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EUROMET – THE EUROPEAN METROLOGY INFRASTRUCTURE

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Abstract: Today's and tomorrow's globalised economy and societal demands ultimately require a globally recognised measurement system and an intensified regional collaboration in metrology. These are corner stones for the mutual recognition of standards and certificates and hence for the acceptance of each other's capabilities, competence, traceability of measurements to the International System of Units and of the quantitative results themselves.
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1 INTRODUCTION

Measurement systems and infrastructures were always of high economic and public interest - at local, regional or global levels. For example some 125 years ago, on the 20th May 1875, in Paris 17 nations signed the Convention of the Metre. Within this framework the well known International System of Units (SI) [1] was developed, a system now implemented around the globe and serving as **the** ultimate stable reference for any kind of quantitive observation or measurement required in research, production, trade, health, environment or security.

The effort to maintain, develop and apply this system in the public and private sector is considerable. This is due to the fact that correct measurements have a widespread impact in our world. Each national government has therefore taken responsibility for its national measurement system in various ways. Most commonly, national metrology institutes (NMIs) were established during the decades before and after the conclusion of the Convention of the Metre. Their main task was to realise and maintain the national standards, and to disseminate these quantities within the country according to the needs of society and the economy. These needs have developed since, as have science, technology, production and economy in general.

In October 1995 the 20th Conférence Générale des Poids et Mesures (CGPM) requested the Comité International des Poids et Mesures (CIPM) to undertake a study on the long-term national and international needs related to metrology, the current level of international collaboration in metrology and the role of the Bureau International des Poids et Mesures (BIPM) itself. The study has been completed and the ensuing report "National and international needs relating to metrology" [2] was adopted by the 21st CGPM in October 1999. The report recognises the increasing importance of collaboration between NMIs and the role of Regional Metrology Organisations (RMOs) which complement the existing metrology structure.

This paper describes the effort undertaken within Europe during the last 25 years to meet the newly emerging needs. It illustrates the development of an intensive co-operation within EUROMET, the European Collaboration in Measurement Standards. The role of Regional Metrology Organisations such as EUROMET will be dramatically enhanced through a Mutual Recognition Arrangement (MRA), signed in October 1999, which sets the international framework for the mutual acceptance of national measurement standards and calibration and measurement certificates issued by national measurement institutes [3]. This paper will go on to outline the implementation of the MRA within EUROMET.

2 PROGRESS THROUGH COLLABORATION

For a long time and as a consequence of the Convention of the Metre and its long-term objectives, the NMIs of Member States and the BIPM have been collaborating at the level of primary and national standards. This has mainly taken place under the auspices of the CIPM and its Comités Consultatifs (CC). During the second half of the 20th century NMIs together with the CIPM and BIPM have developed and implemented a system of units and measurement standards based as far as possible on fundamental or atomic constants. During the same period industrial and scientific demands for the services provided by NMIs have increased significantly and have generally led to an extension of these institutes and their activities.

In parallel with the formation of regional economic structures, NMIs have been setting up their own frameworks of collaboration with the purpose of increasing and optimising their overall performance

and impact. In Europe, this started in 1973 with the Western European Metrology Club (WEMC) [4], an informal collaboration among NMIs within the economic areas of the European Community and the European Free Trade Association. This led in 1987 to the creation of EUROMET, a more extended collaboration among NMIs based on a Memorandum of Understanding (MoU) [5].

- Developing of a closer collaboration between Members in the work of measurement standards within the present metrological structure.
- Optimising of the utilisation of resources and services of Members and emphasis of the deployment of these towards perceived metrological needs.
- Improving of measurement services and making them accessible to all Members.
- Ensuring that the national facilities developed in the context of EUROMET collaboration are accessible to all Members.

Figure 1. Aims of the EUROMET collaboration.

3 DEVELOPMENT OF EUROMET COLLABORATION

Since the signing of the EUROMET MoU a significant increase in metrology collaboration in Europe has taken place. This has happened to a far greater extent than anybody at the time would have expected. More than ever before, contacts and exchange of know-how have emerged among specialists of the Member NMIs, the European Commission as well as of NMIs from outside of EUROMET. In addition, the number of Signatories has increased to 25 including NMIs from Central Europe, as shown on the map below (Figure 2).

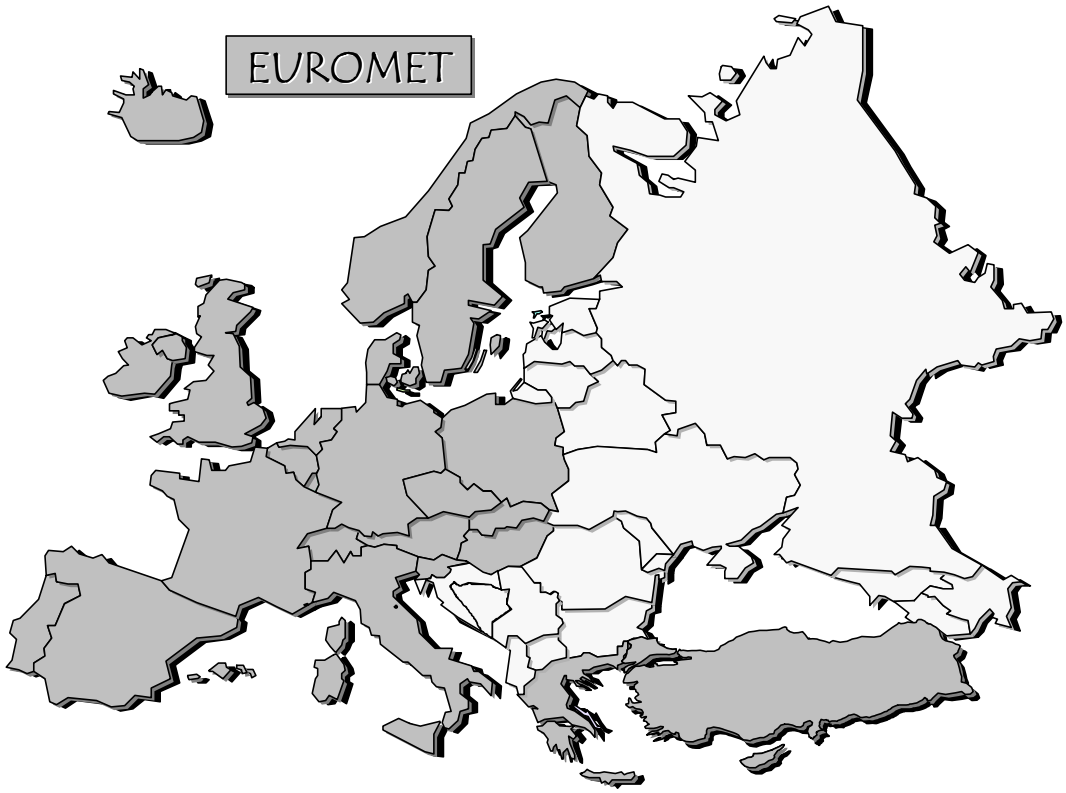

Figure 2. EUROMET Member States as of February 2000 (dark grey colour).

EUROMET now has 11 subject fields, chosen so as to mirror the Comités Consultatifs of the CIPM:

- Acoustics, ultrasound and vibration (Acous)
- Amount of substance (Amos)
- Electricity and electromagnetism (Elect)
- Flow
- Ionising radiation (Rad)

- Length
- Mass and related quantities (Mass)
- Photometry and radiometry (Photo)
- Thermometry (Therm)
- Time and frequency (Time)
- Interdisciplinary metrology (Intmet).

Rapporteurs, Contact Persons from NMIs and experts help manage and set-up an active, efficient framework of collaboration and promote the various projects. The EUROMET Committee (i.e. general assembly), consisting of Delegates designated by the Signatories, carries the overall responsibility for EUROMET and decides upon its own rules. A Chairman, elected from the Delegates assures the co-ordination and daily business, and is assisted by a Secretary, usually from the Chairman's NMI. A Consultative Committee, elected from the Delegates, works with the Chairman in between EUROMET Committee meetings (figure 3 below).

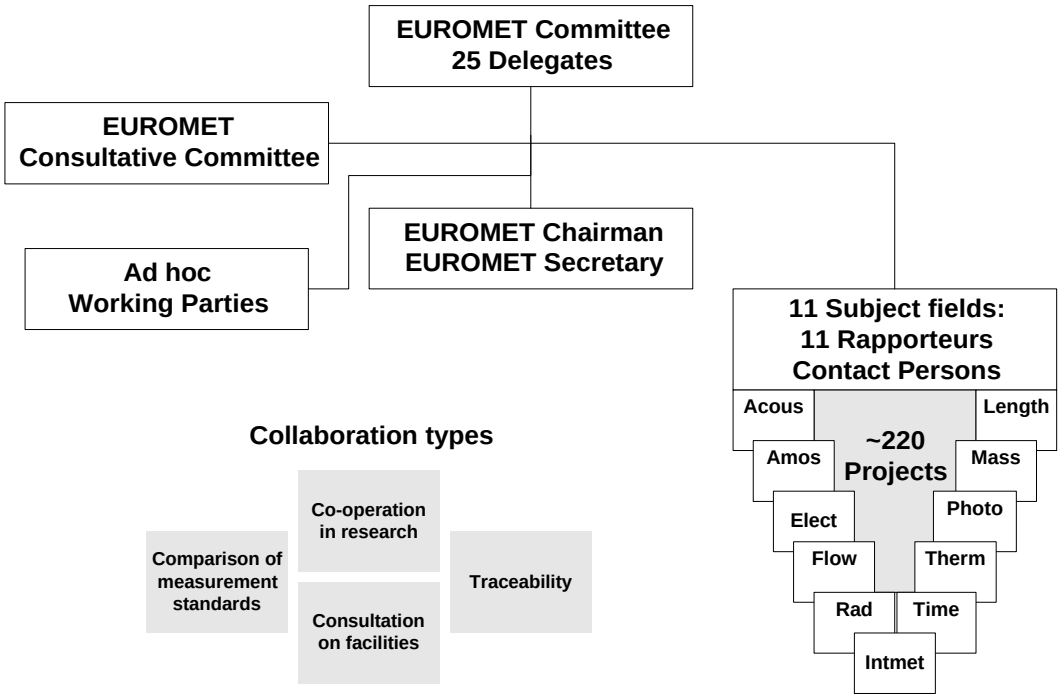

Figure 3. Overview of the EUROMET organisation and the types of collaboration.

Based on the MoU, EUROMET has classified its collaboration in four different types, each of them assisted by guidance documents. *Co-operation in research* is occupied with new scientific phenomena with the potential of leading to new, and in general primary measurement standards. During the last decade on the average 50 projects a year have been active in this field.

Comparison of measurement standards consists to a great extent of comparing national standards, either at the primary or the secondary level. It helps the member NMIs regularly to check and characterise their realisation of the units and to examine equivalence. Since 1992 the number of comparison projects has risen from 30 to 116. The most significant increase has been since 1997, due to the upcoming Mutual Recognition Arrangement. In this context, we expect that the large number of so-called Key Comparisons, defined by the CIPM's Consultative Committees together with the EUROMET supplementary comparisons, may well exceed the number of ongoing comparison projects.

Traceability projects link secondary standards at one NMI to the primary one of another NMI and hence to the SI. Around 30 projects of this type were active over the past few years.

And finally, *Consultation on facilities* provides advice, help and support for the setting-up and running of metrology laboratories at the national level. In this category the number of active projects varied between 11 and 23 over the last 9 years.

Figure 4 below exemplifies the intensive metrology collaboration in Europe. Although the number of projects is not the only measure of the effort undertaken, the bar graph gives some impression of the size of the 11 EUROMET fields and their activities. On the average, every EUROMET member is involved in 60 projects. Larger NMIs are even occupied with up to 150 projects at any one time.

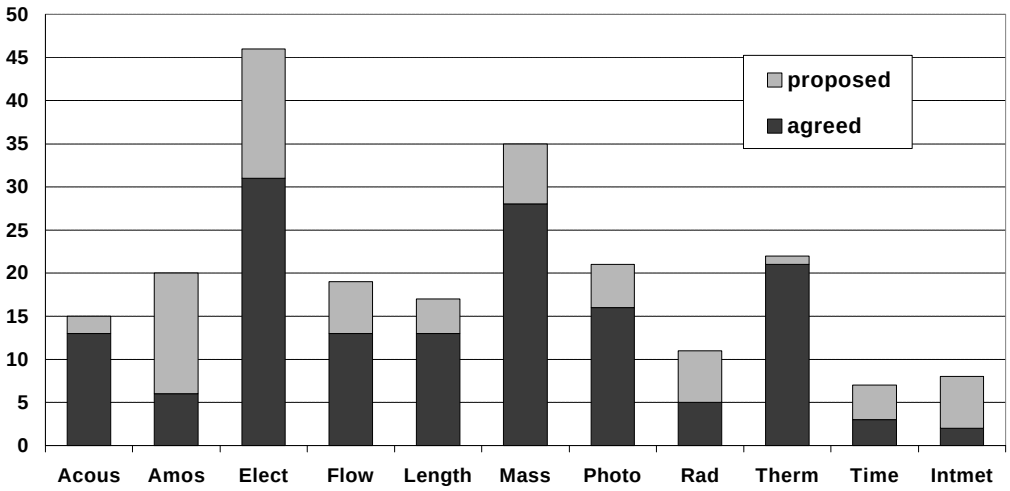

Figure 4. Active EUROMET projects in the various subject fields as of February 2000.

Although EUROMET has no funds of its own, hundreds of metrology projects have been proposed and launched. Over 200 projects have been completed and about 220 are still active in the areas of co-operation in research, comparison of measurement standards, traceability and consultation on facilities. The character of the projects varies from fundamental experiments to explore new measurement methods and techniques to practical issues of direct relevance to customers and to their needs. Some projects were supported by programmes of the EU.

4 EXTENDED ROLE OF REGIONAL METROLOGY ORGANISATIONS

At the 3rd Conference of NMI directors of the Convention of the Metre held on the 14th October 1999 in Paris, a Mutual Recognition Arrangement (MRA) of national measurement standards and of calibration and measurement certificates issued by national measurement institutes was signed by representatives of 38 Member States and two international organisations. This MRA sets the global basis for mutual recognition and acceptance of each others' results at the NMI level thereby guaranteeing traceability to the SI for the entire calibration, testing and conformity assessment community.

The implementation of the MRA represents a major effort for the organs of the Convention of the Metre, the NMIs and the RMOs. As shown in figure 5, the latter are involved in all of the three processes which are necessary to implement and maintain the MRA:

- co-ordinating the RMO key comparisons (KC) and defining and organising supplementary comparisons of measurement standards in their region;
- reviewing the quality systems (QS) of their NMI members with respect to the MRA requirements;
- collecting and validating NMI entries to the so-called tables of Calibration and Measurement Capabilities (CMC).

In each EUROMET subject field the Rapporteurs together with their Contact Persons are in charge of co-ordinating the RMO key and supplementary comparisons as well as of the validation of the NMI calibration and measurement capabilities. A special quality forum has been set-up by the Interdisciplinary Metrology Group (Intmet) to present and examine more than 20 NMI quality systems before the end of 2001. A number of specific projects are conducted in order to break down the implementation process in manageable sub-processes and to progress at a pace compatible with the MRA schedule and which is sustainable for all institutions involved:

- Project 512 Implementation of BIPM's MRA for EUROMET member countries;
- Project 513 EUROMET criteria for establishing and maintaining confidence in other RMOs concerning the implementation of the MRA;
- Project 515 Interlaboratory comparisons of measurement standards and calibration certificates - maintaining the EUROMET comparison database;
- Project 517 Revision of ISO Guide 25 – ways of reviewing and implementing quality systems in the NMIs of EUROMET members.

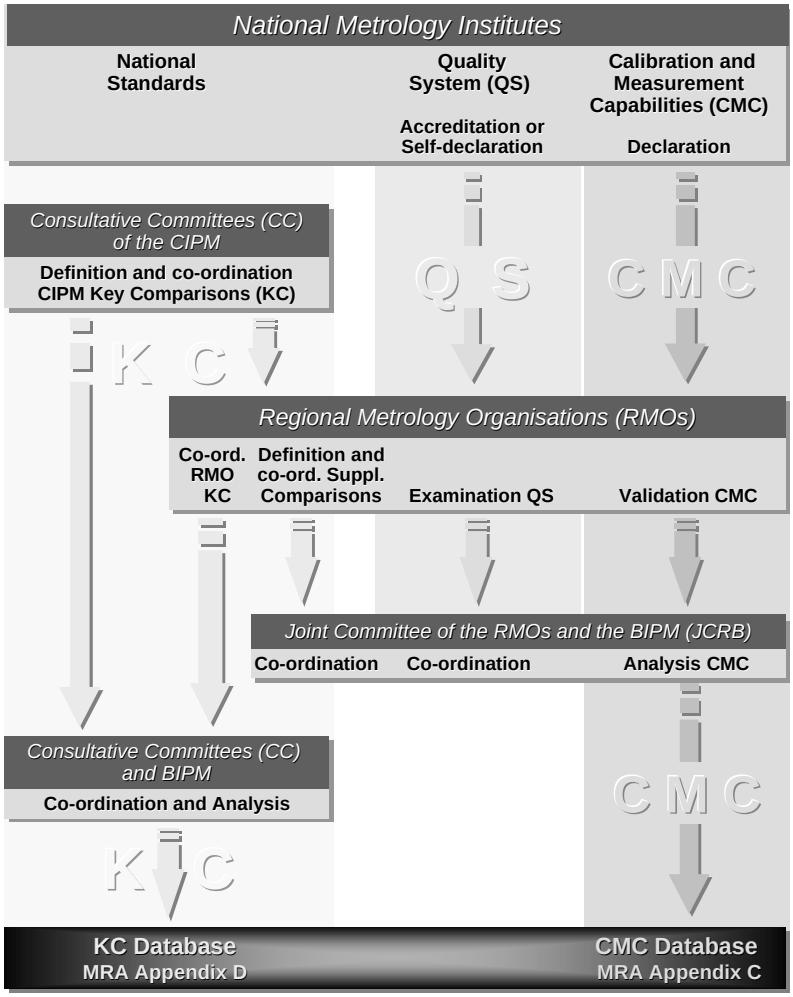

Figure 5. Overview of the processes to implement the MRA, the key comparisons (KC) and supplementary comparisons, the quality system (QS) and the calibration and measurement capabilities (CMC).

For the KC, the international metrology community may take advantage of the many comparisons conducted during the last decade and the ones started in the run up to of the MRA – in total over 100. As an immediate outcome, the corresponding results are published as the KC database by the BIPM on their website. The same is to take place by mid 2000 for the CMC database, which will include all the CMCs of all NMIs and all metrology fields which have been validated and accepted by the RMOs and the Joint Committee of the RMOs and the BIPM (JCRB).

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