Eurachem's 25th Anniversary: Two members' perspective[1]

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Eurachem was founded 25 years ago. Its prime aim, as was set out in the MoU, signed by its members, was to help establish a system of international traceability for chemical analysis. At that time there was little international activity in this topic or in the broader activities that could be classified as metrology in chemistry (MiC), in fact the concept "metrology in chemistry" was hardly in use; GUM [1] had not yet been published, but there had been a lot activity on the evaluation of uncertainty in the higher echelons of physical measurements following the publication of recommendations of the BIPM working party on "Expression of Measurement Uncertainties " in 1980. This way of evaluating and reporting uncertainty had also percolated down to other areas of physical measurement but had attracted little or no attention by analytical chemists. As a matter of fact, the CIPM only started to take interest in chemical measurement in the late eighties.

The GUM was published in 1993 based on these BIPM recommendations and it is such an important landmark in the development metrology that it is worth repeating its basic principles and the changes these engendered. Previously most of the discussion and reporting of accuracy had been based on the concept of a " true value" and random and systematic errors. Since the true value is unknown and unknowable and systematic errors are difficult if not impossible to evaluate, accuracy statements were mainly based on measurement repeatability or in some cases reproducibility. GUM changed all that , as is stated in the introduction to Annex D " the concept of uncertainty in this guide is based on the measurement result and its uncertainty rather than on the concepts " true value" and error"

GUM found fairly rapid adoption for physical measurements but had received very little attention in chemical measurements before the publication of the first Eurachem /Citac guide in 1995, after which, together with pressure from the accreditation bodies, uncertainty evaluation became common practice in chemical measurements as is exemplified by its use in a large number of articles in ACQUAL.

It is strange that uncertainty evaluation was the first step in applying MiC principles, rather than establishment of traceability of measurement results, particularly since it was a primary aim of Eurachem. A workshop on "Traceability and Comparability" was held at CBNM (later IRMM) in November 1992, but it was a number of years, with much discussion and many papers [2] before the first real concepts started to be developed on how to establish traceability and the Eurachem/Citac guide was not published until 2003.

The solution turned out to be very similar to that for physical measurements i.e. establishment of traceability for all of the measured values of quantities that are in the equation for the calculation of the value of the measurand plus traceability for all of quantity values specified in the measurement procedure that do not appear directly in the measurement equation.

[1] This paper is also available as Accred Qual Assur (2014) 19:55–57. DOI 10.1007/s00769-014-1040-0 (http://dx.doi.org/10.1007/s00769-014-1040-0). The content is reproduced with the kind permission of Springer-Verlag, Berlin.

In parallel with this were the equally important developments in terminology, "VIM 2" did not cover adequately chemical measurements and this was rectified in VIM 3 [3].

However evaluation of uncertainty and the establishment of traceability, while necessary, are not sufficient to ensure the quality of the analytical result. In its MoU Eurachem stated that it would promote

- an awareness of quality problems;
- quality assurance strategies;
- validated methods;
- traceability through reference materials;
- proficiency testing.

Eurachem has Working Groups on all these topics (see Annex 1) and other activities associated with quality in chemical analysis. The Working Groups have run a number of international workshops, provided training courses and published a number of guides. A list of these guides is given in Annex 2, all of these guides can be downloaded from www.eurachem.org free of charge.

A major advantage of Eurachem is that it has member organisations in most of the countries in Europe. This means that not only can it draw on experts from laboratories throughout Europe for its WGs but also the member organisations can run Workshops and training courses in their own language utilising the Eurachem Guides. They have translated some of these guides into there own language, e.g. the Uncertainty Guide has been translated into 7 languages and recently into Japanese!

It was realised early on that it was desirable to have similar organisations outside of Europe to collaborate with and initiatives were taken that led to the setting up of CITAC and CCQM. The collaboration with CITAC has been very fruitful. With joint CITAC and Eurachem Working groups it has widened the input and the utilisation of the Guides.

The establishment of CCQM, which held its first meeting in September 1995 was a major step forward, it was set up with the following terms of reference

- to advise the CIPM on matters relating to the traceability to the SI base units of quantitative chemical measurements;
- to co-ordinate the activities of the national metrology laboratories in establishing this traceability at the highest level;
- to keep under review the question of whether there is a need for a programme of work at the BIPM to support this activity.

This is now one of the most active Consultative Committees and has an ongoing programme of key intercomparisons of primary international measurement standards. It also led to many National Measurement Institutes starting programmes on chemical analysis.

Another important development was the request by SPRINGER to one of the authors of this paper, (PDB – 2nd Chair of EURACHEM) as well as Helmut Günzler) to start and lead ACQUAL. The Journal "Accreditation and Quality Assurance", a title which was given a subtitle from Eurachem side (by the two authors of this paper): "Journal for Quality, Comparability and Reliability in Chemical Measurement". This has proved to be a very effective vehicle for the promotion of quality in analytical measurements.

A recent development has been the inclusion of target measurement uncertainty (VIM 2.34) as part of the measurement requirement. The publication of the Eurachem guide "The use of uncertainty in establishing compliance" showed how the uncertainty together with the decision rule is used to assess

compliance with the specification and therefore target measurement uncertainty is indeed a very important measurement requirement.

Good progress has been made in applying metrological principles [4] to analytical measurements but problems still remain. Basically measurement consists of comparing the value of the quantity to be measured to a known value of the same quantity. However due to problems with extraction and matrix effects, a potentially large uncertainty must be accepted, which can be difficult to evaluate. Specialized techniques such as isotope dilution mass spectrometry being much less sensitive to systematic effects in measurement can overcome these difficulties but these are too complicated and expensive for many routine measurements.

In addition, IRMM's "TrainMiC" [5] programme has generated a few thousand lecturers all over Europe and indeed over the world, who received basic education on MiC enabling them to disseminate good basic principles and procedures to perform chemical measurements conforming with sound metrological rules

As part of the 25th anniversary celebrations an international workshop on "Quality in Analytical Measurements" is being held in Lisbon on 19 to 21 May 2014 and will cover most of the areas in which Eurachem has been and still is active. The workshop will look at the whole of the measurement process starting with the defining of the measurand right through to reporting and interpreting the measurement result. In addition to plenary sessions and contributed papers there will be breakout sessions tasked with identifying areas where problems remain.

Further details are given on http://www.fc.ul.pt/conferencia/eurachem-2014

What is lying on Eurachem's doorstep for the 21st century ?

There will be a continuing and increasing need for guidance on the use of concepts and their definition in MiC, as a contribution to global understanding in the field. This is very much needed in view of the fact that other cultures with totally different language structures have become prominent partners in global trade, which has increasingly become dependent on chemical measurements in food, feed and drinks. Also, the need for consistency of clinical and environmental chemical measurement results worldwide is becoming urgent (in the implementation of environmental regulations as well as in the dramatic increase of global tourism with the ensuing needs for clinical –chemical measurements). There are a number of bodies that will be involved in this including CCQM, CITAC and IUPAC to name just a few and there will be a role for Eurachem as well.

Accreditation will play a major part in all of this and there will be need for technical guidance for assessors worldwide to understand and implement in the same way all the concepts and terms we use in analytical measurement.

A topic, which we hope will result from the Workshop in Lisbon, is to identify the areas in the measurement process where quality failures are likely to arise and provide guidance on overcoming them.

In short: whilst much has been done, more is needed in this fast-changing world.

Annex 1: Eurachem guides

The Fitness for Purpose of Analytical Methods: A Laboratory Guide to Method Validation and Related Topics (1998)

Harmonised Guidelines for the Use of Recovery Information in Analytical Measurements (1998)

The Selection and use of Reference Materials (2002)

Guide to Quality in Analytical Chemistry: An Aid to Accreditation (2002)

Accreditation for Microbiological Laboratories (2002)

Traceability in Chemical Measurement (2003)

Measurement uncertainty arising from sampling (2007)

Use of uncertainty information in compliance assessment (2007)

Selection, Use and Interpretation of Proficiency Testing (PT) Schemes by Laboratories (2011)

Terminology in Analytical Measurement: Introduction to VIM 3 (2011)

Quantifying Uncertainty in Analytical Measurement, 3rd Edition (2012)

Annex 2: Current Working Groups

Education and Training

Measurement Uncertainty and Traceability

Proficiency Testing

EEE Proficiency Testing - "Proficiency Testing in Accreditation"

Qualitative Analysis

Uncertainty from Sampling

Method validation

References

1 Guide To The Expression Of Uncertainty In Measurement. ISO, Geneva (1993). (ISBN 92"67"10188"9) (Reprinted 1995: Reissued as ISO Guide 98"3 (2008), also available from http://www.bipm.org as JCGM 100:2008)

2 De Bièvre P, Dybkaer R, Fajgelj A, Hibbert B (2011) Metrological traceability of measurement results in chemistry—concepts and implementation. Pure Appl Chem 83:1871–1933.http://iupac.org/publications/pac/83/10/1873

3 BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML (2008/2012), International vocabulary of basic and general terms in metrology - VIM, basic concepts and implementation, Edn 3, JCGM 200:2012; see http://www.bipm.org/vim: also see Guide ISO 99 (2012)

4 P De Bièvre (2011) Looking back at two decades of "Metrology in Chemistry", Accred Qual Assur 16:591-596

5 www.TrainMiC.org