboratories will only be presented statistically in the final report. It is also important that the number of NMIs who are active in any particular area is included in the data, so that the results shown are not misleading.

WP4 – NMI workshop

- ACTION: Ed De Leer to produce a report with details as stated in the technical annex. 7th November 2003

WP5 – National Analysis

- ACTION: All project participants should submit a National Analysis, including the NMI's view and the stakeholder's view. Project participants should note that this would be included in the final report to the EC. 14th November 2003

WP6 – Stakeholder Consultation

- The European stakeholders' analysis report has been completed and distributed at the Métrologie conference in Toulon.

WP7 – NAS perspective

- The NAS perspective report has been completed and distributed to the participants.

WP8 – Summary and analysis

- This Workpackage provided the input to the ERA workshop and is completed.

WP9 – ERA workshop

- Michael Kuehne reported that the second workshop that was held at Berlin went well with strong interest from the participants to increase collaboration. The opinion was that even when EUROMET project do not have EC support, the format should be similar to FP5 projects. That is these projects should have a start and finish dates, a defined work programme and defined responsibilities. The amount of detail would not have to be as democratic as EC projects. Smaller NMIs are still worried about re-distribution of the provision of services as for some of them this represents an important part of their budget. Future effort should be split into two categories, one related to R&D and the other one to calibrations and services.
- ACTION: It was noted that Spain was not at the ERA workshop and that special effort will be made to try to interest them. NPL to contact SP. 7th November 2003
- A road map should be included in the report and will provide a key input to the iMERA project proposal. It should be ambitious but the wording should be cautious to avoid frightening governments.

WP10 – Dissemination and foresight report

- The final report should include all the deliverables listed in the technical annex (page 18).
- ACTION: All project participants should email Andy Henson if they want to include any country specific recommendation (in addition to the input required under WP5) in the final report. End of November 2003.

- ACTION: Luc Erard to offer to make a presentation of the findings from MERA to the BIPM. End of November 2003
- ACTION: Andy Henson to contact Tom Fairley regarding the format of the final report. 14th November 2003.

WP11 – Management

- ACTION: Project partners to send their draft costs statements to Diane Beauvais at NPL. The forms to fill in are available at the end of the General Conditions (Annex 2). 10th December 2003.
- ACTION: Project partners to send their agreed and signed costs statements to Diane Beauvais at NPL. 19th December 2003.
- For those not in the EURO zone, the exchange rate to use is available at the following: <http://europa.eu.int/comm/budget/inforeuro/index.cfm?fuseaction=home&SearchField=&Period=2003-10&Delim=,&Language=en>. From Annex 2: ‘The cost statements shall be expressed in euro and in the currency used in the accounting of the *principal contractor*. The euro conversion and exchange rates for cost statements and related payments shall be the rates published by the Commission for the implementation of the budget and in force on the first working day of the month following the period covered by the cost statement concerned. No account shall be taken of exchange rate gains or losses between the time of establishment of the cost statement and the receipt of the corresponding payment.’ This means the December 2003 exchange rate should be used.
- **For METAS only:** ‘*Principal contractors* that do not benefit from a financial contribution from the Community are required to submit only a description of the efforts deployed and the resources used in order to carry out the *project*.’
- ACTION: No costs statements are needed for sub-contractors but they have to send an invoice to NMIs to whom they are a subcontractor (NPL and PTB). End of November 2003

iMERA project

- The participants were updated on the iMERA project and ERA NET scheme. The deadline to submit the proposal for iMERA is the 2nd March 2004.
- Diane Beauvais will be drafting the proposal at the UK Department of Trade and Industry with the support of Leslie Pendrill, Maguelonne Chambon and Jan Petersen and Gert Rietveld. There might also be some additional help from CMI.
- In addition Michael Kuehne, Wolfgang Schwitz, Luc Erard, Pavel Klenovski, Ed De Leer, Seton Bennett and Andy Henson will form the review group.