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SUPPORT FOR THE COORDINATION OF ACTIVITIES

Structuring the European Research Area

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## 1 INTRODUCTION

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Although we do not tend to think about it, measurement underpins virtually every aspect of our daily lives. It helps to ensure the quality and safety of the food we eat, the air we breathe and the water we drink. In manufacturing, process control, telecommunications, transport, and virtually every other sector you care to think about measurements are crucial and advances in our capability help us to innovate and ensure the quality and added value of the goods we buy, keeping our economies competitive. It is fair to say that our ability to measure often defines the boundaries of possibility. What we cannot measure, we generally do not understand properly and we cannot make accurately nor control reliably. Research in metrology, the science of measurement, has a profound impact on understanding and shaping the world around us and provides the tools that allow other areas of science to role back their frontiers. Sound data based on reliable measurements forms - or should form - a cornerstone of evidence needed for successful policymaking and regulation from the mundane to issues of global scale such as climate change. Thus, governments in advanced technological countries support a measurement infrastructure and most have national research programmes, delivered primarily by their National Metrology Institutes (NMIs).

As the new millennium got under way the metrology community across Europe were faced with the dilemma of demand outstripping national capability to deliver with the funds available. The need for wider scope and greater precision from industry, from emerging areas, such as biotechnology and nanotechnology, and from non-traditional metrology areas, such as food safety, clinical medicine, environment required a paradigm shift in the way we operated. Thus, the concept of pooling resources across Europe and developing a joint European Metrology Research Programme (EMRP) was born.

The iMERA project brought the NMIs, their ministries and the European Commission together, and in a series of progressive steps enabled us to collectively understand the challenge and resources available across Europe, and to “set the scene” for closer coordination and collaboration. The project addressed the core issues of restructuring the organisation of metrology in Europe and the development of a joint research programme. Additionally the project developed common concepts for topics such as intellectual property, communications, ICT, training etc. Extensive consultation and roadmapping enabled the outline metrology research programme to be developed.

The project was formally structured in five horizontal Work Packages (plus project management), each representing an increasing step upwards in coordination and integration. In practice the project was actually delivered in a series of task groups, often addressing similar topics in more than one Work Package as the level of integration increased. The Task Groups were: “Foresight”; “Priorisation”; “Ownership”; “Research Programme”; “Developing Structures”; “Training and Mobility”; “Special Needs of Emerging Metrology Countries and Expanding ERA-NET”; “Knowledge Transfer, IP Rights and Ethical Issues”; “Measuring R&D Impact”; “ICT Tools”; “Beyond Europe”; and of course “Dissemination, Governing and Consortium Management”.

Each participating country identified areas appropriate for collaboration and coordination. EUROMET, the existing body coordinating metrology in Europe was revamped, enhanced and launched as a “not for profit” legal entity EURAMET (European Association of National Metrology Institutes) in anticipation of the EMRP. Extensive consultation and roadmapping enabled the outline metrology research programme to be developed.

That EMRP is being rolled out in two phases, spun out from iMERA. Phase I is the first of a new type of medium size action launched under FP7, an “ERA NET-Plus”, aimed at aligning and enhancing national programmes with European Commission support. Resources from the publicly funded metrology laboratories from 20 European countries, plus the European Commission’s measurement institute (IRMM), have been committed within a single joint Call for metrology research projects. In total the programme brings together some €64.6M of research project resource, with the European Commission providing €21M of funding, the balance provided from the national resources. The two-step Call ran between May and December 2007, and pivoted around independent peer review and selection of the very best metrology research proposals. A total of 21 collaborative projects have been

launched in four Targeted Programmes, each project chosen for the quality of science and potential to make a significant contribution in its field.

The SI & fundamental projects address some of the deepest challenges in metrology; providing answers for new standards that push forwards the boundaries in metrology for mass, current, temperature, light down at the single photon level, and time to unimaginable small uncertainty (parts in  $10^{-17}$ ). Projects that will help increase the precision and reliability of measurement at the very highest level, increasing our understanding of the fundamental constants and support the redefinition of some of the Units within the International System of measurements.

Metrology projects within the health area aim to underpin new diagnostic tools for early disease detection, increasing our understanding of biomolecules and biomarkers, biospecies and ion activity underpinning clinical chemistry and clinical medicine. They accelerate the exploitation of new regenerative treatments and offer major improvements in the accuracy of external beam and implanted source cancer therapies. Answers will be sought for better measurement of field strength and specific absorbed dose for non-ionising radiation in support of the Physical Agents Directive, protecting workers from harmful electrical fields.

The length and dimensional metrology projects address precise and reliable measurement for nanoparticle characterisation, and develop state of the art traceable displacement measurements to drive the development of next generation ICT hardware. Moving up in scale, enhanced capability in 3-D metrology will improve the manufacture of large precision objects such as aircraft components. Finally innovative techniques will overcome limitations related to variations in the refractive index of air in precise optical measurement techniques over multi hundred metre distances.

Metrology projects in the electrical and magnetic area will help underpin the reliability of power distribution as renewable generation increases its contribution to the grid, and will delve deeply into the world of nanomagnetism and spintronics. Electrical measurements are everywhere so improved quantum standards for AC current and improved Quantum Hall resistance measurements offer rewards far and wide.

All of the Phase I projects were successfully running before the end of iMERA, though with start dates ranging from February through to July 2008 only very limited research results can be expected at this stage. However, all of the projects are making excellent progress, and the Phase I overall is firmly on track.

Focus now is firmly on Phase II of the EMRP, which is still in the preparatory phase and will use Article 169 of the European Treaty. This article enables the interested Member States (and those states associated to the EC Framework Programme) to work with the European Commission to create large scale multi year programme. Funded by the 22 participating countries and the European Commission, Phase II has a proposed value of €400M over approximately seven years, and includes some useful enhancements over the Phase I. For example the programme will provide the opportunity for the user community and other stakeholders to directly suggest topics that the NMI community should address with its resources. Additionally researcher excellence and mobility grant funding will be available to bring external expertise into the projects, and possibility will be available for organisations to participate in the projects with their own resources, where appropriate.

In early December 2008 the EMRP under Article 169 successfully completed the internal scrutiny and budget processes inside the Commission, and thus became a formal proposal from the Commission to the European Parliament and Council of Ministers. Currently those bodies are completing their review, and we are hopeful that the so-called “co-decision” process can be completed before the European Parliamentary elections this summer. There are further steps that will need completing, the European Court of Auditors have to be satisfied with EURAMET’s governance and management processes and a detailed contract will need to be negotiated between EURAMET and the European Commission based on the Council Decision. However, things are looking promising, and we hope to launch the first call to the metrology community in 2009. Metrology for the energy sector is the lead candidate as the first topic to be addressed. More details about EURAMET activities, including the EMRP 2008 outline programme and the existing research projects launched in Phase I, are available on the EURAMET website (<http://www.euramet.org/>).

## 2 PROJECT EXECUTION

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### 2.1 Project Objectives

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The iMERA project was structured into five main work packages, plus a further work package associated with dissemination, governance and management, and the formal objectives of each workpackage are given below. Work package 5, relating to the Realisation of the ERA in metrology through Article 169 of the Treaty, was restructured slightly as the project progressed and the concept turned from a hazy ambition to a distinct possibility with defined pathways.

#### **WP1 Systematic exchange of information and best practice for metrological research programme owners and national metrology institutes.**

- Understand the different approaches to the metrics that underpin the rationale for and exploitation of metrological R&D, and the mechanisms to achieve them
- Provide opportunities for national programme owners and managers to review and adopt best practice in other countries
- Provide the understanding to enable high-level policy input necessary for increased commitment to the ERA-NET objectives
- Develop the climate to foster a common approach towards Article 169 joint activity in metrology during the 7<sup>th</sup> Framework programme

#### **WP2 Strategic activities**

- Assess existing foresight information
- Build the environment and processes, particularly amongst the “owners” to facilitate joint activities
- Identify the activities best addressed collaboratively
- Overcome legal or other issues (e.g. IPR) necessary for the joint activities
- Identify options to overcome other barriers to joint activities
- Enable European countries with emerging metrology programmes to participate successfully in joint research activities
- Facilitate European countries facing special needs
- Understand in which circumstances it is appropriate to collaborate with researchers beyond Europe, and to evolve the mechanisms to do so
- Ensure societal and gender issues are appropriately handled

#### **WP3 Joint activities**

- Interact with European stakeholders to develop and execute a systematic and on-going dedicated European metrological foresight process
- Improve the mobility of European metrologists, in particular for countries with emerging research programmes
- Enable European metrologists, in particular from smaller countries, to participate successfully in joint research activities
- Initiate jointly planned research projects in selected pilot areas.

**WP4 Transnational activities**

- Identify, with the agreement of all stakeholders, the strategic European metrology research activities
- Adapt the existing terms of reference for EUROMET committees according to the needs of joint research
- Open state-of-the-art national metrology facilities to scientists from other European countries
- Start a research project on a shared-funding basis.

**WP5 Realisation of the ERA in metrology through Article 169 of the Treaty**

- Develop a European Metrology Research Programme (EMRP)
- Identify and overcome legal and technical obstacles for national participation in Article 169 funded research
- Develop the organisational structures and their terms of reference in preparation for an Article 169 based EMRP
- Ensure sustainability of the solution beyond the time of financial support of the Commission
- Prepare the national funding aspects in preparation for an Article 169 based EMRP.

**WP6 Dissemination, Governance and Consortium Management**

- Ensure that stakeholders are appropriately informed as the project progresses so that they may input with a full understanding of the issues
- Provide appropriate governance for the project
- Establish appropriate management for the ERA-NET ensuring the deliverables are achieved within the timescales and budgets and contract requirements



## 2.2 Contractors Involved & Coordinator Contact Details

### Contractors:

	<b>Name</b>	<b>Short name</b>	<b>Country</b>
CO 1	National Physical Laboratory	NPL	UK
CR 2	Department of Innovation, Universities and Skills	DIUS	UK
CR 3	Bundesministerium für Wirtschaft und Technologie	BMWi	Germany
CR 4	Physikalisch-Technische Bundesanstalt	PTB	Germany
CR 5	Laboratoire National de Métrologie d'Essais	LNE	France
CR 6	National Institute for Research in Metrology	INRIM	Italy
CR 7	SP Technical Research Institute of Sweden	SP	Sweden
CR 8	Slovak Office of Standards, Metrology and Testing	UNMS	Slovakia
CR 9	Slovak Institute of Metrology	SMU	Slovakia
CR 10	Ministry of Economic Affairs – Competition Directorate	EZ	The Netherlands
CR 11	Van Swinden Laboratorium	NMi	The Netherlands
CR 12	Danish Fundamental Metrology Ltd	DFM	Denmark
CR 13	Federal Office of Metrology	METAS	Switzerland
CR 14	Justervesenet	JV	Norway
CR 15	Czech Office for Standards, Metrology and Testing	COSMT	Czech Republic
CR 16	Czech Metrology Institute	CMI	Czech Republic
CR 17	The Central Office of Measures	GUM	Poland
CR 18	Metrology Institute of the Republic of Slovenia	MIRS	Republic of Slovenia
CR 19	Centre for Metrology and Accreditation	MIKES	Finland
CR 20	Institute for Reference Materials and Measurements	IRMM	European Community

CO = Coordinator      CR = Contractor

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## 2.3 Work Performed

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The iMERA project pursued a step-by-step approach. The exchange of information between the national programmes underpinned the process of creating a community at European level of not only the national metrology institutes, but their ministries too. The exchange of information between the national programmes helped identified best practice, and has influenced thinking and operation of national metrology programmes, and of course at European level.

Strategic activities led to pilot joint research projects, with defined work plans, resources, responsibilities and time scales - funded by the existing national programmes. Extensive foresight, stakeholder consultation and road-mapping activities have given direction, and have identified new areas of activity, and allowed the Outline European Metrology Research Programme to be developed in 2007 and revised and reissued in 2008 to align with the formal Commission proposal for the Article 169.

Many of the issues that underpin successful collaboration have been addressed, for example, intellectual property, communications, training, the needs of the emerging metrology countries within Europe, understanding impact and the role of countries beyond Europe etc. These tasks provided the consortia with both a better understanding and practical progress towards a coordinated response on these issues. The work packages and tasks of the project are listed below.

### WP1 – Systematic Exchange of Information and Best Practice

- T1.1 National programme landscaping
- T1.2 Overview of national foresight processes
- T1.3 Overview of national prioritisation
- T1.4 Knowledge transfer (KT) activities
- T1.5 Measuring the impact of the national metrology R&D programmes in Europe
- T1.6 Understanding ICT tools
- T1.7 Training opportunities and exchange of personnel

### WP2 – Strategic Activities

- T2.1 Assessing existing foresight
- T2.2 Programme owners and programme managers
- T2.3 Identifying opportunities and quantifying the benefits of collaborative R&D and shared facilities to aid national funding decisions
- T2.4 Investigating the legal issues related to the Joint Activities
- T2.5 Addressing intellectual property issues
- T2.6 Addressing the special needs of emerging EUROMET members
- T2.7 Beyond Europe – addressing wider collaboration
- T2.8 Working group on ethical, gender and societal issues
- T2.9 Expanding the ERA-NET
- T2.10 Consultation and Go/No-Go decision

### WP3 – Joint Activities

- T3.1 Joint foresight studies
- T3.2 Joint training and mobility
- T3.3 Launching joint research



**WP4 – Transnational Activities**

- T4.1 Identification of strategic European metrology research activities to support innovation and quality of life
- T4.2 Adapting the EUROMET committees' terms of reference to facilitate joint ERA-NET activities
- T4.3 Opening of special facilities to other European metrologists
- T4.4 Launch of 'Quick Start' centrally funded research project

**WP5 – Realisation of the ERA in metrology through Article 169**

- T5.1 Preparation of the European metrology research programme to be executed as an Article 169 activity within the 7<sup>th</sup> Framework Programme of the Commission
- T5.2 Development, review and optimisation of the European structures for joint metrological research on the basis of Article
- T5.3 Ensuring sustainability
- T5.4 Agree national commitments for participation in the Article 169 EMRP
- T5.5 Support the Commission by preparing documentation
- T5.6 Developing the envelope of operation for the Article 169

**WP6 – Dissemination, Governance and Consortium Management**

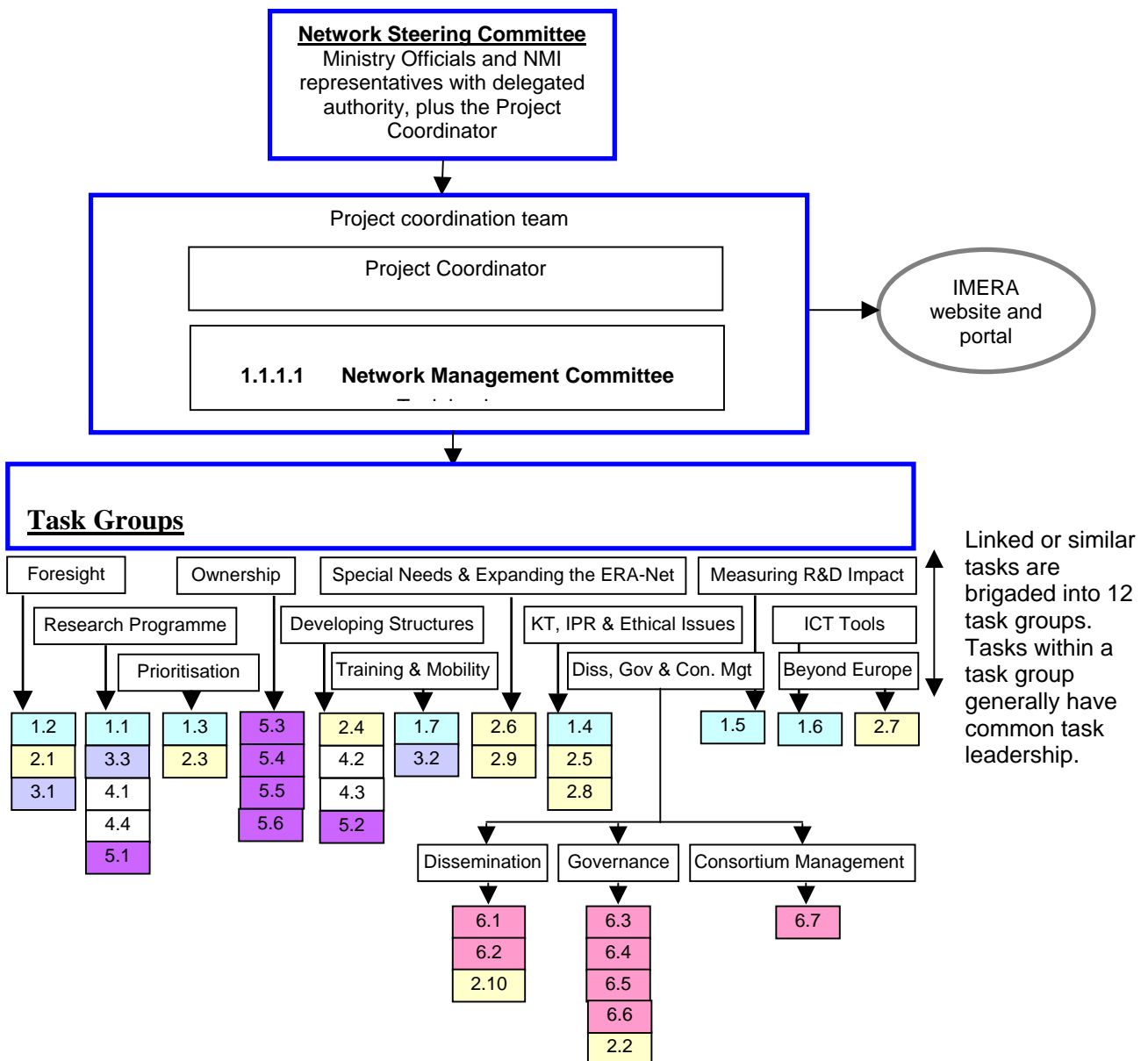
- T6.1 Dissemination and PR
- T6.2 iMERA web portal
- T6.3 The Network Steering Committee (NSC) meetings
- T6.4 Independent High level advisors
- T6.5 Network Management Committee (NMC) meetings
- T6.6 Partner Reporting
- T6.7 ERA-NET coordination

The Work Packages can be understood as increasing stages on the road to the final goals, rather than being thematically based. Consequently a novel approach has been taken to organising the tasks, so that tasks with a common theme are grouped, irrespective of the Work Package in which they sit (see Figure 1). Task leaders then managed these groups. These task leaders were responsible for delivery and formed the Network Management Committee, which was chaired by the coordinator. The approach has worked well, enabling a complex project with 20 partners and almost 40 tasks, each with its own task team, to be effectively managed. A high-level policy group - the Network Steering Committee - consisting of senior representatives of the national governments and their NMIs plus the project coordinator have met regularly to oversee the project and provide advice on direction. The members of the NSC and project partners ensured appropriate conditions for a successful project, and in-depth research collaboration are fulfilled; these include issues of mobility, stakeholder consultation, needs analysis, knowledge transfer, impact assessment and IPR.

As foreseen as a possibility when the project was developed, the increasing expectations generated by the project outstripped the capabilities of the existing informal EUROMET collaboration of NMIs in Europe. Consequently the project led the way for the launch of EURAMET e.V., a new "not for profit" legal entity more suited to the enhanced levels of collaboration and coordination. Launched in January 2007, EURAMET took over the formal role of Regional Metrology Organisation within the intergovernmental Metre Convention in the summer of 2007, and the old EUROMET MoU was then terminated. EURAMET e.V. is incorporated in Germany. The NMIs from a total of 32 countries have joined EURAMET e.V., and the majority of these participate in the research initiative. Even those countries that do not participate in the R&D activities, benefit because they hold and

disseminate improved national standards that are traceable to the highest-level standards created by the R&D performing countries.

A second key action within the iMERA project led to the publication of the multi-disciplinary European Metrology Research Programme (EMRP) in 2007, updated and published in 2008 to align with the latest Commission requirements for the EMRP. The EMRP has been piloted utilising the ERA-NET Plus mechanism launched under the 7<sup>th</sup> Framework Programme. This spin out “iMERA-Plus” EC supported project committed some 64.6 M€ to 21 Joint Research Projects in a call and independent selection held in 2007, and the projects started in the first half of 2008.



**Figure 1: Task group structure of iMERA**

The formal proposal for Phase II of the EMRP under Article 169 is currently passing through Council of Minister and Parliamentary scrutiny, with every possibility of being passed before Parliament dissolves for the summer elections in 2009. This €400M, programme will be over some 7 years supporting research projects delivered by the national metrology institute and designated institute network, but also including researcher excellence grants and mobility grants to bring external expertise. The research activities are overseen by the EURAMET EMRP Committee, established during the iMERA project and now fully active and effective. Lessons learnt in phase I, and the scale and complexity of Article 169, have led to some substantial evolutions related to the Article 169 package and its planned modus operandi. Chief amongst these changes have been the commitment to

10 % cash “common pot” to help fund grants and to cover programme running costs (carried by the participating countries).

A series of iterations with the Commission Services led to an agreed basis for the Commission generated Council text, and the iMERA objectives were realised with the adoption of this proposal by the European Commission on 4 December 2008, ahead of the original deadline (winning crucial extra time and increasing the chances of a positive Co-decision before the European Parliament dissolves for the June 2009 elections). This project concludes having fully achieved its objectives due to the hard work and commitment of the NMIs and ministries in the 14 countries participating in iMERA, and the 8 countries that have joined in along the way to become full partners in the Article 169 initiative, and the Commission Services with whom we have worked extensively.

### **2.3.1 Task Group – Foresight**

#### **Objectives**

The foresight activities began with task T1.2 in which we gained an overview of national foresight activities to simply understand who did what and with which methodologies. In Task 2.1 the information available from the various national foresight activities was shared and assessed to enable the degree of commonality of view of the future to be established. Finally in Task 3.1 a joint foresight study was undertaken with the objective of developing a common view at European level for metrology going forward. The foresight task illustrates the iMERA approach in which the same topic is addressed in steps of increasing integration, initially in WP1 surveying of the existing national approaches to foresight, then in WP2 assessing the foresight information available from national studies, and finally conducting the joint “European Metrology Foresight 2008” study in WP3.

For the purpose of these activities, the following general definition for technology foresight was chosen: *The process of technology foresight involves a systematic attempt to look into the longer-term future (more than three years) of science and technology, with the aim of identifying and assessing the areas of strategic research and emerging technologies which could have a strong impact on science, economy and society, including industrial competitiveness, wealth creation and quality of life.*

This approach taken to foresight can also be summarised as: *A set of techniques used to support policy-makers in building up long term strategies through structured and focused interaction with experts and stakeholders.*

The first task addressed:

- Definition of a taxonomy of foresight methodologies
- Preparation of a questionnaire
- An *ad-hoc* workshop on national foresight activities (Ljubljana)

The second and third tasks addressed:

- Assessment of existing information available from existing national foresight studies

Which in turn formed an input to the final task, the joint foresight study which included:

- Task team meetings (planning and analysis phase)
- Stakeholders workshops (Health, Energy, Environment)
- Focus Group meeting on Security (NMIs only).

Resulting in the final report: “*Foresight 2008*”

## Work Performed:

The first step was to understand the national approaches to distilling metrology needs from industry and other stakeholders. A questionnaire on national foresight initiatives on metrology was distributed to the iMERA partners and to the larger EUROMET community. The questionnaire included a classification of the different methodologies of foresight as a brief common glossary for the identification of the main methods used in foresight exercises. It addressed key aspects of national foresight activity such as:

- Classification and listing of studies and processes
- The general nature of national foresight studies to identify the future metrology needs:
- The level of participation of NMIs
- Objectives, extent, time span, scope
- Who promoted and conducted the study
- Adopted methodologies
- Cost, stakeholder involvement, frequency and running period
- Outcomes (dissemination) and effects (uses for planning and prioritisation)

Completed questionnaires were received from 19 countries, i.e. all the 14 countries of iMERA partners, plus 5 non-iMERA partners. A total of 53 national studies were presented as foresight studies, however only in the case of 9 countries did their cited studies fit into a generally accepted definition of Foresight (e.g. in terms of long-term future and of expectations of diverse players), thus reducing the total number of relevant foresight studies. Information provided included:

- Foresight studies dedicated to metrology or involving some metrology area (19 from 9 countries)
- Metrology studies and NMI strategy plans (11 from 6 countries)
- Foresight and other studies not directly related to metrology (10 from 7 countries)
- Market/Customer surveys related to future calibration activities (3 from 2 countries)
- Specific metrology projects/studies (19 from one country)
- Other (unclassified) studies cited in the questionnaire (8 from 4 countries, the EU and the CIPM).

The analysis of the questionnaires showed the large variety of national foresight processes ranging from rudimentary elements to formal studies. The preferred methodologies resulted to be:

- Environmental scanning
- Expert panels
- Genius forecasting
- Brainstorming.

An iMERA workshop was held in Ljubljana (2005) shared knowledge of foresight activities amongst the European metrology players and offered opportunities at national level to identify best practice to improve steering of national programmes. As many NMIs (and their ministries) were grappling with challenge of identifying their future strategy the workshop was timely and welcomed. Outside of the European agenda it contributed to more rigorous assessment at national level and changes in behaviour. For example the UK now appoints international experts to help steer the purely national programmes.

What clearly emerged from this analysis was that the knowledge of the current needs of stakeholders was not sufficient for the metrology institutions as the promoter of society development and that too much focus was on the near future (lack of long-term vision).

In addition to identifying similar trends to those identified, perhaps not surprisingly, as the priority themes of the FP7, the main needs underlying the outcomes of the various metrology foresight exercises were:

- Metrology needs in support of sustainable competitiveness and innovation

- Needs of innovative measurement standards and methods (including new advanced materials, nanostructures, handling of atomic structures, etc.)
- Sector specific needs and developments (in physics and engineering, in chemistry and biotechnology, and the related various industrial and Quality of Life sub-sectors).

Building on the information drawn from reviewing the content of the national foresight studies, the final step was to conduct a joint foresight activity (through task team meetings, stakeholders workshops and Focus group meetings) under Task 3.1. The process for conducting this exercise - “Foresight 2008” – pivoted around Stakeholder consultation to supplement the knowledge already generated and existing in the metrology community. The task team agreed:

- To address the main issue of stakeholder consultation through workshops (method of expert panels) rather than through a questionnaire.
- To launch the stakeholders workshop with NMIs participation (mainly as audience).
- To select, under the workshop theme “*Metrology needs and measurements priorities*” the sectors of *Health*, *Energy* and *Environment* as the areas with the highest potential impact.
- To promote a Focus Group meeting (only for NMIs) on *Security*.

The four main activities, held in 2006 and 2007, saw deep interaction (often for the very first time!) between the metrology community and the stakeholder community in this demanding exercise.

### *Health workshop*

The purpose of this workshop was to consult a varied set of experts from different backgrounds in order to help identify and discuss possible priority areas. In particular, the overall objective was the integration of stakeholders’ views, assessments and priorities into the process of formulating a special programme on metrology for bioscience and healthcare.

The selected sub-topics were:

- Improving traceability in clinical and bio-chemistry
- Metrology in drug manufacturing
- Quantitative imaging
- Improving comparability of measurements with medical devices
- Regulatory and consumer issues.

15 key topics were recommended ranging from data analysis to home diagnostics, from glucose measurements to bio-variability, from measurements of bio-markers to “virtual human”, with priority topics such as “Traceability in clinical chemistry”, “Quantitative and molecular imaging”, “Virtual human”, “Point of care diagnostics and home care” being identified.

A peculiar feature of this area is that metrology in health relies much more on other disciplines, i.e. there is a clear need of research projects in other disciplinary groups (EURAMET TCs or FGs), e.g. dosimetry issues are in the roadmaps made by the EURAMET TC on Ionising Radiation, ultra-sound imaging in the TC-AUV.

Special emphasis was placed by the stakeholders on the need to develop not only standards but reference measurement procedures as well and to take into consideration “soft” factors like influences of bio-variability, operator error, subjective interpretation, environment, benefit for the patient.

### *Energy workshop*

The selected sub-topics were:

- Fossil fuels (oil, natural gas)
- Electrical power
- Nuclear energy
- Liquid natural gas (LNG)
- Renewable energy sources (wind, solar, biofuels, marine)

Predictions of the contribution of the various alternative primary energy sources in the total primary energy demand show that fossil fuel is currently by far the largest contributor and will remain so in

the next decade. Therefore to mitigate against climate change caused by greenhouse gas emissions carbon capture and storage is of utmost importance. Specific key topics or metrological challenges have been indicated for each of the above selected sub-topics.

The main conclusions were the following. Major changes will occur in the energy sector as a consequence of the need to secure supply of energy and to reduce global warming. These are issues of considerable concern in Europe and therefore have high priority. However, the challenges in bringing about a significant reduction of greenhouse gasses and at the same time satisfying the increasing energy demands are enormous. They cannot be met by one single solution and in many options are needed to achieve this. Moreover, energy systems will change: instead of centralized systems there will be decentralized distributed systems, composed of a combination of central units and a variety of distributed units. All this means there are significant drivers for metrology to help solve problems concerning for instance two-way billing, reduced uncertainties, cryogenic metering.

Significant metrological support to the energy sector will help in addressing these challenges. Thus metrological support to the energy sector must be prioritized and the breadth of the application be accommodated.

#### *Environment workshop*

The selected sub-topics (environmental areas) were:

- Air
  - Climate modelling and global warming
  - Air quality, including particulate sensing
- Water
- Soil
- Biosphere

For each sub-topic, a very detailed and specific list of needs has been drawn up, comprising a total of 16 identified issues under the Air sub-topic, 11 under Water, 5 under Soil and 3 under Biosphere.

Mention was also made of the impact of Energy, from production to use, which cut across all environmental sectors – for instance as much as 65% of the anthropogenic greenhouse-gas emissions are estimated to come from energy generation, transportation and consumption. Measurement technology therefore needs to be developed aimed at lowering the costs of renewable energy, increasing the efficient use of energy and in changing the way energy is produced and distributed, and should be part of the first European Strategic Energy Technology Plan.

#### *Security focus group*

During the project the “security” agenda increased in priority in Europe. In response a focus group was therefore created, open to those NMIs/ DIs currently active in metrology research in support of the security sector. The areas to be considered were those where metrology supports the security industry, and not those areas concerned with improving the security of metrology or metrological data. Contact was made with the Commission’s Joint Research Centre, Institute for the Protection and Security of the Citizen (JRC-IPSC) in Ispra, Italy.

The aim of the Security Focus Group was to decide whether there was sufficient metrology research dedicated to supporting the security sector suitable for collaboration to justify the elaboration of a dedicated Targeted Programme in security as part of the EMRP.

In addition to the objectives and activities identified as a theme in the 7<sup>th</sup> Framework Programme, the background was given by the large number of themes referred to security in the EMRP 2007 (where Security is not a separate area) and in the iMERA Roadmaps. In a round robin session, all participating NMIs presented their research currently undertaken in support of the security sector, and the discussion was focused on potential areas of collaboration:

The ‘Grand Challenges’ were identified as:

- Identity theft
- Counter-terrorism
- Anti-counterfeiting
- Radiation protection
- Radiological risk prevention
- Border control
- Environmental
- Infrastructure

Whilst the key technical areas were:

- Data fusion
- Sensor networks
- Forensic metrology
- Development of standards and protocols
- Quantum cryptography
- Trace spectroscopy

The unanimous decision of the participants was to recommend the formation of a Targeted Programme-Security within the EMRP, covering metrology in support of security. From the areas of interest, it was clear that there were large areas of overlap between the participants in the Focus Group, and that this potential for collaboration would increase by enlarging the number of polled NMIs. Finally, having a separate TP-Security within the EMRP would place focus on security within the metrological community and our customers and owners – demonstrating how metrology brings direct benefit to society, and making metrologists focus on the practical application of their work in security-related metrology.

## Conclusion

All the key-topics, needs, priorities emerged through this *Foresight 2008*, are indicating where European metrology research is going.

An important aspect is the role of stakeholders. Improving the interactions between stakeholders and metrologists has been delivered through this exercise. The needs identified have been formulated by people who have a broader vision than often found within metrology experts. Specialists in metrology should primarily formulate the solutions to those needs. The general solution is in the extension of the cooperation between NMIs and of the interactions between international experts. However, it should be noted that the research needs identified and collected in the workshops and through the project activities are obviously representative of the stakeholders with whom interaction has taken place, and other views may exist in a wider community. Therefore any Call system for projects should allow other ideas to be proposed, not just by the metrology community based on the captured needs during the study, but from the wider stakeholder community.

By promoting NMI-led cooperation, supported by an on-going foresight activity, the EMRP will bring together NMI efforts and EC funding of European cooperative research. Establishing metrology foresight benefits from the wealth of sector-based general or technological foresight studies from which measurement challenges can be distilled.

The completion of this exercise is thus highlighting not only the new needs for metrology, but is also identifying changes in the way the NMIs operate by having had the occasion of being really outwards facing incorporating stakeholders’ views. Also in this way, these foresight contributions to the EMRP will hopefully stimulate new strategic development plans based on a deeper collaboration of the European NMI community. The longer-term aim for the European metrology community when addressing foresight will be in the direction of:

- systematisation and fixed periodicity
- greater involvement of stakeholders
- extension of the study to cover the whole metrology infrastructure/system in the country
- moving from a technical approach to a more socio-economic description.

With the aim of more effective foresight studies in the future, particularly optimising use of the many sector based general or technological foresight studies from which measurement challenges can be distilled.

## **2.3.2 Task Group – Prioritisation**

### **Objectives**

Prioritisation lies at the heart of the so called « metrology dilemma », that is demand driven societal expectations and technological developments requiring a level of support from the metrology community that outstrips the resource available. All countries with metrology research programmes have to make tough choices when deciding which entire areas they do or do not support, and then which projects are to be supported within those areas. The wide variety of structures for delivering metrology in the participating countries is reflected in the wide variety of processes used for identifying metrology R&D priorities, ranging from defined protocols and using external advisors through to far less formal processes. Task T1.3 provided a systematic overview of the methodologies, and the various approaches, and provided a forum for sharing experience and knowledge. Task T2.3 focused on identifying opportunities and quantifying the benefits of collaborative R&D and shared facilities, primarily to aid national funding decisions. The objective of these two tasks was to overcome the then status quo, in which collaborative opportunities were identified *after* national decisions on priorities and budget allocations have been taken, and the opportunities are identified by the R&D delivery teams as best they can. This places a major constraint on the level, scope and depth of collaboration that is possible.

### **Work Performed**

Against this background Task 1.3 was aimed at providing a systematic overview of the methodologies of national prioritisation processes and considering their strengths and weaknesses. The outcome of this was also a substantial input to Task 2.3 which was aimed at developing a core set of principles, suitable for application to each national process, that help identify potential collaborative opportunities and assess whether collaboration would increase the impact of projects *prior* to programme prioritisation and finalisation.

The outcome will then enable programme formulators and the prioritisation teams to make recommendations during prioritisation that will yield projects of maximum impact.

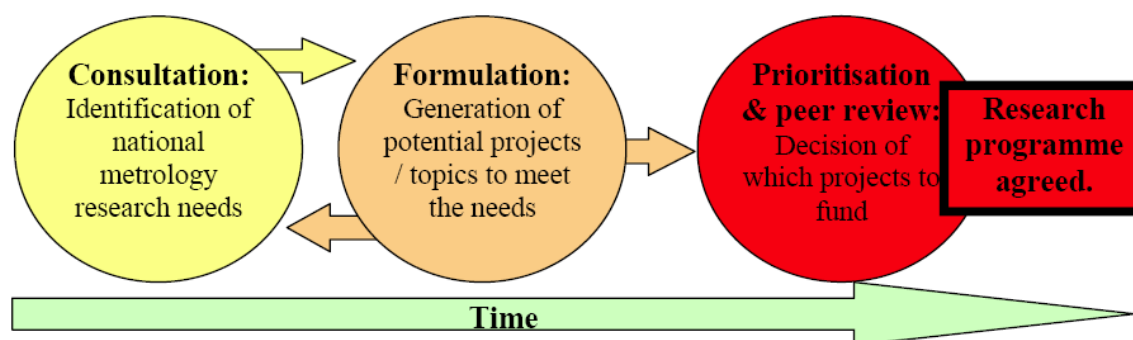
#### National prioritisation processes, historical basis

In order to get an overview of the national prioritisation processes, a questionnaire was prepared and circulated to all iMERA participants to collate details of the national processes used for prioritisation of national metrology research programmes. This was followed by a workshop of participants in the iMERA project to review this collated data, and to explore the strengths and weaknesses of the various approaches used by National Metrology Institutes (NMIs) across Europe for prioritisation of national metrology research programmes. It identified opportunities to improve the coordination of national metrological R&D programmes at a European level, and has made suggestions to achieve this for the consideration by those who prioritise national programmes. It explored some of the issues that will be important for the prioritisation of a European Metrology Research Programme. Finally the output of the workshop was summarised in the deliverable report.

During Task 1.3 it became clear that each NMI has an internal process whereby suitable project proposals are generated.

The metrology needs of the host country are traditionally identified using a range of consultation techniques that vary from country to country; some use highly formal investigations of need, while others use less formal mechanisms. Following this, a number of desirable research and development (R&D) topics/project proposals are considered/formulated to address these identified needs. Countries prioritise these potential projects in order to agree a final research programme. The process is shown in Figure 2.





**Figure 2: Generation of a Research Programme**

Historically (i.e. pre-iMERA) decisions on prioritisation and budget allocation taken nationally were, with some exceptions, generally without systematic consideration as to whether one or more of the potential projects might best be tackled in collaboration with other NMIs. Consequently there was no consideration of collaborative solutions when budgets were allocated.

The process of topic/project prioritisation varies enormously from country to country, but whatever formal or informal mechanism was used, the possible topic/projects were somehow prioritised in order of benefit/cost. The available budget was then allocated between the proposed topics/projects; typically in descending order of benefit/cost until the entire budget was allocated. Sometimes several project budgets were reduced in order to fund a higher number of projects, each at a lower level than requested. It was inevitable that some potential topics/projects were not funded, and were therefore rejected from all future considerations.

Some collaboration occurs regularly through the mechanisms of EUROMET/EURAMET or of EU funded research, typically but not solely for intercomparisons where collaboration is essential to the project aim, but outside of these projects collaboration was - and is - the exception rather than the rule, particularly in the larger budget NMIs. The smaller but research intensive NMIs, such as in the Nordic countries, have a somewhat better track record of planned collaboration and have contributed and benefited greatly in the twenty years of EUROMET collaboration – the predecessor organisation of EURAMET. However in general across Europe it was only after national prioritisation (and the inevitable project rejection) that the project delivery teams identified collaborative opportunities, if at all. This identification was often not supported by any process and occurred on an ad-hoc basis, often by virtue of personal contacts, and only then because of motivated researchers.

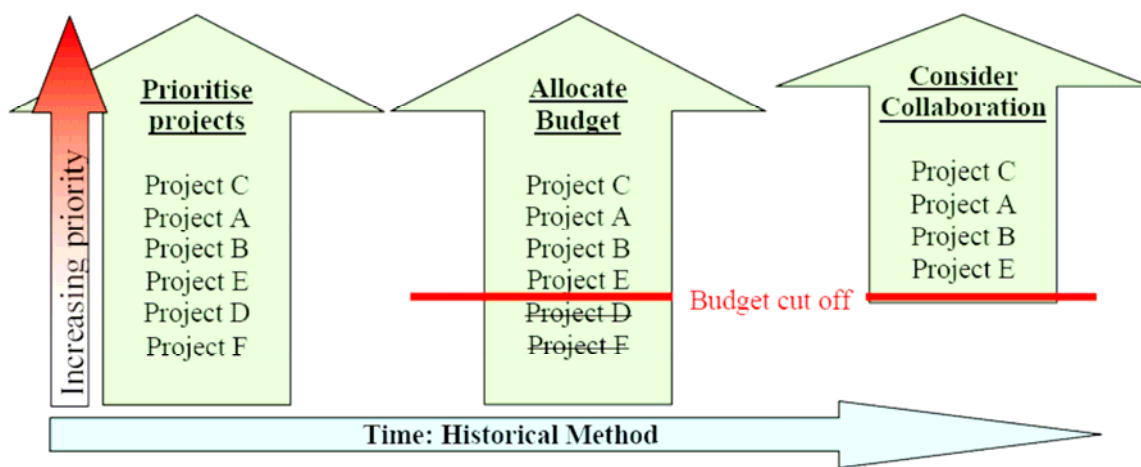
The historical method of identifying collaboration after national prioritisation has a major intrinsic flaw: projects that were rejected at the national benefit/cost analysis could not be considered for collaboration later on, irrespective of the merit.

The historical mechanism for prioritisation at a national level further hindered the development of collaborative projects for a couple of reasons, such as differing formulation timetables across European partners.

#### Considering collaboration as part of the national prioritisation process

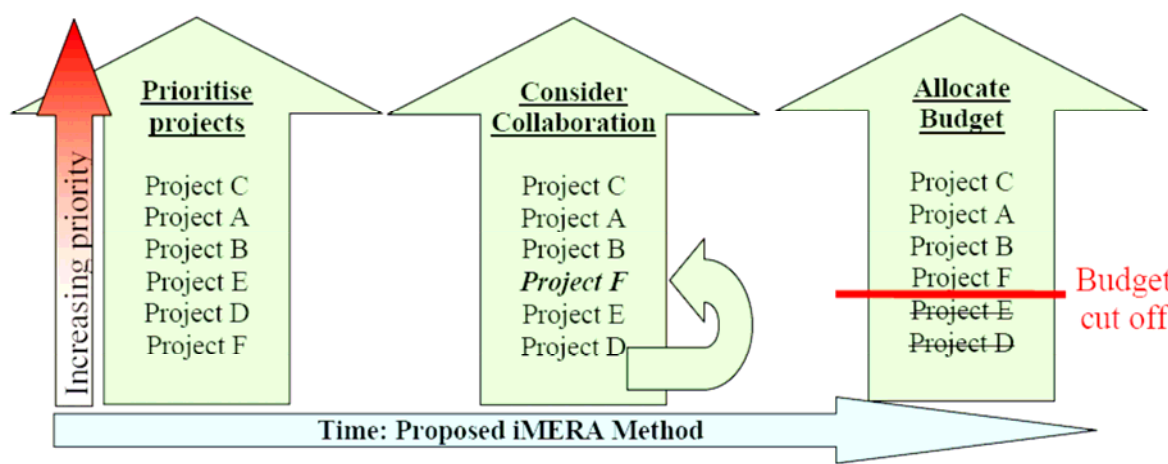
Following a series of discussions and drafts during Task 2.3, simple guidelines were created that assist programme formulators and prioritisers in identifying if a proposed project is suitable for collaboration. This purpose was to assist programme formulators and prioritisation teams through the *consideration* of collaboration, to assess if the project benefit/cost ratio can be increased were it tackled collaboratively with other NMI partners. We postulated that if collaboration was considered *prior* to the funding decision being made, the list of selected projects may change.

Consider the hypothetical situation of Project F, which is extremely costly and thus was rejected as unaffordable at a national level, as shown in Figure 3, despite the fact it had huge potential benefits nationally and to a broad European audience.



**Figure 3: Project prioritisation (historical method)**

If Project F had been considered for collaboration prior to prioritisation, the NMI concerned may well have found that further NMIs were also interested in pursuing this research, and sharing the costs. Thus the project cost for a given country is less, and the potential impact, through access to results generated by partners, greater. This situation may have created a more realistic ranking of benefit/cost for Project F. The outcome of this hypothetical situation is that the expensive project may become affordable if approached collaboratively and thus improve its place in the prioritisation rankings, as shown in Figure 4.



**Figure 4: Project prioritisation (proposed iMERA method)**

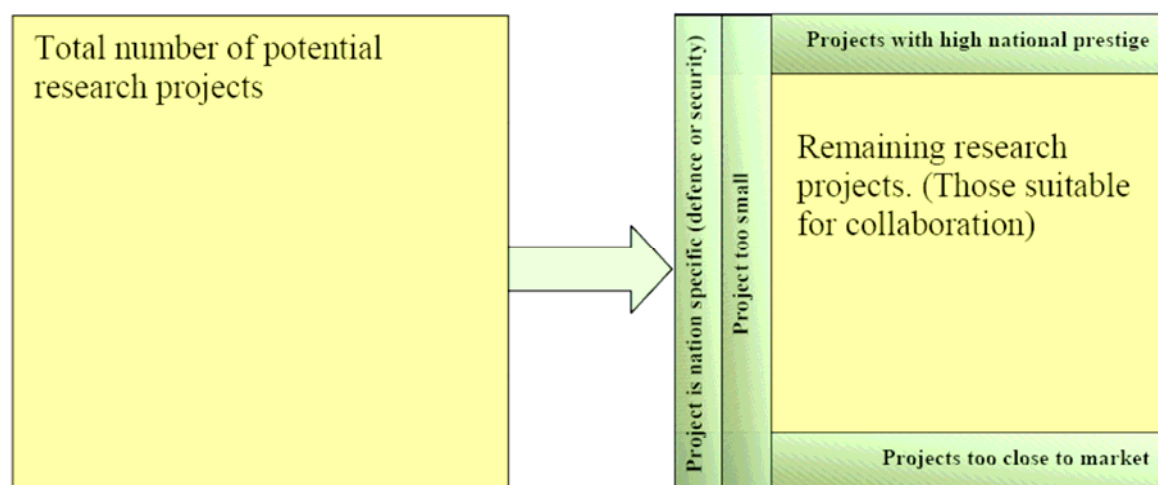
This shows the case where benefit is increased through collaboration, hence higher priority. There is also the case where benefit is the same (i.e. same results) but costs are reduced due to only having to include a proportion in the domestic programme. In this scenario Project E may also be above the cut off.

The proposed method of identifying collaborative opportunities at the project formulation stage aims to equip the programme formulators and prioritisation team with information to effectively estimate a project's benefit/cost, including contributions for collaborative projects. In turn this should allow the finalised project proposals to achieve maximum scientific impact, with the available resource.

A two-stage approach has been developed to identify opportunities where collaborative research and development (R&D) may increase impact:

- Identifying R&D opportunities that may be suitable for collaboration in principle
- Assessing how collaboration would change the potential benefit/cost ratio of a proposed project.

Unlike many market areas, the “market” fulfilled by the NMIs is very strongly suited to collaborative projects. All NMIs work in an area of market failure (where the free market is unable to produce goods and services efficiently for consumers) leading to a public funding support by government in order to benefit the “public good” and whose definition tends to be broadly similar across Europe. With the NMIs responding to similar drivers it is not surprising that their individual strategies align to a very large degree.



**Figure 5: Proportion of R&D projects suitable for collaboration**

For any NMI undertaking research and development a small number of potential research projects will be inherently unsuitable for collaboration irrespective of the size of the R&D budgets, as shown in Figure 5.

The four primary reasons for unsuitability are:

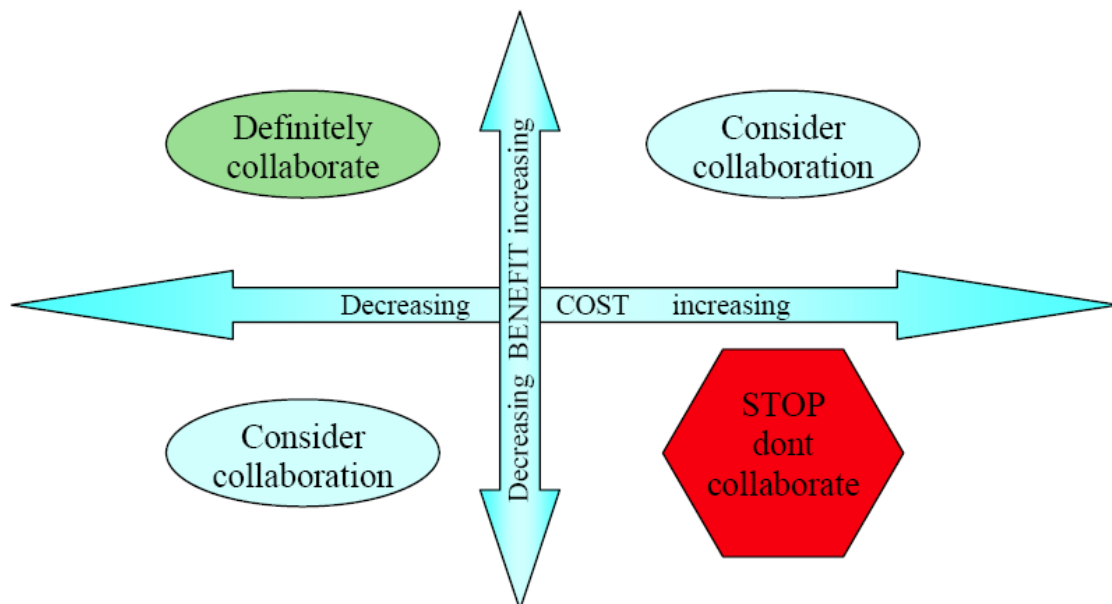
- 1) Low financial value projects (where the cost of collaboration outweighs the benefits)
- 2) Nation specific projects (where the project needs are not shared between partners, e.g. defence or security)
- 3) Research of extremely high prestige to a particular country, e.g. prize winning research. (Though this need not always be a barrier to collaboration.)
- 4) Project output is very close to market (collaboration may occur but vertically with say, a manufacturer, rather than another NMI)

In the cases where projects are inherently unsuitable for collaboration, the nation concerned would prioritise the research solely through their national programme. In all other cases the formulator should consider collaboration opportunities in the early stages of formulation to test the hypothesis that collaboration may increase project benefit/cost.

In order to assess the benefits and barriers of collaboration in a semi-quantitative way a relative benefit/cost approach has been used, which mirrors the benefit/cost prioritisation undertaken by most nations. The variation in both the financial cost, and the project benefits to the national interest are assessed in four sections:

- A. Reduced project cost due to collaboration
- B. Increased project cost due to collaboration
- C. Reduced project benefit due to collaboration
- D. Increased project benefit due to collaboration

In most cases the user can estimate a percentage value change for each of the bullet points above, and then adds these to give the final benefit/cost variation, which is represented diagrammatically below:



**Figure 6: The effect of changes to benefit/cost, related to desirability of collaboration**

The values assigned may be based on experience rather than hard financial data, though historical data may be used where available. The figures used should be relative to the total benefit/cost that was assigned to the original, non-collaborative project proposal. Thus the approach is independent of the particular costing methodology used to assign the project costs. A “Collaboration Guidelines” was developed with prompts to held those applying the process.

### **Conclusion**

Tasks T1.3 and T2.3 highlighted the need to ensure that potential collaborators clearly understood the benefits that collaboration would bring to them and to the bodies that fund them, whilst recognising that not *all* challenges are best addressed collaboratively. The tasks provided a conceptual framework to help develop national processes take into account collaborative opportunities before prioritization decisions were finalised, rather than trying to “back fit” collaboration after the fact.

### **2.3.3 Task Group – Ownership**

#### **Objectives**

This Task Group performed a vital function in the project, ensuring that NMI enthusiasm in proposing new ways of organising and executing research and associated activities did not diverge from a realistic sustainable solution, summed up in Task T5.3 “Ensuring sustainability”. This task has been focusing on monitoring sustainability of solutions for implementing Metrology in the European Research Area beyond the time of financial support of the European Commission. The aim of this task was to ensure that - when creating legal and organisational structures for the implementation of the EMRP - care was taken that these structures and the defined procedures remain suitable for continuation of trans-national activities in the time when the financial support of the European Commission has ended. The task team has provided oversight to ensure that sustainability is appropriately considered when developing structures and processes. Additional three further tasks supported the formal development of the Article 169 proposal by the Commission. In Task T5.4, in which agreement was sought regarding the various individual national commitments, cumulatively making the total 200 M€ participating country commitment necessary for the Article 169 EMRP, Task T5.5 supporting the Commission Services through the impact assessment and preparatory phase of Article 169, and Task T5.6 in which the envelope of operation was developed and agreed with the Commission services as the basis of the text of the Commission proposal to the Council of Ministers and the European Parliament.

## Work Performed

The EU contribution will only be committed over a fixed term, probably seven years. However, given the benefits of collaboration, the procedures for the EMRP allow for a continuation of collaboration beyond this timeframe.

The various tasks were attuned in the course of the project as the initiative for Article 169 developed over the lifetime of the project. The prime activity of the task team throughout has been to provide oversight to ensure that sustainability is appropriately considered when developing structures and processes. This has included discussions with partners and the provision of supporting briefings to the Network Management Committee (NMC) and Network Steering Committee (NSC).

Throughout their development consideration has been given to the funding methods, legal bodies and structures of EURAMET to ensure the collaboration in metrology is sustainable beyond the supportive funding essential to launching the extensive collaborative projects of the EMRP.

The task leaders have followed the discussions within the EU on Article 169 actions and provided input as necessary. They have been involved in discussions on the task to develop the EMRP and have ensured that there is nothing in the procedures which would preclude extension of the participating member states.

A survey of all the partners was carried out to determine the feasibility of national funding for the contributions required for funding the EMRP as an initiative under Article 169. The results of this were analysed by the task leaders. The most critical issue concerned was the possible requirement to provide a common funding (“a common pot”). The implementation as a total (real) common budget for the EMRP was not compatible with the constitution of funding models for personnel and infrastructure for a multitude of NMIs.

Different budgetary and lawful restrictions were identified in Tasks 5.4 and 5.6. In consequence a mixed-mode financing concept was chosen as the best practicable way of implementation a common funding structure.

Where such issues appeared, relevant partners were encouraged to take steps to remove obstacles. For example, the UK has reorganised its method of funding Metrology R&D which enables changes to research programmes in progress. Other participating countries likewise adjusted their internal mechanisms, and in the case of a number of the smaller countries that joined the initiative, countries launched formal metrology R&D activities for the first time. This facilitates interfacing between national programmes and the EMRP 2007 (ERA-NET Plus) as well as in future the Article 169 for metrology. Especially from the national ministries perspective, it was important to find a financing model appropriate for all participating countries in the EMRP taking into account all their different general conditions (and budgetary position). Also the model needed to optimise use of the NMI and DI infrastructure and staff available in the various institutes in the participating countries. Furthermore, ensuring sustainability also encompassed the need for the development of a decision-making process such that each participating country is able to play a part in the EMRP and benefit from the EMRP, despite the huge variation in resources. This is particularly well reflected by the weighted voting in the EMRP Committee that takes into account the different resources available in each country, but does not allow dominance by the two largest players who command more than 50% of the resources. The establishment of the legal entity EURAMET, which was covered in Task Group 5 - Developing Structures, exposes all this.

It has been recognised through the project that whilst EURAMET provides an effective framework for a continuing relationship between the NMIs, there is no such framework linking the Ministries responsible for ownership of the national metrology programmes. It was considered that development of such arrangements would be beneficial to ensuring the sustainability of collaboration between European ministries responsible for metrology beyond the end of the iMERA project. In association with iMERA meetings, but self-funded by the ministries, two “Metrology Programme Owners Meetings” have been held. The first took place in Slovenia, on 12 February 2008, and the second in the Hague on 19 November 2008. These meetings included presentations and discussions on the progress of iMERA, what ministry staff could do to support the EMRP and other information on European and international activity relevant to metrology.

A crucial element of developing the Article 169 phase of the EMRP related to agreeing how the participating country commitment would be made up, and this was addressed in task T5.4. Initially a position was agreed in August 2006. The budget had been established originally by judgment on the portion of national budgets that could effectively be used for collaborative R&D. The starting point for the negotiation was drawn from the data collected under WP1. This same % figure was applied to each national metrology R&D budget. A check was made that the resulting numbers did not exceed likely demand (in fact it was realistically, far less than demand). Thus the original proposal was established for a 500M€ programme over 7 years funded 50/50 by the participating countries and the Commission. However the Commission decision to place the EMRP Article 169 in the second wave of A169 initiatives, and in the meantime to offer the chance of support through an ERA-NET Plus, and then reduce the Commission maximum contribution through Article 169 to 200 M€, and the addition of some new partner countries (albeit with very small budgets) meant that the original 2006 position was no longer valid. A new initiative was undertaken throughout 2008 to establish a new position. The discussions were multifaceted, however, they can be categorised more simply as follows:

- Addition of new countries
- Strong encouragement for countries with minimum level of participation to increase their share of the budget
- Offer to the countries with middle sized budgets to increase their share of the budget if they want to
- Consequent reduction in share of the budget for the larger players.

From early in the initiative the concept of a “reserve” budget was established. This reserve does not increase the overall programme size; it simply means that if one country is more successful than expected in the competitive selection process we can be confident that the promised resources will really be available. Of course if one country is more successful, then another is less successful, so the overall programme “size” does not change. This helps ensure that projects proceed because of their excellence, not because of national quotas, or “juste retour”.

As these various changes were happening in parallel, a series of iterations were necessary to arrive at the final balanced budget provided to the European Commission at the time of the adoption of the Commission Decision on 3 December 2008.

The final step in the process was formal commitment of the budget via letter from the Ministries. However, in many cases, despite pre preparation, the Ministries were not able to initiate the approval process until the formal proposal was made available to the Member States and non-member Participating States on 4 December 2008. Thus the European Commission had received only a few letters by the end of the project, with the remainder still in preparation, and in the expectation that they would be issued in the first few weeks of January 2009. No difficulties have been reported, and no major problems are foreseen. However, should a particular country in the end not be able to make the commitment it is clear that other countries could and would step in to re balance the budget. Should other eligible countries choose to join the initiative at a later stage, again a new balanced budget will have to be established.

In parallel, voting, liability and cost sharing was agreed amongst the Article 169 participants, again the principle being established in the summer of 2006, but the application updated as the initiative developed. It was also used for the spin-off iMERA-Plus contract, and is based on the square root of the national commitments. This formula provides a fair and effective balance between those countries with large budgets committing significant resource, and those with much smaller budgets, and is unanimously supported by the participating countries.

As EURAMET does not have any significant assets a formal basis has been agreed for the sharing of liability related to European Commission R&D funding provided to EURAMET for its members to execute the elements of the EMRP. A new liability and cost statement template, developed from that used for iMERA-Plus, was developed and circulated. The costs for running the Article 169 have been agreed in principle, and a detailed budget for 2009 circulated to participants. At the time of reporting over half of these statements have been signed, the remaining ones are in the process of

being signed, and no significant problems are foreseen. Signature of the cost and liability statement is mandatory for participation in the Article 169.

During the latter part of the project significant support was given to the Commission Services as they conducted an impact assessment and then prepared the various legal and supporting texts that make up the proposal to Council of Ministers and European Parliament. The project provided significant support under task T5.5 with many informal documents, documentary references, identified stakeholders, advice, opinion and comment provided to the Commission. Additionally on three occasions members of the project have met with the Commission services and the independent review group in Brussels to aid the Commission internal assessment processes.

Whilst the formal process was proceeding the task team developed the envelope of operation for the Article 169 EMRP in sufficient detail to enable planning, modus operandi and budget profiling by the Commission and the partners. The task team also incorporated lessons learnt from the operation of the ERA-NET Plus phase of the EMRP. The EMRP Committee appointed “core group” of Andy Henson (the appointed EMRP Programme Manager), Michael Kuehne (the EURAMET Chairperson) and Luc Erard (the EMRP Committee Chair) supported by members of their team and the EMRP Committee developed the envelope of operation and interacted with the Commission Services to ensure alignment between evolution of ideas in EURAMET and in the Commission Services. This core group built on the earlier experience of developing a set of “guiding principles” early in the project, expressing simply the philosophy and values of the intended collaboration, and used the same approach to developing the operating envelope. They studied the outputs of the various iMERA WPs and discussed with the formal representatives in the EMRP Committee meetings. Based on this a series of “cornerstones” were developed and revised during 2007 and 2008 that described the “shape” of the Article 169 and the negotiating stance from the perspective of the participating countries. This approach formed the basis of the extensive discussions with the Commission Services.

## **Conclusion**

The association EURAMET has been transformed from EUROMET, the European Collaboration in Measurement Standards, which was based on a Memorandum of Understanding. EURAMET is a registered association of public utility under German law (e.V.). It has been developed with an extended structure not only being the Regional Metrology Organisation (RMO) in Europe, but also fulfilling the requirements of a Dedicated Implementation Structure (DIS) of an Article 169 initiative. EURAMET’s decision-making processes have taken into account the different development stages of each participating country as well as their different available funds. The European Metrology Research Programme (EMRP) has been developed under Tasks 4.2 and 5.1 of this iMERA project. First projects are funded within the spin out ERA NET Plus project iMERA-Plus. The administration of the calls by EURAMET and the procedures proved the excellent applicability. The project partners, plus the countries that have additionally joined the initiative, have worked with their national administrations (up to Minister level) to prepare the Article 169, including agreement of the national commitments, cost and liability sharing, and development of the modus operandi for Article 169. The European Commission has put forward the formal proposal for supporting the complete EMRP through Article 169 of the European Treaty based on the output of these tasks.

It has been agreed that the metrology programme owning ministries should continue to meet on an annual basis, e.g. in combination with EURAMET meetings. Such networking of ministry staff in the field of metrology, which did not exist before iMERA, is a positive example of the lasting legacy of the iMERA project.

### **2.3.4 Task Group – Research Programme**

#### **Objectives**

The research programme activities lay at the heart of the iMERA project. At the beginning of the project each country was well aware of the metrology research programme it operated, but almost completely unaware of the programmes operated in other European countries. Thus task T1.1 “national programme landscaping” provided the foundations for the later tasks. The next task, T3.3 used existing research activities to test two models, one addressing procedural aspects of collaboration, the second to test joint cash funding of collaborative activities. The purpose of this task was to provide experience and case studies in managing collaborative R&D at European level, moving beyond the traditional “best effort” collaboration that had been the norm up until that time. Task T4.1 identifying strategic European metrology research activities, was far more substantive. It drew on the earlier foresight task group output, stakeholder consultation, in-house experience, a major roadmapping exercise and other lessons learnt and data gathered from the other project. These activities enabled the actual writing of the outline of the European Metrology Research Programme to be undertaken in the final task T5.1.

#### **Work Performed**

In order to elaborate a European Metrology Research Programme (EMRP), it was necessary to identify the R&D capabilities in European countries in the metrology domain, and to estimate the potential R&D resource for a common programme. The key tool used was the development, distribution, completion and analysis of a questionnaire sent to all European National metrology Institutes (NMIs). The questionnaire elicited data regarding the NMI activities, and required each NMI to collate and report the same data for the designated institutes (non NMI institutes formally identified in each country to supplement the NMI capability) in their country. Thus an overall “landscape” of publicly funded metrology R&D was established.

The result included an overview of the collective budget dedicated to metrology activities, in particular R&D metrology activities. Interesting and relevant information have been also collected on the number of persons working per “metrological fields”, in new research areas, and on R&D subjects developed at the present time in the different NMIs.

The complete analysis showed a collective annual resource of about €190M, representing about 1 500 FTEs (Full Time Equivalent), dedicated to the metrology research and developments activities within Europe. It was noted that 80 % of the resources is concentrated in the four major NMIs (and their supporting designated institutes), e.g. Germany, United Kingdom, Italy and France. Nevertheless, contributions from other countries are quite important. The financial support to R&D activities in metrology of Denmark, the Netherlands, Finland and Switzerland, was (at the time of the study) between €3M to €5.5M, and for Czech Republic, Portugal, Sweden and Turkey, the contribution between €1.1M to €1.8M.

Within the collective metrology R&D budget, about 60 % is dedicated to improving the calibration and measurement capabilities (CMC), and can be considered as the answer to urgent industrial - user needs, and 40 % of the resources are dedicated to new or long term research. New research areas represent more than 10 % of the EURAMET R&D total budget, for developing information technology, software, materials, and studies mainly for applications in healthcare, medicine, biotechnology and food sectors. A large fraction of resources is devoted to nano-reference (including nanometrology, nanoforce, nanostructure, nanotechnology, etc.). Chemistry is also a field with an increasing level of activity and now seems to represent about 10 % of the collective European R&D resources in metrology.

Across Europe, metrology employs highly qualified persons with two thirds PhD and/or engineers, and one third technicians. Women represent only 22 % of the total scientific and technical staff, but this is quite a high rate considering the number of women graduates in the science field.

European countries were surveyed with regard to views regarding deeper collaboration and cooperation. The results confirmed the collective will to move strongly in this direction, and confirmed that EUROMET (now EURAMET), the European collaboration, should provide the focal



point. Collaboration is not starting from a zero base line: around 85 % of the European countries had already collaborated to some degree in research within EUROMET, although mostly related to scientific comparisons.

This analysis was an important milestone for the other tasks of iMERA project (in particular for the development of the EMRP and knowledge transfer) and gave a snapshot of R&D axis within European metrology at the time. It provided the data to establish realistic boundary conditions for any joint programme.

The landscaping questionnaire gave the opportunity to gather and share a large amount of information on the metrology R&D activities performed by European NMIs (including Designated Institutes), a community of more than 100 institutions. This included the manpower available in each metrology field, new areas in development, an idea of available financial support per field, etc.

In summary, the landscape:

- gave a snapshot of R&D activities in each country, in each metrological field;
- gave a global view of metrology R&D in Europe per domain;
- gave a better idea of manpower in each metrology sector and globally;
- pointed out new areas of development;
- provided a view on mobility opportunities;
- was an essential step to enabling a trans-national research programme.

The concepts of more formalised collaborative research then needed to be tested. Whilst EURAMET NMIs have collaborated on an ad hoc basis in R&D for a number of years this has been at a rather modest level and using a very informal process. Consequently many proposed projects either never got going, or faltered part way through due to differences in national objectives, available funding, availability of personnel etc. To enable European NMIs to collaborate on R&D in metrology at a strategic level – the aim of this project – new processes were developed and trialled.

This was achieved by launching a closed call amongst the partner NMIs, requesting topics to pilot the new call processes, typically using existing on going activities funded by individual national research programmes. The proposed projects were subject to a trail selection criteria developed to ensure selection of appropriate high quality pilot research projects. Fifteen proposals were received, and 10 deemed to meet the criteria. These 10 projects involved a total of 82 participations from 27 different countries, and for a total of around 700 man-months, value around €77M. Partners were mainly NMIs. The following table gives the list of the successful projects from the pilot Call, identifying the coordinating laboratory for each project.

2005 Call – Successful Projects			
Title	Pilot Laboratory	Country	Theme
Toward more accurate temperature fixed points	LNE	FR	T&TP
Determination of an accurate $T_p$ vs $x$ (isotopic) relationship for neon	INRIM	IT	T&TP
Advanced mathematical and computational tools in metrology: a European collaboration in research	INRIM	IT	IntMet
Recommendations for the calibration and evaluation of pH on site measuring instruments	LNE	FR	MC
Use of the temperature amplifier as a new temperature standard for contact thermometry	INRIM	IT	T&TP
Measurement of acoustical impedance of artificial ears	NPL	GB	AUV
Tip and sample interactions in scanning probe microscopy	NPL	GB	L&DM
New determinations of the Boltzmann constant	PTB	DE	FM
Binary Josephson array power standard	PTB	DE	EM
Improved thermodynamic temperature measurement capability for high-temperature blackbodies	PTB	DE	T&TP

\* *IntMet* (Interdisciplinary metrology), *T&TP* (Temperature and thermo-physical properties), *MC* (Metrology in Chemistry), *AUV* (Acoustic, ultrasound and vibration), *L&DM* (Length and dimensional metrology), *FM* (Fundamental metrology), *EM* (Electricity and magnetism).

The processes that were trialled were devised to be portable to an eventual joint funded programme (the EMRP). The key lesson learnt was the need for R&D projects to be operated with official commitment by NMIs for their participation/resources/timescales, effectively a transformation in approach from informal ‘best effort’ collaboration to commitment in a contractual or quasi-contractual framework.

Task T4.4 was set up to test an alternative mechanism to financing collaborative research, that is the idea of laboratories funding (in cash) projects based on the value of the outcome, rather than the work done, and to gain understanding through experience of the practical challenges associated with the “common pot” model.

A subset of the partners (LNE, NPL and PTB) agreed to contribute a small amount of budget from their national funding allocation to a common fund, which was to be used to fund suitable technical research projects named “Quick Start”. LNE was nominated to be the recipient and manager of the common funding, the “common pot”.

Several small potential projects were proposed and the decision was taken to proceed with two of these, namely:

- “The study of a real-time control unit for JDAC arrays, with the application to watt balance experiments”.
- “Co-C cells, Kelvin unit, a collaborative project for defining Co-C eutectic as a Temperature Fixed Point in the future International Temperature Scale. Application of Cobalt-Carbon eutectic cells to thermocouples”.

For each of the two projects, the following documents were required:

- Technical description of the projects, including a time table and deliverables;
- Collaboration agreement;
- Operating budget.

Each partner paid their one-third cash contribution to LNE, who distributed the funds as required in proportion to costs incurred. The two research projects were launched and completed on schedule and a final report was produced for each project.

A number of lessons were learnt from this task. Firstly the cost and administration of cash transfers was disproportionate to the scale of these small projects. Secondly NMIs have a fundamental difficulty in providing cash beyond a small threshold: most NMI funding is in the form of facilities and human resource, not cash. Thus to free up significant cash, faculties would need to be closed or staff laid off, which then later would be needed for the delivery of the project! Although successful in terms of enabling research collaborations, it did not make much sense as a general *modus operandi* either for small projects because of administrative costs, or for larger scale activity as it would lead to a ludicrous situation of releasing the human and facility resource to generate the cash, and then not having that resource to deliver the science. This was a vitally important lesson and influenced later thinking when the Article 169 was shaped.

The focus then moved to identifying strategic European metrology research activities and preparation of the European metrology research programme under tasks T4.1 & T5.1. The main goal of the tasks was to draw up a European Metrology Research Programme (EMRP) to be executed through an Article 169 based activity. This programme was elaborated with the results of the foresight studies and the identification of the strategic European metrology research activities to support innovation and quality of life. The process of elaboration of the EMRP was performed in several steps that involved different groups of EURAMET.

The first set of groups consulted were the EUROMET technical committees, which include the representatives of all EUROMET (at that time) member countries, and represent the knowledge of the collaborative research in metrology and of the long-term needs of the calibration laboratories in Europe. They were briefed on the issues of the EMRP at a workshop during which they were acquainted to the road mapping exercise. The EUROMET technical committees members identified key issues and constructed roadmaps with supporting documents for the following domains directly linked to the International System of Units (SI):

- 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

As the preceding domains did not yet cover some important subjects, focus groups were initiated to produce roadmaps for:

- *Metrology for New Materials*
- *Metrology for Life Science*
- *Software and Mathematical Tools for Metrology*

At the end of the exercise, 43 roadmaps and associated notes were issued, they describe how to reach scientific or technological targets from the current status of the science through experimental realisation or studies. The roadmaps are available (access requires registration, but is open to all and free, see <http://www.technology-roadmaps.eu> )

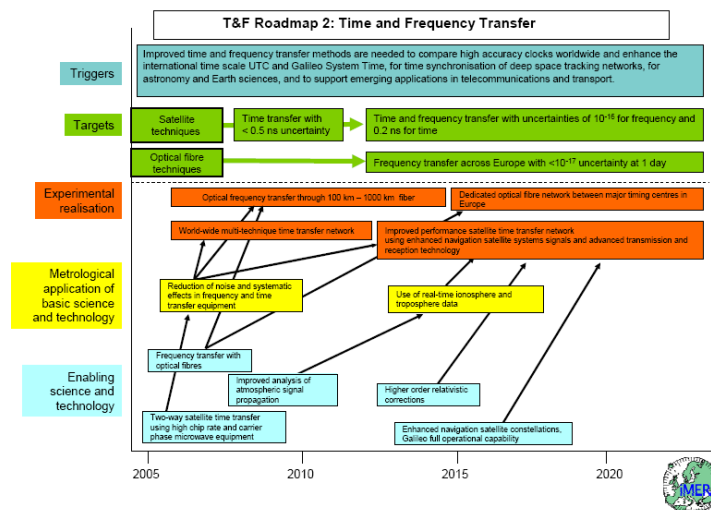
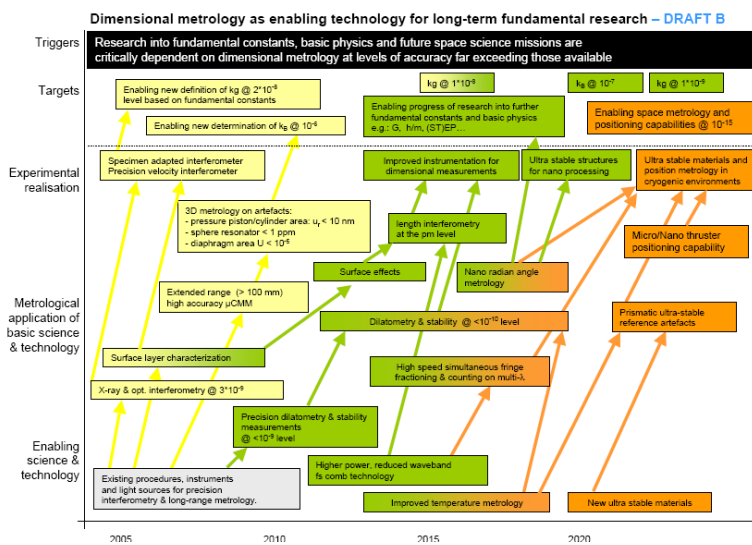
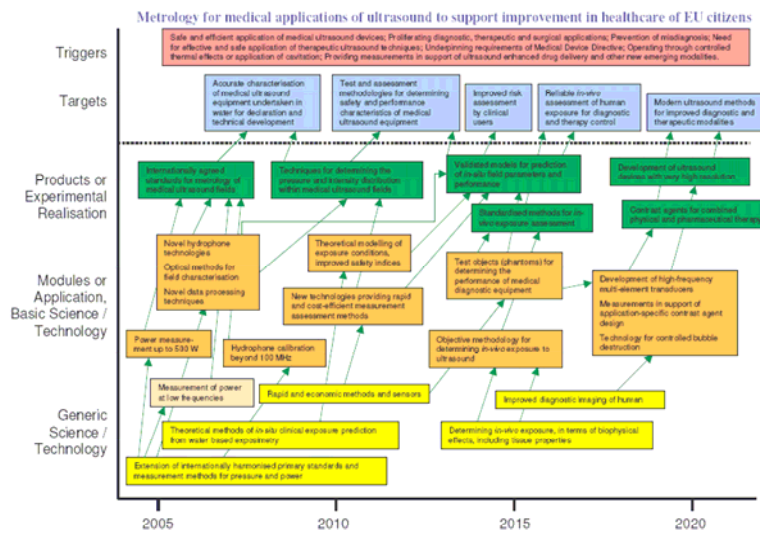


Figure 7: Examples of the 43 iMERA metrology roadmaps

The second step was the analysis and validation of the content of the roadmaps – and more crucially the detailed underpinning texts - by the Executive committee of EUROMET (at that time). The committee provided feedback at each EUROMET technical committee meetings.

The third step was the elaboration of the EMRP using the roadmaps, the results of the foresight studies, and any other available data. A first draft was proposed by a core team which adopted the three key approaches:

- A new approach for the metrology research community in which “grand challenges” are addressed by bringing the various strands of measurement science to bear on socio economic issues of European and international relevance. The key challenges have been identified: **health, energy, environment, and new technologies**. They relate closely to the priority areas of the Seventh Framework Programme, and will require input from the EURAMET Research Council to focus resources in the most effective way on the appropriate metrology and measurement aspects.
- The development of cross-disciplinary solutions to solve direct challenges related to fundamental metrology, typically the fundamental constants and the redefinition of the SI units: ampere, kilogramme, second, mole and candela.
- Focused R&D within single metrology disciplines, aiming at improving the accuracy and the realisation and dissemination of the primary and secondary units of measurement. This “unit based” (that is mass, length, time etc) research is the backbone of metrology R&D. It underpins industrial activity and supports societal needs (typically through provision of data, measurement techniques, instruments, procedures, documentary standards, and reference materials etc necessary for proper operation of regulations and Directives).

The programme provides underpinning elements to the 7<sup>th</sup> Framework Programme and the European Commission has established a an Interservice committee to avoid unnecessary overlap with the Framework Programme and to achieve, if possible, synergy with Framework activities across Europe, particularly related to the socio economic grand challenges.

The programme provides underpinning elements to the 7<sup>th</sup> Framework Programme and will be coordinated formally with the European Commission by the EMRP Committee in order avoid overall and achieve, if possible, synergy with Framework activities across Europe, particularly related to the socio economic grand challenges.

The programme also includes a section on capacity building in metrology based on three grant schemes: researcher excellence grants, researcher mobility grants and early-stage researcher mobility grants.

The first outline document – EMRP Outline 2007 - (March 2007) was jointly approved by the EMRP Committee and the newly born organisation EURAMET in 2007. In order to comply with the latter requirements of the Commission, the document was up-dated in November 2008 and again approved by the EMRP Committee (outline November 2008). The consensus document now - EMRP Outline 2008 – is publicly available from the EMRP section of the EURAMET website [www.euramet.org](http://www.euramet.org).

## Conclusion

A common understanding of the national programme landscape has been developed, providing the basis for much of the planning for the EMRP research agenda. Piloting the various processes enabled the team to gain practical expertise and to fine-tune the processes. The success of these activities are demonstrated by the rapid and successful “spin out” of the iMERA-Plus initiative that formed the first phase of the EMRP.

The information gathered from the metrology community, the stakeholders, and foresight analysis enabled the actual EMRP Outline to be developed effectively and efficiently, in 2007. The EMRP Outline required only modest adaptation to align with the final Commission proposal for the Article 169, when that became available towards the end of the project. The development of the EMRP Outline reflects the willingness of the participating countries to establish a joint research programme featuring scientific, management and financial integration. It will accelerate the development, validation and exploitation of new measuring techniques, standards, instruments, reference materials and knowledge aimed at driving innovative developments in industry and commerce, improving the quality of data for science, industry and policymaking and supporting the development and implementation of directives and regulations.

### **2.3.5 Task Group – Developing Structures**

#### **Objectives**

It was clear when the iMERA project was formulated that EUROMET, the existing structure for collaboration in metrology in Europe would at the very least need to evolve, and very possibly need to be revamped completely, probably (as proved the case) becoming a legal entity rather than an informal organisation. Thus the objectives of the tasks in this task group were to look at the major changes in structure.

In Task T2.4 the legal issues related to the joint activities were investigated, looking at the various options ranging from whether the current informal “club” status of EUROMET was suitable for the Joint Activities, through options such as the establishment of a European Economic Interest Group (EEIG) or some other legal structure. Task 4.2 was pitched one layer further down, that is to address not the structure itself but the committees and bodies within the structure. It recognised that EUROMET, or some replacement body, would require terms of reference very different from those existing at the outset.

The Task group for Task 4.3 also wanted to examine and pilot opening up access across Europe to major metrology facilities, often available only in one or a small number of countries.

The final task, T5.2, was fine tuned during the lifetime of iMERA. Its purpose was to turn the earlier studies into concrete action, creating optimised organisational structures and their terms of reference for the EMRP, with the particular aim of establishing and launching a legal entity appropriate for the metrology Article 169.

All these tasks are linked together by the common goal to develop the metrological structures in Europe to provide the metrological base needed by society, economy and science to meet the challenges of the 21<sup>st</sup> century. Therefore this report provides a single narrative coverage of the above tasks.

#### **Work Performed**

##### **Metrological developments in Europe until the end of the 20<sup>th</sup> century**

Ancient civilisations like the Egyptians established sophisticated metrological infrastructures needed for taxation, trade and building activities. By the early 19<sup>th</sup> century in Europe the national states had developed metrological infrastructures based on their own national systems of weights and measures. Whilst this had been satisfactory until that time, with the industrialisation in the 19<sup>th</sup> century two fundamental changes occurred:

- A great demand for more precise measurements arose not only in the classical field of weights and dimensional measures but also in new areas like electricity that could only be satisfied by extensive research and development activities.
- The growing cross border trade in particular with industrialized goods required the agreement to an international system of measures.

As a result either the classical “National Offices of Weights and Measures” started to engage in metrological research or specific new metrological institutes were established dedicated to metrological research. In parallel the leading industrial countries set up a treaty (Convention of the metre) agreeing to an international system of weights and measures (today the SI system) and setting up an international body to coordinate the realisation and dissemination of that system, the International Bureau of Weights and Measures (BIPM) in France.

By the end of the 20<sup>th</sup> century practically all European countries had established a national metrology institute (NMI) responsible for the dissemination of the SI units to its national customers. The larger of these institutes are engaged actively in Research and Development (R&D) activities mainly in support of nation industries. The size and scope of European NMIs vary significantly due to the different national needs ranging from institutes with more than 1500 employees to those with less than 10.

## **The situation at the beginning of the iMERA project**

All NMIs have a common ground, the realisation and dissemination of the SI units. In 1987 NMIs of Western Europe created EUROMET, an organisation for the cooperation of National Metrology Institutes (NMIs) and Designated Institutes (DIs). After the fall of the Iron Curtain, EUROMET was joined by the NMIs and DIs of central and Eastern Europe. The main focus of EUROMET was the technical cooperation in the fields of

- Provision of traceability to the SI
- Organisation of intercomparisons of national measurement standards
- R&D for metrology
- Consultation on facilities

Cooperation was facilitated through participation in Technical Committees (TCs) where one contact person per member country represented the interests of the NMI and/or DI in that specific field. Similar activities occurred also in other areas of the world. Regional metrological organisations (RMOs) like EUROMET were established in particular for traceability provision and intercomparisons of national measurement standards.

The provision of traceability was normally established through bilateral projects. These activities were very successful and gained great importance throughout the lifetime of EUROMET. The participation in intercomparisons was extremely important to achieve confidence in the degree of equivalence of the national measurement standards in the different European countries. However, R&D cooperation was not as successful as the first two activities, mainly due to the fact that

- the national research programmes were established beforehand
- projects were created mainly on an ad hoc basis
- no specific project funding was available
- contact persons lacked the authority to commit their NMIs to specific projects
- the progress of agreed projects was slow due to lack of available resources

The consultation on facility projects worked quite well as they were mainly bilateral in nature where an experienced NMI transferred know how to an NMI which was setting up new capabilities in its laboratories.

A major disadvantage of the EUROMET structure was the fact that it did not have legal capacity and therefore was unable to acquire its own research funding. In 2002 and 2003 EUROMET ran the MERA project, supported by the European Commission (contract No. G6MA-CT-2002-04012), (Planning the European Research Area in metrology). A major outcome of this project was the conviction that in particular in the field of R&D significant synergy could be gained by moving from loose cooperation in research to dedicated collaborative research through the coordination of the national research programmes. The iMERA proposal (implementing the Metrology for the European Research Area) was submitted to the European Commission to support an ERA-NET in the field of metrology to explore the way forward and to create the structures and procedures required for an Article 169 based European Metrology Research Programme.

## **The way to go forward**

At the start of the iMERA project in April 2005 the initial question was whether the informal status of EUROMET on the basis of the EUROMET Memorandum of Understanding was suitable for Joint Activities under Article 169. The possibilities, perspectives and obstacles to converting EUROMET into a legal entity were analysed and possible different legal structures were described. Options such as the establishment of a European Economic Interest Group (EEIG) and other legal structures were explored. The criteria that were considered for the selection of a legal structure were amongst other things: the status of a non-profit organisation; the administrative outlay; liability for members and directors; the nominal capital; and the compatibility of a future internal organizational structure with the existing EUROMET structures. The criteria had been established on the basis of an enquiry amongst the iMERA partners about their possible problems involving participation in a civil law association.

As a result of this discussion, the decision was in favour the establishment of a legal entity, suitable for both the operation of an Article 169 based EMRP and the other purposes of EUROMET as a Regional Metrology Organisation. After weighing up the pros and cons of different legal structures available in the member states it was agreed that the Association of Public Utility under German Law (e.V.) would be the best option for this legal entity.

An action plan for the establishment of the legal entity and the transfer of the present EUROMET to the future entity was developed by the task team in consultation with the relevant EUROMET bodies, the General Assembly (GA) and the Executive Committee (EEC), and was communicated to the iMERA Network Steering Committee for approval. The relevant points of this transfer process have been exposed in a resolution, which was adopted by the last General Assembly in June 2006.

In addition to the development of the most suitable structure to plan and execute the EMRP the question was addressed how to open special facilities existing in one country to the metrologists in other countries. A special facility in this meaning has capabilities which are either unique inside Europe or significantly above the general state of the art. Terms of Reference (ToRs) for Special Facilities (SF) were established and 14 pilot facilities were identified. The pilot period started in March 2006 and ended in March 2008. The SF providers defined their user conditions and user fee regulations. 34 expressions of interest for the use of these Special Facilities were received and 14 Pilot Projects (PP) were successfully implemented during this period. User support groups were created on a case-by-case basis, adapted to the specific needs of the pilot projects. The possibilities of using the special facilities generated great interest in the potential users, but fewer pilot projects were implemented than originally expected, which is due to two factors:

- NMIs traditionally only prioritise work where they have available resources, thus in a short timescale demand is limited (time is needed to change the culture)
- Lack of financial resources or changed priorities on the side of the potential users slowed down the activities

#### Pilot facilities and realized pilot projects

1. PTB – Clean room facility: 2 PP implemented
2. PTB – Natural environmental radiation fields: None
3. PTB – High capacity force and torque standard machine: None
4. PTB – Hydrodynamic test field: None
5. PTB – TULIP: None
6. PTB – Primary temperature radiators: 6 PP implemented
7. NPL – Low temperature scanning tunnelling microscope: None
8. NPL – RF&microwave antenna measurement facilities: None
9. NPL – Grid computing system: None
10. DFM – Free and diffuse field calibration: 2 PP implemented
11. DFM – Electrolytic conductivity: None
12. INRIM – 1 MN dead weight force standard machine: None
13. LNE – Angular measurement machine: 1 PP implemented
14. LNE – Primary pressure standard: 1 PP implemented

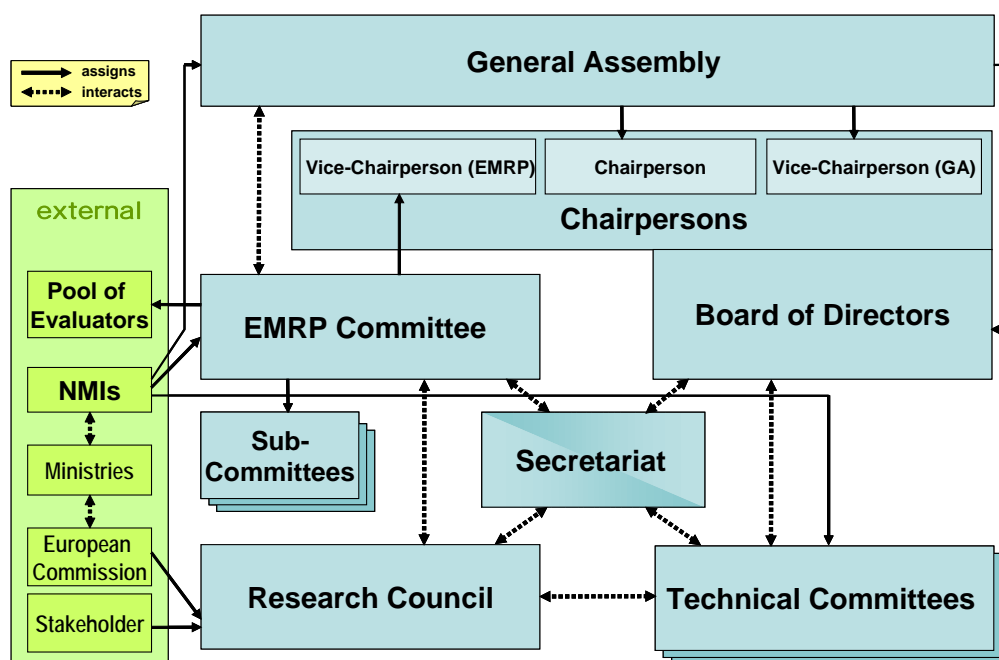
A major obstacle to start a pilot project turned out to be the lack of special funding (lack of financial and personnel resources). This has been expressed by European NMIs as well as by NMIs beyond Europe. However, it should be possible to overcome this obstacle once potential users include pilot projects in their long-term planning (including financial planning). It is the view of the participants that it will take some time before greater use of special facilities in other countries (for national purposes rather than for collaborative projects) becomes common.



A clear interest for a continuation and more extensive use of the Special Facilities has been expressed by EURAMET members and is being discussed within the responsible EURAMET bodies.

### The new European metrological structures

In January 2007 the new legal entity “EURAMET”, the European Association of National Metrology Institutes, was launched and was recognized by the German authorities as a registered association (e.V.) with non-profit status in April 2007. The structures of EURAMET are closely related to the old EUROMET structures but take into account the specific responsibilities to plan and execute a multimillion Euro EMRP.



**Figure 8: Organisational structure of EURAMET e.V.**

The General Assembly (GA) is composed of the member NMIs of EURAMET. There is only one member per country. If the metrological infrastructure in a country is composed of more than one NMI, then the country must decide which NMI will be the member. The other NMIs and further DIs can join EURAMET as associates, having no voting right. The governance of EURAMET is provided by the EURAMET byelaws and the EURAMET e.V. Rules of Procedures (RoP). A specific set of RoP cover the EMRP Committee. The terms of reference of EURAMET e.V. were prepared within the iMERA project and discussed with the EURAMET members and agreed by the EURAMET GA.

Membership in the EMRP committee is for those NMIs only that have a national metrology research programme and have made a national commitment to the EMRP. The EMRP Committee elects its Chairperson, who serves as a further Vice-Chairperson of EURAMET. The EMRP Committee has the ultimate decision power in all questions relating to the EMRP.

The Board of Directors (BoD) is composed of the Chairpersons and six further directors elected by the GA from its members. The composition of the BoD should reflect the diversity of the members in respect of geography, level of metrological development and metrological impact in Europe.

The TCs are composed of one contact person per country from the NMIs or DIs of that country. At the time of this report, there are 10 vertical TCs (responsible for specific fields in metrology like electricity & magnetism (TC-EM), temperature (TC-T), etc. and two horizontal TCs for Interdisciplinary Metrology (TC-IM), and for reviewing the quality management system of the NMIs and DIs in the framework of the CIPM-MRA (TC-Q). These TCs continue the tasks already pursued by EUROMET like traceability provision, the organisation of intercomparisons of national measurement standards and consultation. The organisation of intercomparisons is now integrated in

the framework of the CIPM-MRA and includes intercomparisons with other RMOs to achieve worldwide recognition of calibration and measurement capabilities.

Another body that did not exist in EUROMET is the Research Council. This body is an external high-level advisory board consisting of 7 institutional and 9 personal members from industry, research and academia. Its main role is to give advice and comments on the EMRP.

#### Institutional members of the Research Council

1. BIPM
2. Commission representative and advisor as appropriate
3. European research Council
4. European Parliament (ITRE); this position is presently unoccupied
5. EUROLAB
6. European standardization body
7. WELMEC

In 2007 EURAMET applied for and received funding for the first phase of the European Metrology Research Programme under the framework of the ERA-NET-Plus funding of FP7. The call procedure and project selection was successfully executed by EURAMET in 2007 and the list of selected projects agreed by the Commission. All projects have started in 2008. The total funding for 21 selected Joint Research Project are in the order of €64.5M. financed 2/3 by national research programmes and 1/3 by EU contribution. The successful planning and executing of this iMERA-Plus research programme through EURAMET has demonstrated the capabilities of EURAMET to plan and execute major metrology research programmes. In parallel to the beginning of the iMERA-Plus research programme, the Commission has successfully executed an impact assessment procedure for the Phase II potential joint programme under Article 169 EMRP. The impact assessment was carried out for the Commission with the support of independent experts. Based on the positive outcome of the assessment the Commission has submitted a proposal to Council and Parliament for the EMRP on 4 December 2008.

#### **Conclusion**

The task group “Developing Structures” was in charge of investigating the legal issues related to Joint activities. The recommendation to establish the organisation as a registered association of Public Utility under German Law (e.V.) was taken up in January 2007 when EURAMET e.V., the European Association of National Metrology Institutes, was created as legal entity. In 2007 EURAMET demonstrated its capability to plan and execute a large metrology research programme with the start of iMERA-Plus, a EU co-funded metrology research programme with a funding volume of about €64M. EURAMET is now ready for the planning and execution of an Article 169 based EMRP. The tasks of the task group “Developing Structures” have been successfully concluded.

### **2.3.6 Task Group – Training and Mobility**

#### **Objectives**

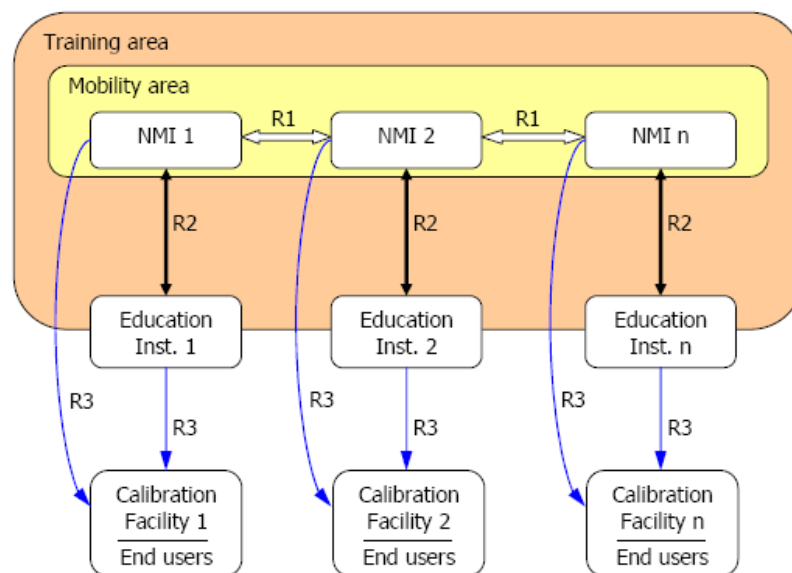
The objective of this task group was to review relevant existing national metrology training activities and national mobility sponsorship schemes, Task T1.7, and to look for opportunities to increase joint training and mobility, Task T3.2.

#### **Work Performed**

#### ***Background***

Continuous improvement and development of the European region as a knowledge based economy, increases the demand for professional workers. There has been an expansion of professional employment in all European Countries. R&D activities have a central role within a progressive knowledge based society, key to which is the specialised long-term professional training of researchers and scientists.

Education and training is certainly one of the most important aspects of good performance in any field of technical activity. Metrology is a complex scientifically based infrastructure activity. Therefore it is important to understand the ways of training, as well as the mobility of metrology experts. Figure 9 explains the concept of training and mobility transfer on the European level metrology structure.



**Figure 9: Mobility and training diagram at the European metrology level**

Figure 9 shows NMIs at the top row. End users, shown in the bottom row, are typically calibration facilities at the secondary national level and the whole system of industrial metrology.

Educational institutions, shown in the middle row, usually play an important role in metrology education at the national level and are sometimes link between NMIs and end users. Relationships denoted by arrows labelled R3 are typically part of knowledge transfer (KT) activities and these are covered in detail in iMERA Task 1.4 Knowledge Transfer.

Arrows labelled R1 in Figure 9 indicate the exchange of personnel between NMIs. Arrows labelled R1 and R2 denotes the education and training material development activities that are the main focus of this task. The shaded area labelled ‘training area’ indicates the scope of education and training development activities and organisations within scope of this review. The shaded area labelled ‘mobility area’ indicates the organisations and activities encompassed by the survey on mobility.

It is important to note that mobility of researchers varies across countries. According to OECD annual data large number of Asian academics worked in US academies, academic mobility from

Turkey and Russia has increased while on the other hand the mobility from European countries has slowed down.

### ***Training opportunities and exchange of personnel***

Under the work package WP1 - Systematic exchange of information and best practice, Task 1.7 - Training opportunities and exchange of personnel, a survey on training possibilities and teaching material developments among EUROMET partners was performed. The questions were designed to develop a view of the feasibility of preparing, maintaining and sharing education material, so as to provide a common European metrology education platform. The survey focused on the availability of metrological materials, provided either by NMIs, their designated institutions or other related institutions, such as universities, public research institutions etc.

In order to obtain information on training and education at NMIs, respected associated or designated institutes and related educational institutions engaged in metrology were surveyed for the following information:

- existing metrology education materials and training activities
- existing mobility and exchange of personnel cooperation
- future plans
- expressed or foreseen needs of training
- participation in common European metrology activities

A questionnaire was prepared and distributed to all partners of the iMERA project. The partners were asked to forward the questionnaire to all parties within the country that they judged might be involved in metrology education and/or training.

Based on the information gathered by this questionnaire, the following overarching themes were analysed:

- an overview of the majority of existing (and future) teaching and training materials, either freely available among all partners or conditioned by certain requirements,
- a proposal for a possible common education material in basic metrology expertise, available to all EUROMET partners across Europe in order to achieve a more harmonised treatment of key metrological parameters (such as uncertainty issues etc.),
- a concept of basic metrology university education across Europe, following the principles of Bologna declaration for the restructuring of the European higher education system.

Metrology training and education is typically divided to general metrology issues, under which uncertainty calculations and quality assurance find their own treatment, and measurement quantities, specifically physical and chemical ones. Questions related to metrology training and education were hence structured under the following topics:

<i>Physical quantities:</i>	measurement of specific basic and derived quantities, except the mole
<i>Chemical quantities:</i>	measurement of chemical quantities and use of reference materials.
<i>General metrology:</i>	all aspects of scientific, legal and industrial metrology, including instruments, sensors and IT/software and traceability.
<i>Uncertainty calculations:</i>	general uncertainty evaluations, statistical evaluations, GUM
<i>Quality assurance:</i>	quality system, conformity assessment.

A few most interesting, although somewhat anticipated conclusions, are the following:

- Majority of metrology training and production of training materials is performed by NMIs.
- Training in metrology in chemistry and knowledge about quality systems are rather low priorities.
- Majority of participating EUROMET member states do not have dedicated metrology undergraduate or post-graduate courses.
- NMIs in most cases provide the most complete, comprehensive and advanced metrology knowledge in respected countries.
- NMIs do seek cooperation with other educational institutions.
- The most widely developed teaching materials cover general metrology, physical measurements and measurement uncertainty.
- Relatively few countries are involved in bilateral cooperation metrology programmes or EU financed national programmes. Situation is currently under improvement with programmes to support new EU candidate Member States.
- Hands-on training is considered as most appropriate form of gaining expertise and experience.
- An interesting but not surprising result is the fact that less than 20 % of available materials are freely available.
- There is almost always a specific request for all materials to quote the source, give the reference and respect copyright.

It was clear from the answers that general conclusions on individual questions are sometimes misleading and should be interpreted carefully case by case. It was also clear that it would be necessary to extend the survey to many more institutions if we want to draw more precise conclusions regarding individual questions. As a concluding remark, the response of EUROMET members to the questionnaire was very positive and good enough to have a representative number of participants and reasonably reliable conclusions.

### ***Joint training and mobility programme***

In spite of the fact that the necessity for training and education was present almost everywhere, there has been so far no initiative to analyze the situation on the European level in order to try to optimize individual endeavours. Training in metrology is no exception to other training and teaching programmes, which have also been developed primarily on the national level.

With the development of a more unified European metrology system, closer collaboration of national measurement institutes became a reality, and as a consequence both the need and the possibility for joint training programmes emerged. The MERA project, extended cooperation of European NMIs, iMERA and a number of other EU stimulated and facilitated programmes and projects all clearly identified the need to a better structured joint training programme.

It was therefore the obvious next step of this task to analyse the existing teaching and training possibilities across Europe, identify specifics, current good practices and also propose the improvements when necessary or possible. The first step was to identify key subjects in the metrology education across Europe and examine their interrelations. It was clear from the beginning, that it is not only NMIs that should be surveyed, but professional educational institutions and end users, such as calibration laboratories, as well.

In order to obtain more detailed information on joint training and mobility at NMIs, respected associated or designated institutes and related educational institutions that are engaged in metrology, were asked to provide further information on the following topics:

- analysis of mobility of EU metrologists, and other eligible partners
- qualification of metrology personnel

- common training material
- preparation of common training courses.

For the purpose of obtaining relevant information on these topics a questionnaire was prepared and distributed to all partners of the iMERA project and broader to all EURAMET community.

Within first topic we gathered relevant information on *horizontal mobility between or among NMIs*, related to cooperation among several NMIs, and *bilateral mobility* which is coordinated by national ministries and possible relation to cooperation between two NMIs, agencies, institution, etc. associated with metrology. Thirdly, we identified *EU mobility programmes*, which include identification of mobility programmes and use of those models in mobility in metrology. Mobility was also considered from the perspective of Marie Curie programmes, BIPM surveys and possibly related to the use of special facilities.

The information gathered on the topic of mobility acts a reference resource for the development of improvements of the mobility opportunities for European metrologists, particularly for countries with emerging research programmes.

Within second topic – qualification of metrology personnel – we classified metrologists in EU countries/NMIs. All information was gathered in common classification scheme. It contains information about academic qualification (for example B.Sc., M. Sc., PhD etc.), name for some qualification degrees and years of experiences necessary for promoting between named degrees.

Within the third topic we prepared a set of common training courses. Availability of training courses in EU was analyzed and existing training courses were identified. We gathered all available training courses in a training courses table. Partners were asked to name current and future training courses, to write down short description, duration of each course (in hours), type of course, language, target group and possibility of sharing the course material with the statement of terms and conditions by which the material can be shared.

Freely available education material was collected from some partners. Altogether, 179 education materials in various forms and extent were gathered and used in preparation of common training material.

Currently available teaching programmes to be universally useful do almost not exist. Quite often, very interesting topics are in local languages. In the case of English language, this is not a problem, but even French or German present certain barriers to wider usage. It is also evident that a number of very interesting subjects are well covered, but limited and restrained to particular environments.

Only a limited number of existing materials could be easily upgraded to the level of the common use, but an option is to start the formation of the common pool of materials, available to European metrology community. In this respect, the additional “web assisted training” initiative is one of the promising solutions for the future, which was covered in the extended Task 3.2, in which the use of a common learning management system MOODLE was successfully demonstrated.

## Conclusion

The present report addresses for the first time the issue of training opportunities, exchange of personnel, developing joint training materials and mobility programmes for metrology across Europe.

Since the report has been part of the iMERA project, which was initiated within the community of European National Metrology Institutes (NMIs), it is not a surprise that NMIs were the most active participants within the project. However the views of a wide variety of institutes were also included, through the responds to questionnaires. Currently EURAMET consists not only of NMIs but also of a large number of Designated Institutes (DIs), with the status of associated membership. These associated members are very often research institutes and university departments, which have the potential to be a good source of required teaching materials in future.

Training and education as well as the mobility issues were of utmost importance to be analyzed. It was proved that both activities are very interlinked, that there are big differences in the state of the

development across Europe, and that several previous perceptions on the subject have to be slightly changed.

With the respect to the teaching and training materials, it was seen that there is a huge variety of materials across Europe, but almost always in different forms, approaches etc. Making the bulk of teaching materials freely available is not a currently feasible option. All authors and institutions have requested certain fees for materials, since the development of training material requires considerable investment. Furthermore, the delivery of training generates income for metrology institutions. It is clear that the value of the training materials has to be acknowledged in order to properly manage intellectual property rights and the investment made in their production.

Mobility as such has not been recognized as widely implemented as compared to the development of the teaching materials, and is currently based more on bilateral projects and cooperation among NMIs. Even the Marie Curie initiative has not been completely used. One of the potentially important stimulations for mobility is wider use of special facilities. Special facilities should be considered and used much more in the future.

The major conclusion of the report is that training, education and mobility, are the key instruments to fully implementing the idea of the European research area in the field of metrology. It is therefore crucial to continue with the endeavours in those directions.

### **2.3.7 Task Group – Special Needs and Expanding ERA-NET**

#### **Objectives**

The objectives for this task group were to ensure that the special needs of emerging EUROMET members were addressed, Task T2.6. This was partly to encourage greater engagement in the metrology research agenda (whilst all countries have national metrology institutes, not all conduct metrology research), and also partly in anticipation that other countries, beyond the 14 participating in iMERA, would show interest as the initiative gains momentum. In Task T2.9 the option was kept open as to whether to contractually expand the iMERA project if interest was shown, or to include non partner European NMIs (and their ministries) in the activities in a less formal way.

#### **Work Performed**

Metrology organisations in Europe collaborate within the EUROMET grouping (the European Regional Metrology Organisation, now EURAMET e.V., [www.euramet.org](http://www.euramet.org)), currently consisting of 33 countries plus the IRMM of the JRC of the European Commission. At the launch of the iMERA project in April 2005 not all EUROMET countries have well-established programmes for metrological R&D, a prerequisite to effectively participate formally in the ERA-NET and its associated activities. Some countries have limited research capabilities, or simply plans for such activities in the future. The new Member States and future accession countries often faced particular difficulties. On the way to their accession, the stress was originally given to organizational and legislative matters and to strengthen their technical infrastructure for metrological services currently in demand. The task team was assigned with the task to analyze and develop a strategy to increase participation in R&D from this community.

Additionally the task team was expected to explore in this context the potential to be gained from the recent changes in European Union policy offering the possibility of linking European structural funding in support of the European Research Area.

The approach employed started with the development of a questionnaire to be circulated to all the EUROMET members. Responses were received, collated and analysed to form the basis for next steps. Firstly, the partners considered important to associate themselves with this task were identified and secondly the proposed next steps were extensively discussed by the task team at the Ljubljana iMERA workshop in October 2005. It was concluded that matters associated with both the Tasks 2.6 and 2.9 could be most effectively addressed by way of a dedicated workshop in Prague.

In parallel, communication was initiated between COSMT (Mr. V. Ludvik) and the CEC DG Research (Mr. David Uhlir) on the subject of a possible use of structural funds to support research activities in the eligible member countries.

After carefully discussing the agenda among the task team and with the partners, the workshop took place in Prague on March 8 – 10, 2006 where almost two days were devoted solely to the Task 2.6. The workshop attracted 51 attendees from 24 European countries, especially new and associate EU ones. Break-out sessions where underlying matters were actively discussed by all the participants were essential working tools at the workshop. Among others, the representative of EC DG Research made an extensive presentation at the workshop highlighting all the aspects of structural funds to be used to develop infrastructure for research in metrology. This was also found to be of relevance to other research communities. The information gathered during the workshop in terms of presentations, discussions in the break-out sessions and other documents was assembled and was collated into the Deliverable D2.8 of the project.

During the Prague workshop, participants identified the main obstacles to a wider thrust into research activities in metrology. These included organizational structures, internal obstacles, external relations, awareness raising and formal attributes of RTD programmes. Research activities in NMIs have historically been associated with one of their main missions, i.e. development and maintenance of national standards in realization and dissemination of units of measurement. Firstly, no clear differentiation between maintenance work on national standards and true research or their true development has been made in the past. This has had the effect of preventing any possible kick-off of more extensive research activities based on the multi-source financing now available in all the countries. Furthermore, it somehow marred what is going on inside and prevented any classification or insight in these matters understandable to the outside world.

In some cases limited RTD programmes have nevertheless existed, and were quite common in the former socialist countries. Unfortunately, such programmes suffered for a number of reasons: general separation from the outside world; lack of prioritization and of funding in hard currency; pretentious formulation of individual research projects; lack of truly independent assessment and evaluation of those projects. In some cases this resulted in unacceptably low standards in research work. Those negative attitudes in some form have persisted even to this day and they could potentially endanger the future of research in the NMIs concerned.

The identified obstacles and deficiencies are intertwined and mutually interdependent so that it is difficult to identify the primary (core) movers (causes) to improve the situation significantly. The experience of others and common sense command that there are three key factors required to enable a breakthrough here:

1. the responsibility of top management is to set down a clear-cut mission for the organization and to pay more attention to strategic planning. To develop, under the conditions provided by market economy, a “new approach” to “metrological research” based on experience gained by participation in international projects like e.g. iMERA
2. to hire highly qualified motivated staff
3. to embark on multi-source financing of NMI activities inclusive of research (i.e. to develop corresponding services alongside the research, for example).

The emergence of the concept of a joint European metrology programme provided choice to those countries considering launching metrology R&D activities. That is to say either launch an independent national programme or to launch a programme with the intention of engagement in the joint programme. The concept of the joint EMRP has proven very attractive. Over and above the iMERA 14 partner countries Austria, Belgium, Estonia, Hungary, Portugal Romania Spain and Turkey have all joined the Article 169 initiative, albeit in some cases with very modest budgets.

In case of a positive decision towards greater involvement in R&D the elements of an action plan for emerging NMIs were formulated as a major output of the project.

The main rationale of the action plan was as follows: high quality human resources → increased overall penetration in research projects → tangible results → to raise public awareness (PR to the



Government, industry, public at large) → long-term financing of research in metrology → motivation of the staff. → back to the beginning (closing the loop).

The proposed action plan should be considered as a recommendation of a rather general nature that cannot realistically fit to all the emerging countries in its entirety – it could be applied in full or in part as fits with local conditions. The action plan is equally applicable to other areas of research with public financing in the same situation. The action plan serves as a model, which can be adapted to various situations on national level and to be broken down to a more detailed plan. The decision to implement it is fully a responsibility of the emerging NMIs themselves and their regulatory bodies. As a result of the project it has been concluded that the best way forward for the community of emerging countries to start (collaborative) R&D in metrology based on the following 4-tier approach:

- to initiate activities in research around “islands of positive deviation” within the institutes, it is not worth trying to be active everywhere;
- ideally, topics should be chosen not to repeat research already performed by others (very difficult but still possible, e.g. in metrology in biology and chemistry, nanometrology, vacuum - in new areas)
- a broader “collaborative” environment (working in teams) either on the national level (“national ERA”) or internationally (EURAMET, EU FP programmes) should be sought when starting with research activities
- if possible to look for areas that might catch the eye of media or public at large (e.g. metrology in chemistry or ionizing radiation might be currently the most promising in this aspect – quality of life).

All the objectives of the task have been fulfilled. As a by-product of the project, a formulation of specific projects for the EMRP programme tailored to the needs of the emerging countries was made under the buzzword “capacity building” - it was assumed that a small percentage (15 %) of the EMRP projects would be open to proposals prepared by the emerging NMIs which eventually did not happen (was not in line with the ToR of EMRP as finally approved by CEC).

The impact of this project task on research activities can be seen in the following:

- it provided emerging NMIs with a rationale of how to tackle their involvement in metrology-related R&D and with a clear strategy of how to progress on the issue
- the deliverable will be further used in the activities of the focus group IM-FG DevInf on metrological infrastructures established within EURAMET within Technical Committee Interdisciplinary Metrology
- it has a direct association with on-going discussion on the role on national infrastructures (like e.g. NMIs) in a community of countries like the EU in comparison with community infrastructures (like e.g. IRMM)
- it provided emerging countries with clear guidance of how to use EU structural funding to strengthen national infrastructures in research
- the conclusions are general enough to be taken up and used by other research communities in Europe considering their way forward.

The Task Team also had to consider, within Task T2.9, how best to cope with growing interest by EURAMET countries beyond the original 14 participants in iMERA. At the launch of the iMERA project in April 2005 EUROMET consisted of 31 countries (plus the IRMM-JRC). Two further countries, Croatia and Serbia, have since joined, there are 4 corresponding (potential) applicants: Albania, FYROM, BiH and Montenegro. Participation in the iMERA ERA-NET was offered to all EUROMET members with the proviso that they must have a nationally funded metrology R&D programme/activity. Almost all of the countries with significant metrology R&D did join the consortia, and the project was launched with 14 countries (plus IRMM-JRC). A small number of countries with R&D were unable to join the iMERA consortia at the time for a variety of reasons (such as institutional reorganisation preventing a commitment on the required timescale).

Additionally, the iMERA activities have stimulated a number of countries that currently did not have nationally funded metrology R&D to consider launching such activities to enable them to engage in the process. The task team led by CMI with partners NPL of the UK and NMi of the Netherlands undertook an evaluation with two key thrusts:

- Identify which non-partner countries wished to engage with the initiative
- Establish the most appropriate mechanism from the following
  - Formal contract partner with additional funding requested from the Commission
  - Formal contract partner, but with no additional funding
  - Informal collaboration, perhaps with provision of travel and subsistence

The task is closely intertwined with Task 2.6 aimed at addressing special needs of emerging EUROMET members whoever they are as a prerequisite to join the ERA-NET. The deadline to finalize both tasks was revised which was given by the tight schedule to get prepared for Article 169 (of the European Treaty) based activities in the EU FP7.

Extensive electronic communications were made between the Project Coordinator and representatives of the target countries on underlying matters since the beginning of the project. Some representatives of these countries attended the first workshop of the project in Ljubljana, Slovenia in October 2005, specifically from Austria, Croatia, Hungary, Ireland, Portugal, Serbia & Montenegro, Spain and Turkey. During the Ljubljana workshop, next steps were discussed between the task team and the target countries resulting in a decision to organize a joint workshop to fix matters for both Tasks 2.6 and 2.9. This Emerging Countries Workshop took place in Prague, Czech Republic on March 8 - 10 and the whole one-day session was devoted to the Task 2.9 matters. Representatives from the following countries/NMIs were invited to attend: Poland, Norway, Slovakia, Turkey, Belgium, Croatia, Austria, Portugal, Lithuania, Ireland, Spain, Israel, Bulgaria, Serbia-Montenegro, Hungary, Malta, Luxemburg, Slovenia, Cyprus, Romania, Greece, Estonia, Czech Republic. Of the invited countries, only Portugal, Israel, Luxemburg, Cyprus and Greece did not attend. Latvia and Iceland had indicated that they were not ready to join even the activities under Task 2.6.

Under the project, a number of special facilities in the old member countries have been made opened to the iMERA community – ways should be explored of how to facilitate their use by young scientists from emerging countries through structural funding, e.g. by a partial support of the corresponding Travel and Subsistence costs (T/S). Additionally, there was unanimous support for the concept of Knowledge Transfer projects under any Article 169 initiative such that modest funding could be used to provide support for engagement with - on a project by project basis - NMIs from EUROMET countries that are not formally able to join the Article 169 based EMRP – unfortunately, this has not eventually materialized (CEC has preferred excellence of research in the entire programme).

The best way forward for the community of emerging countries to get prepared for collaborative R&D in metrology should be based on the following two-tier approach:

- to be kept properly informed about the course of development in underlying matters
- to provide modest funds to continue supporting T/S costs to attend crucial meeting of the project through prudent management of the existing budget.

The cost/benefits of formal iMERA project contract amendment for inclusion metrology NMIs that were not participating as formal partners in the iMERA did not make sense, particularly as there were no longer available funds from the Commission (the last call under FP6 was in autumn 2005).

All the objectives of this task of a more housekeeping nature to the whole project have been fulfilled.

## Conclusion

Of the 33 EUROMET/EURAMET countries 14 formally participated in iMERA. Engaging with the metrology NMIs that were not participating as formal partners in the iMERA contract, particularly those from countries whose metrology systems are still emerging, required a 2-tier approach:

For iMERA itself:

- the decision was taken that the cost/benefits of formal contract amendment to add new partners, with all of the contractual obligations, did not make sense, particularly as there are no longer available funds from the Commission (the last call under FP6 was in autumn 2005).
- interested parties were kept properly informed about the course of development in underlying matters;
- modest funds were provided support T/S costs to attend crucial meeting of the project through prudent management of the existing budget.

Additional countries that have the capability, which expressed an interest and were prepared to accept the obligations, were invited to join the specific mechanisms related to research funding (ERA-NET Plus and Article 169). A total of 19 countries participated in iMERA-Plus and 22 (at the time of writing) in the Article 169 initiative.

### **2.3.8 Task Group – KT, IPR and Ethical Issues**

#### **Objectives**

This Task Group addressed three different aspects, which while not core to developing a new structure for EURAMET or writing the research programme, are nevertheless important in the wider context if an integrated approach is to be realised. Task T1.4 Knowledge transfer (KT) recognised the importance of optimising KT, and had the objective of sharing and promoting best practice. Whilst Intellectual Property Rights tend not to be a major issue (most NMI research is put into the public domain) Task 2.5 had the objective of ensuring a sound approach to IP was developed suitable for large multi partner metrology R&D projects. The objective of Task 2.8 was to ensure that any ethical, gender and societal issues were identified, recognised and addressed.

#### **Work Performed**

##### **T1.4 Knowledge transfer (KT)**

Measurement knowledge transfer is a key factor in metrology's impact on modern society since better measurement is an essential component in promoting innovation, growth and welfare. KT is considered a key element in a European Metrology Research Programme since new measurement knowledge, created in research, needs to be transferred to be useful.

Metrology KT is a two-way information exchange between national metrology institutes (NMIs) and metrology stakeholders (universities, practitioners, industry, regulators). A wide variety of knowledge transfer mechanisms have evolved to different degrees in participating countries such as direct research collaboration with industry, collaborations with regulatory agencies, universities etc, "metrology clubs" - interest groups around specific topics, best practice guides, scientific publications and participation in documentary standards activities.

A European survey conducted during 2005 in iMERA of the various national approaches to transferring the knowledge generated by metrological R&D activities gave some indication of the expectations and experiences of metrology KT of European stakeholders. Of particular interest was to determine the best ways of learning about measurement and which measurement subject. In the iMERA KT survey of 2005, no great differences overall were found amongst the various metrology knowledge transfer **mechanisms** in terms of the benefit as perceived by stakeholders. Nevertheless, university training in metrology is ranked lower than say NMI research collaboration in terms of benefit of these mechanisms of metrology KT. Similarly, there are no great differences overall amongst the various **subjects** of metrology in the need as perceived by stakeholders. Nevertheless, metrology training in the emerging technologies (such as bio, nano, etc) and in societal needs is ranked lower than say training in measurement uncertainty and quality assurance. The overall low ranking of an emerging technology is to be expected and is in line with investigations of the overall awareness of European citizens in emerging technologies such as nanotechnology, which are also typically more of a research issue than an industrial concern at the early stages of development. The survey also investigated the rating of the various metrology KT mechanisms and subjects by

stakeholders compared with NMIs. In most cases, stakeholders appeared to give higher ratings than NMIs, that is, NMIs have a tendency to underestimate the value of metrology KT.

At a one-day workshop (D1.4), held in Berlin on 1<sup>st</sup> December 2005, coordinated by the iMERA Task 1.4 KT team, presentations were made not only of the survey results but also four case studies – two NMIs and two stakeholder organisations – of metrology KT. In workshop break-out discussions, the nature of and suggested plans for metrology KT as part of the projected European Metrology Research Programme were formulated.

## Conclusions

For the future, the aim is to improve the effectiveness of metrology KT as a means of improving knowledge level of metrology in the European Union and elsewhere. Metrology KT covers a wide range of measurement needs/subjects as well a broad spectrum of KT mechanisms. For the future, the aim is to improve the effectiveness of metrology KT as a means of improving knowledge level of metrology in the European Union and elsewhere. Metrology KT covers a wide range of measurement needs/subjects as well a broad spectrum of KT mechanisms. This calls for a **specific, proactive coordinated action** of metrology KT in Europe, over and above the usual knowledge transfer attached to any project. As a result of the project, KT will take a higher prominence within EURAMET in the future.

## T2.5 Intellectual Property Rights (IPR)

The task team addressed intellectual property issues through Task T2.5. How best can one build an open innovation platform which will proactively address, clarify and utilize IP while encouraging closer collaboration in research amongst European national metrology institutes (NMI), EURAMET and the future EMRP?

Recommendations and tools for IP have been developed as part of the iMERA-Plus project and presented in a confidential report concerning the management of Intellectual Property under EURAMET EMRP funded projects. The final report includes recommendations about how best can one build an open innovation platform which will proactively address, clarify and utilize IP while encouraging closer collaboration in research amongst European national metrology institutes (NMI), EURAMET and the future EMRP. The aims of IP management in EMRP are discussed, IP terms and their implementation are discussed, and a recommended set of EMRP IP Terms proposed. The role of EURAMET is discussed along with provision of guidance to project participants – tools for project participants are provided (template agreements, IP code of conduct).

After an initial data gathering exercise including a survey of IP at European NMIs, a number of recommendations on IP Management have been formulated, comprising the documents:

- IP Management Recommendations for EMRP Projects
- Proposed IP terms for EMRP projects
- Code of Conduct for EMRP project participants (including PPT presentation)

The following four outline recommendations are made in relation to IP management under EMRP projects:

- Adopt proposed IP terms in Schedule 1 as standard IP terms for all EMRP funded projects.
- Make project funding conditional on participants accepting standard consortium management terms including IP management terms.
- EMRP to provide support on IP issues to project participants who require it.
- EMRP committee to ensure that structures and resources are in place to carry out its role in relation to the IP aspects of the consortium agreement, documenting projects' progress in relation to IP, and publication of results.

The EMRP Committee and the EURAMET Secretariat will use the recommendations and documents respectively. These recommendations and their rationale are examined in more detail in the final confidential report.

Templates for IP, which can be adapted for individual project use, are:

- EMRP Materials Transfer Agreement
- Visiting Worker Agreement
- Collaboration Agreement for EMRP joint research projects

In addition a number of reference documents, such as the EU Commission's Annex II General Conditions for FP7 are available.

These recommendations and the results of the iMERA Task 2.5 were disseminated to participating NMIs along with a recommended IP Policy included in the ERA-NET Plus 'iMERA Plus' proposal under preparation.

## T2.8 Ethical Issues

The Task Team addressed ethical, gender and societal issues through Task T2.8. Reliable measurement results are important in almost every aspect of our daily life, ranging from fundamental science, through industrial quality assurance, global trade to health, safety and Quality of Life. It is therefore natural to examine both the benefits and potential risks associated with metrology in ethical and societal terms. In the final report produced as part of the Task (D2.10), a number of recommendations are given aimed at handling ethical issues in the future EMRP and EURAMET:

- The EMRP should consider an interdisciplinary activity to investigate the social and ethical issues expected to arise from the development of some measurement technologies
- Consideration of ethical and social implications of advanced technologies (such as nanotechnologies and metrology) should form part of the formal training of all research students and staff working in these areas and, specifically, that this type of formal training should be listed in the European Metrology Research Programme
- Full use of co-operation and networks among the laboratory community and stakeholders (industry, authorities, etc) through, for example, committees and working groups. This ensures on the one hand those making decisions outside of the metrology community understand the importance of sound measurement data (for example in setting regulatory limits of say, contaminants), and on the other that the metrology community fully understands user community concerns and issues.

This Task also included a gender study and in the final report of this part of the Task (D2.11), a number of recommendations are given aimed at **improving the gender balance** in European metrology.

Of particular interest are recommendations addressing the:

- Gender aspects of career development in iMERA project partners' organisations, including about 20 national metrology institutes and government ministries throughout the European Union.
- Review of gender issues and equal opportunities policies in R&D at EU level, with a specific focus on science, including the position of women in science, barriers facing women in science and actions adopted across Europe to counteract the trend.

These recommendations are to be suitable for inclusion in the plan for tackling gender issues in the EMRP and the activities of the legal entity EURAMET e.V.

## Conclusion

The objectives of the task group addressing were met. The activities have provided useful input and guidance as the European metrology initiative moves forward, including the provision of templates etc. and have guided thinking specifically on IPR policy etc.

### **2.3.9 Task Group – Measuring R&D Impact**

#### **Objectives**

This Task Group focussed on Task T1.5 Measuring the impact of the national metrology R&D programmes in Europe.

The main objectives were: to survey the processes used in the participating countries to identify and measure the impact of their national metrology programme R&D activities; to identify opportunities for the practitioners to share knowledge and improve the national processes; and to hold a workshop on metrology impact assessment. Sample short “success story” leaflets were to be produced that highlight the impact of European metrology

The task was extended to allow a deeper consideration of the issues.

#### **Work Performed**

##### **State of the Art at the start of the project**

It is one of the explicit aims of the iMERA project to increase the impact of metrology R&D in Europe by increasing the cooperation amongst National Metrology Institutes (NMIs). The relevance of impact measurements, and the need for “success stories” proving the relevance of the metrology R&D, is broadly recognised by the NMIs in Europe. Impact measurement of R&D projects is seen to serve both as a justification of finished projects as well as a tool for prioritisation of new project proposals (see also iMERA Task 1.3).

At the start of the iMERA project, a questionnaire was sent around to all partners in order to gather the opinions on and experience with the measurement of the impact of metrology R&D. The findings of this questionnaire are summarised in a report (deliverable D1.5).

An overall finding of the questionnaire is that the measurement of socio-economic impact of metrology R&D projects is hardly performed. One of the main reasons is the lack of suitable tools for quantitative measurement of economic impact and impact on quality of life. As a consequence, impact measurement is mainly limited to more *indirect* impact parameters like scientific output, international cooperation, and knowledge transfer. The main finding of the inventory is that *there is a large gap between the desire for metrology R&D impact measurements and the availability of adequate methods for actually doing this.*

##### **Workshop on metrology R&D impact assessment**

In order to make a step forward towards better metrology R&D impact measurement in Europe, a well-attended workshop was held with all iMERA partners held in Torino, Italy, on 25 October 2006 (deliverable D1.8).

First of all, the participants of the workshop – especially the government representatives – again emphasized the necessity of metrology R&D impact measurement. The presentations given at the workshop clarified that impact studies resulting in clear “success stories”, presented in a widely understandable ‘socio-economic language’, are most convincing in showing the relevance of metrology R&D and in proving that the money in this research is well spent.

In the afternoon breakout session of the workshop four different practical approaches to metrology R&D impact measurement were discussed:

- case studies
- industry area or sector approach
- overall review of metrology R&D impact

- impact of fundamental metrology research

Each of these approaches appears to have its own merits and demerits, which were extensively discussed by the workshop participants. It was concluded that each of the four approaches discussed in the workshop should at least be considered within the EMRP. Another proposal was to make impact measurement a continuous activity within the EMRP, possibly best performed by a specialist working group.

### **“Success story” leaflets on impact of European metrology R&D**

Following one of the recommendations of the “impact workshop”, some experience in the actual performance of R&D impact measurement studies was gained by collecting and collating short “good news” stories of actual realised impact in several industry and metrology sectors. These stories are presented in the form of 10 impact posters (supplemented by two existing posters on metrology impact already available from NPL), since this format is felt most appropriate for non-expert audiences 2006 (deliverable D1.9).

The 12 impact posters were presented at the European Metrology Research Programme (EMRP) launch event, held in Bled, Slovenia, on 12 February 2008. They were furthermore presented in an event organised by Lower Saxony representatives in Brussels on 25 June 2008 and are placed on the EURAMET web site ([www.euramet.org](http://www.euramet.org)).

### **Conclusion**

Impact measurement is a perennial difficulty for metrology, where the impact is often indirect. Not surprisingly, all iMERA partners are highly motivated to improve the measurement of impact, since impact underpins that money invested in metrology R&D is well spent.

In this task significant progress has been made towards a more regular impact measurement activity by NMIs in Europe. Existing practices have been reviewed and shared among the partners, several new methodologies have been identified and discussed, and finally a series of “success story” leaflets have been produced. This will be a good basis for further impact measurement activities in the execution of the European Metrology Research Programme (EMRP).

Original Task 1.5 activities completed according to original schedule (month 12, deliverable D1.5). Extension work completed on schedule (month 19, deliverable D1.8; month 36 for D1.9).

## **2.3.10 Task Group – ICT Tools**

### **Objectives**

Key aspects related to information and communication technology as a tool in the ERA-NET were to be surveyed in task 1.6 identifying any obstacles to later work packages. Areas to be addressed included, but were not limited to: data exchange, databases, data quality criteria, video conferencing, data confidence and security. The establishing a web-portal was a further main deliverable.

Based on the results of the survey, task 1.6 was extended to produce a review of good practise in video conferencing to promote increase adoption of these communication tools. The extension to task 1.6 also reviewed recent advances and best practise in: internet-enabled metrology, the use of cryptographic techniques to provide Internet security and the standardisation of measurement data formats.

### **Work Performed**

Information and communication technology (ICT) is a powerful enabling tool for metrology. ICT tools control metrology instrumentation, capture and analyse data. The opportunities afforded by the rapid developments of ICT for metrology research are considerable

Harmonised Internet-based communication and information exchange potentially lowers the barriers to delivering joint research projects between European NMIs. Task 1.6 was established with the primary objective to investigate the current status of ICT tools in the across NMIs. This was required to determine whether the ICT tools adopted in the various organisations could pose obstacles to joint research projects.

A survey was designed in Task 1.6 to capture high-level information on the ICT tools and the IT infrastructure provided within the NMIs. Survey questions were targeted at IT managers, metrologists and managers. Multiple-choice questions were used with the objective of producing a quantitative assessment of the use and implementation of a range of ICT tools. The free text responses within the survey enabled qualitative analysis. The survey was conducted electronically and had 81 respondents: 54 % metrologists, 35% managers and 11% IT administrators.

Analysis of the survey provided understanding of the extent to which the current ICT tools enable effective research collaboration. The findings also revealed operational differences and gaps. The main results from that surveys were:

- ICT-tools used in European NMIs are reasonably compatible for cooperation
- General-purpose software is dominated by Microsoft products, except for software for instrument control and measurement data processing
- Remote instrument control is possible today through systems developed in some of the European NMIs, further development and standardisation is under way and will facilitate new methods of performing measurement services and collaborative research
- Full archive sharing is difficult at present due to the use of different systems and access issues, document sharing within iMERA by the web-portal works well
- Software for project management is not used everywhere, and the software solutions used are not likely to be compatible

LabVIEW from National Instruments is the most commonly used software for controlling instruments and running experiments (46%). Measurement data is processed using MS Office (40%), Labview (19%), Matlab (10%), Mathematica (7%) and other tools (25%). Most metrologists (70%) store data only in files. 52% of metrologists felt that it would be good if metrologists in Europe, within the same discipline, used the same format to store measurement results. However, only 14% felt that it would be easy to convert measurements into a common format.

The survey of IT managers revealed that different Internet security solutions were currently in operation. This provides perspective on the likely challenges to be overcome should it be required for systems at different sites to be more closely connected together.

Communication and timely exchange of information is an essential requirement for the effective delivery of joint research projects. A web-portal was implemented in support of the iMERA project. This sub-task was undertaken with the aims of: improving communication; information sharing; and fostering a knowledge community. The selected web-portal environment provided a number of collaboration tools. The web-portal was configured for iMERA by Soft Capital. The portal was launched mid-October 2006.

The usage statistics and a survey of usage were compiled in mid-March 2007. There was relatively low uptake of the usage survey 12%. However, there was overall a positive response to the implementation of the web-portal. The ability to obtain information readily was viewed to be of great benefit. The active iMERA team members primarily made contributions to the web-portal. 282 documents were posted in the resource centre. The iMERA team posted 185 documents. Approximately half of the EUROMET TC made use of the web-portal to communicate and distribute documents. 43 documents related to EUROMET TC roadmapping were deposited.

The main survey in Task 1.6 shed light upon the limited use of video conferencing tools and identified that equipment is available in several NMIs. In order to encourage the use of these facilities, an extension was added to task 1.6 to focus in on this topic. A report was compiled



covering the basics of video conferencing and the factors hindering its use. Generalised good practice guidelines were presented.

A shared awareness of best practise in ICT techniques and procedures to ensure information security and data integrity provides an important underpinning for collaborative work. Moreover there is a growing new trend to provide remote operation over the Internet in calibration and measurement services. This introduces a new range of security issues related to confidentiality and integrity of data distributed over the Internet.

In recent years, several NMIs and calibration laboratories, in Europe and beyond, have run projects in the area of Internet-enabled metrology. Within the extension of Task 1.6, specific internet-enabled metrology applications were reviewed. The report provides an introduction to this transformative technological development for wider awareness in the European NMIs. It provides a list of the most important examples of the application for Internet-enabled metrology carried out worldwide. System architectures and network topologies are described, and evaluated in terms of security risks. The advantages of flexible architecture of iMET, a generic prototype solution for secure instrument operation, were detailed.

For Internet-enabled metrology to realise its potential to generate a step-change in the automation of calibration services, many challenges will need to be overcome, primarily those of Internet security and data integrity. The state of the art in techniques for Internet security using cryptography and data standardisation was reviewed and reported. These review chapters serve as a strong primer to raise awareness in the European metrology community of these important ICT technical issues.

More specifically, the security requirements related to metrology on the Internet were described within the review. These are given in section 4.4 of the task 1.6 extension report version 1.0. Descriptions are provided of mechanisms to ensure the authentication of personnel and instrumentation and the secure transfer of data (4.5, 4.6 and 4.7 of the task 1.6 extension report version 1.0). The report highlights the findings of the project 'Selma' concerning the secure transfer and authentication of measurement data from household electricity meters.

The European metrology community recognises that the current operational tendency is to save measurement data in many different formats. This is acknowledged as creating inefficiencies. The review outlines the fundamental requirements for data format standards for measurement data. The existing standards being developed worldwide are reviewed. The conclusion from these projects was that XML provides a number of techniques and applications that can be used for curation of measurement data, certificate data and calibration history data. A view has been taken that the development of new numerical data analysis applications would be a key driver for forcing the data standardisation.

## **Conclusion**

Overall the publication of the main survey information and analysis delivers a reference resource for the community. This was the main deliverable of Task 1.6. The findings can serve to influence and shape in joint research projects: for example communication plans; project management; improve research information exchange and knowledge dissemination. In addition, the report made recommendations of improvements and refinements that could further enhance cooperation. The recommendations prompted an extension of the task to deliver a review Internet-enabled metrology, the use of cryptographic techniques to provide Internet security and the standardisation of measurement data formats. Good practise guidelines in the use of video conferencing tools were produced.

The implementation of the web-portal facilitated information sharing during the iMERA project.

Fundamental challenges to the current ICT tools were also identified. In particular the prevalence of the use of Microsoft was highlighted. With advocacy in the EU in favour of open source software being adopted by the public services, consideration of compatibility between applications is central to joint research between NMIs. Therefore, the survey acts a strong evidence base for ICT development strategies and policies for upgrades. The survey reveals the impact that changes may have on joint research activities.

Recent advances in ICT have the potential to deliver significant new opportunities for the metrology community. Addressing Internet security and data standardisation will be key to rapid adoption.

### **2.3.11 Task Group – Beyond Europe**

#### **Objectives**

Working through Task Group T2.7 “Beyond Europe”, the overall objective of this task was to ensure that we accommodate the international aspect of metrology. The EUROMET/EURAMET community principally operates internationally through the 52 country strong Metre Convention. The task team was set the challenge of determining whether collaboration beyond the boundaries of Europe is appropriate for major metrological R&D challenges such as nano-metrology and food safety.

#### **Work Performed**

Since the purpose of the iMERA project is to adapt European Metrology R&D to perform more efficiently and to be organized so that it operates as an Article 169 institution, it does not immediately lend itself to involvement by third countries. International interest in the project has been focussed through presentations at conferences, as well as through participation as observers at workshops and seminars. There have been more than 30 events of this kind. The dominant third party is the US, as well as the regional metrology organizations, SIM and APMP. The promotional activities addressing countries beyond Europe were recorded.

Third countries provided useful insight at key outward facing iMERA meetings.

- The working group and technical committee meetings held alongside and including the Ljubljana Foresight workshop 19-20 October 2005 was attended by representatives from NIST (US), NMIA (Australia), CARDS (Croatia), ZMDM (Serbia and Montenegro) and UME (Turkey).
- The Emerging Countries meeting in Prague meeting on 8-10 March 2006 was attended by representatives from DZM (Croatia), ZMDM (Serbia and Montenegro) and UME (Turkey).
- The Impact workshop held in Turin on 25th October 2006 was attended by UME (Turkey).

A policy on international collaboration for the iMERA project was developed: *The iMERA project should keep an open information policy towards interested parties outside Europe, as long as the legitimate confidentiality is not infringed. In particular, foreign participation in research projects, training, special facilities, and meeting should be encouraged, subject to the consent of all involved partners.*

This policy has been adopted, and a number of the projects in the iMERA Plus spin out contract have collaborations beyond Europe.

A Memorandum of Understanding was negotiated between EURAMET and NIST (USA) and signed in February 2008. The activities within iMERA have developed a legally acceptable basis (“exchange of letters”) to enable transatlantic collaboration between EURAMET JRP’s and NIST.

The effort to promote common use of special facilities spurred some interest from third countries, when the facilities in question were globally “special”. However, only a few of these matured into actual sharing of facilities. This was due to practical issues such as travel funding and prior commitments of the interested parties: problems that were amplified by the short period of time that was given to this activity.

## Conclusion

The iMERA project has attracted general interest beyond Europe. Training, research projects of global relevance and the concept of open special facilities are of greatest relevance to organisations and countries beyond Europe.

However, practical and logistic issues have prevented third party participation at a significant scale. This experience is reflected in iMERA Plus, and is likely to appear in the Article 169. Whilst the iMERA team would not have been adverse to the development of say, grant funding, for participants beyond Europe, it is clear that this could simply raise expectations that could not be fulfilled.

### **2.3.12 Task Group – Consortium Management, Governing and Dissemination,**

This Workpackage has proceeded well, there have not been any major problems with management or governance, and relations between partners have been good throughout the project. All deliverables were on time (the project extension was due to changes in the Commission timing rather than due to any delay inside the project), and the project was delivered on budget. At the end of the project 8 additional countries joined the initiative under Article 169, over and above all the original 14 countries that are partners in iMERA. Based on this evidence it is fair to claim that the management and governance of this very complex project has been successful.

### Objectives

This Task Group covered a variety of tasks led by NPL the iMERA Coordinator, with the objective of ensuring the sound management and governance of the project, including two crucial Go / No-go decision points, and dissemination of the information to stakeholders. An additional task in this group had the objective of bringing the metrology research programme owners and programme managers together across Europe creating a community, for the first time.

### Work Performed

The Network Management Committee (NMC) has managed the project effectively, to time and budget. This NMC was led by the project coordinator and made up of the other Task Group Leaders, and handled the task management of the project. The NMC met at 6 monthly intervals during the project lifetime. Decisions related to the project overall were made by all consortium partners (most but not all being task leaders).

Additionally a Network Steering Committee was established composed of 8 senior Ministry or Ministry/NMI representatives (typically Director level), again, chaired by the project coordinator. The NSC met on a number of occasions and provided top level steering and oversight, including advice to the project coordinator. In the later stages with the iMERA project supporting the longer term Article 169 the EURAMET EMRP Committee effectively took over many aspects on the non-contractual governance role for issues going beyond the end of the project.

A high level of dissemination has been maintained throughout the project, ranging from many presentations and published articles on the project itself, to consultation with stakeholders, to the creation of an on line “blog” facility for the metrology roadmaps (access requires registration, but is open to all and free, see <http://www.technology-roadmaps.eu> ) which has attracted more than 10 000 views.

Historically, prior to the iMERA project, whilst the NMIs had lots of contact it has not been in the context of managing their R&D portfolios, with few or no discussions between those responsible for metrology R&D programme management. The ministries across Europe had no prior contact at all in relation to their role as “owners” of the metrology R&D programmes. Indeed in many cases they would not even have been able to name their opposite number ministries in other countries. In task T2.2 a single community was created for those responsible for identifying and funding metrology R&D priorities and for those responsible for managing programmes. This task is one of the most crucial, and has been one of the most successful, in the iMERA project. Significant changes in the ways of working in Europe and the realistic possibility of launching a joint programme of research are dependant on building a common view across Europe supported by both the NMIs and the

ministries that fund them. The first of two fora was in Berlin in December 2005. It was at this meeting that the ministries informally committed to the iMERA objectives, setting the positive tone for the work that followed, and started the long and complex task of assessing the adjustments necessary in the processes and practices inside the ministries to enable engaging in the joint programming activities. This progress was cemented at the second forum held in Bratislava in October 2007. Indeed the ministries recognising that the establishment of the EMRP required closer and long term sustainable interaction between the ministries decided to establish a ministry consultation group, not part of the original planning, and this group has since met on a number of occasions and is likely to do so far beyond the current project. It is interesting to note that this group do not limit themselves to topics that fall directly within the EMRP research agenda. They have discussed investments in the underpinning infrastructure, the need to explain and justify metrology budgets to non-expert audiences within government, prioritisation and governance issues that are common. International exchanges as part of national assessments (either in structures or national programmes) has increased as a result of this interaction (examples include the appointment of non UK experts to the UK metrology programme advisory groups).

Dissemination activities of major note include an EMRP event held in Brussels, and a presentation to the European parliament's ITRE Committee late in the project. . Information was provided more widely to Parliamentarians and other personnel from the European institutional through publication in the 2007 and 2008 DODS EUROSOURCE.

Additionally partners undertook various dissemination activities at national level, including informal and formal meetings with their ministries and European Parliamentarians, plus the presentations and papers identified in Annex 1 to this report. Amongst the metrology community the project has organised/hosted some 300 plus meetings and workshops, published at least 45 articles, papers and presentations, and through some 40 plus conferences and information events presented to over 10 000 people.

A dedicated portal was established early in the project, primarily to provide a private work area for the partners. The web portal remained fully operational as the basic resource management tool for the project until the end of the project with the project records and information transferring to the EURAMET website as an ongoing resource and archive. By month 45 the portal included some 65 news items, 749 documents, almost all of which have been generated within the project, 75 separate user groups and over 200 members.

*And Finally...*

The project coordinator would like to thank the project partners, the staff at the European Commission and the International Office team at NPL, to acknowledgment their dedication and commitment to the iMERA project and the wider European metrology initiative, which has been of the highest order thought the project lifetime.

## **End Results & Impact**

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The iMERA project fulfilled its objectives fully. It has transformed the way publicly funded metrology research and development is addressed in Europe. The project developed and implementing a new way of working, the NMI community supported by their ministries and the European Commission now brings its collective abilities and resources to bear on the major issues of the 21st century. This is far from the starting point, when similar but disparate individual national programmes struggled alone to try to tackle every problem and challenge, often without sufficient staff or funding. The vehicle for this change has been the European metrology collaboration, at the beginning of iMERA operating as an informal grouping, now revamped and re launched as EURAMET e.V., a not for profit legal entity. With structures appropriate to take on large-scale programme management in addition to its inherited role as the European Metrology Research Organisation under the Metre Convention, EURAMET is well placed for the coming decades.

At a pragmatic level the IMERA project has created the environment for change. The project led the development of the joint European Metrology Research Programme and addressed the many supplementary issues needed for success. It has spun out Phase I of the EMRP under iMERA Plus, a 64.6 M€ ERA-NET Plus contract with 21 the independently evaluated research projects selected and launched, all making good progress. The iMERA project led the development and has paved the way for Phase II of the EMRP under a multi year Article 169, a programme of 400 M€, total value, with the formal Commission proposal is making good progress within the Council of Ministers and European Parliament. There is every reason to be optimistic; a decision is possible in June 2009 with the programme launch before the end of 2009.

Ultimately the benefits for the European economies and for the citizens of Europe do not come from reorganisations. It is the efforts and excellence of the metrology researchers that will help improve the competitiveness of European industry, and the quality of life of the peoples of Europe. The metrology researchers now have structures, and tools to be go further, faster. Providing the Article 169 is successful, they will have the funding to fuel them along the way.

The iMERA project has lived up to its name, “implementing metrology in the European Research Area”.

### 3 DISSEMINATION AND USE

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A high level of dissemination has been maintained throughout the project, ranging from many presentations and published articles on the project itself, to consultation with stakeholders, to the creation of an on line “blog” facility for the metrology roadmaps (access requires registration, but is open to all and free, see <http://www.technology-roadmaps.eu> ) .

Dissemination activities of major note include an EMRP event held in Brussels. Additionally information was provided more widely to Parliamentarians and other personnel from the European institutional through publication in the 2008 DODS EUROSOURCE.

Additionally partners undertook various dissemination activities at national level, including informal and formal meetings with their ministries and European Parliamentarians, plus the presentations and papers identified in the Final Plan for Using and Disseminating the Knowledge. Amongst the metrology community the project has organised/hosted some 300 plus meetings and workshops, published at least 45 articles, papers and presentations, and through some 40 plus conferences and information events presented to over 10 000 people.

The project also attended the EU Institutional Open Day in June 2008 in Brussels attended by many thousands of people, providing a stand to bring the importance of measurement to the attention of the public. A laser height gauge provided a focal point, offering the public the chance to have their height measured to unprecedented accuracy!

Additionally the project updated and expanded an earlier publication “Metrology – in short” creating a 3rd edition, and including the new European metrology infrastructure and more detail on the impact of metrology. By the end of the project request had been received and granted for the translation and free distribution in 8 further languages from interested bodies worldwide.

A dedicated portal was established early in the project, primarily to provide a private work area for the partners. The web portal remained fully operational as the basic resource management tool for the project until the end of the project with the project records and information transferring to the EURAMET website as an ongoing resource and archive. By month 45 the portal included some 65 news items, 749 documents, almost all of which have been generated within the project, 75 separate user groups and over 200 members.

Further information on European metrology is available at [www.euramet.org](http://www.euramet.org).