Accred Qual Assur (2014) 19:55–57
DOI 10.1007/s00769-014-1040-0

INTERNATIONAL BODIES

Eurachem's 25th anniversary: two members' perspective

Alex Williams · Paul De Bièvre

Received: 24 January 2014 / Accepted: 5 February 2014 / Published online: 26 February 2014

Eurachem was founded 25 years ago. Its prime aim, as was set out in the Memorandum of Understanding (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 field that could be classified as Metrology in Chemistry (MiC); in fact, the concept "Metrology in Chemistry" was hardly in use. The "Guide to the Expression of Uncertainty in Measurement" (GUM) [1] had not yet been published, but there had been a lot of activities on the evaluation of uncertainty in the higher echelons of physical measurements following the publication of recommendations of the International Bureau of Weights and Measures (BIPM) working party on "Expression of Measurement Uncertainties" in 1980. This way of evaluating and reporting uncertainty had also percolated to other areas of physical measurement but had attracted little or no attention from analytical chemists. As a matter of fact, the International Committee for Weights and Measures (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 of 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 adopted in this guide is based on the measurement result and its evaluated uncertainty rather than the unknowable quantities "true" value and error."

GUM found fairly rapid adoption for physical measurements. However, it had received very little attention in chemical measurements before the publication in 1995 of the guide "Quantifying uncertainty in analytical measurement" by Eurachem and CITAC (Cooperation on International Traceability in Analytical Chemistry), after which, together with pressure from the accreditation bodies, uncertainty evaluation became common practice as is exemplified by its use in a large number of articles in this journal.

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 is the latter that was a primary aim of Eurachem. A workshop on "Traceability and Comparability" was held at the Central Bureau for Nuclear Measurements (CBNM, later the Institute for Reference Materials and Measurements (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 "Traceability in chemical measurement" 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

A. Williams is Chairman of the Eurachem WG on Uncertainty and Traceability; P. De Bièvre was Eurachem Chairman 1993–1995.

A. Williams (✉)
Camberley, Surrey, UK
e-mail: aw@camberley.demon.co.uk

P. De Bièvre
Kasterlee, Belgium

equation for the calculation of the value of the measurand plus traceability for all of quantity values specified in the measurement procedure but do not appear directly in the measurement equation.

In parallel with this were the equally important developments in terminology. The second edition of the "International Vocabulary of Basic and General Terms in Metrology" (VIM 2) did not cover adequately chemical measurements, and this was rectified in VIM 3 [3].

However, the evaluation of uncertainty and the establishment of traceability, whilst 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 (WGs) on all these topics (see "Appendix 1") and other activities associated with quality in chemical analysis. The Working Groups have run international workshops, provided training courses and published a number of guides. A list of these guides is given in "Appendix 2"; all of these guides can be downloaded from the Eurachem website [4] free of charge.

A major advantage of Eurachem is that it has member organisations in most of the countries in Europe. This means 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. Many of the guides have been translated into other languages; for example, the Uncertainty Guide has been translated into seven European languages and recently even 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 (Consultative Committee for Amount of Substance—Metrology in Chemistry). 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 (International Committee on Weights and Measures) 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 comparisons of 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) as well as Helmut Günzler to start and lead the journal "Accreditation and Quality Assurance" (ACQUAL). The journal, which was given a subtitle from the Eurachem side (by the two authors of this paper): "Journal for Quality, Comparability and Reliability in Chemical Measurement", 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 (entry 2.34 of VIM [3]) as a part of the measurement requirement. The publication of the Eurachem Guide "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 an important measurement requirement. Eurachem plans to contribute more on how to set this requirement.

Good progress has been made in applying metrological principles [5] 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, such as those arising from extraction or so-called matrix effects, a potentially large uncertainty must be accepted, which can be difficult to evaluate. Specialised techniques such as isotope dilution mass spectrometry are for a limited number of measurement tasks less sensitive to systematic effects for liquid or gaseous samples. However, they cannot overcome these difficulties for most measurement requests and are too complicated and expensive for many routine measurements.

The IRMM's "TrainMiC" [6] programme has been particularly helpful in disseminating Eurachem's guidance and has generated a significant number of lecturers all over Europe and indeed over the world. TrainMiC participants receive a basic education on MiC enabling them to disseminate good practice and procedures to allow chemical measurements conforming with sound metrological rules to be performed.

As part of the Eurachem 25th anniversary celebrations, an international workshop on "Quality in Analytical Measurements" is being held in Lisbon on 19–21 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 definition 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 the workshop flyer [7].

What is lying on Eurachem's doorstep for the twenty-first 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, e.g. in food and feed. 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 in global tourism with the ensuing medical needs). There are a number of bodies that will be involved in this including CCQM, CITAC and IUPAC (International Union of Pure and Applied Chemists) to name just a few, and there will be a role for Eurachem as well.

Accreditation will play a major part in 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.

Appendix 1: Eurachem guides

- Quality Assurance for Research and Development and Non-routine Analysis (1998)
- 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)
- 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)
- Accreditation for Microbiological Laboratories, 2nd Edition (2013)

Appendix 2: Current Working Groups

- Education and Training
- Measurement Uncertainty and Traceability
- Proficiency Testing
- EEE (EA/Eurolab/Eurachem) Proficiency Testing—"Proficiency Testing in Accreditation"
- Qualitative Analysis
- Uncertainty from Sampling
- Method Validation

References

1. ISO (1993) Guide to the Expression of Uncertainty in Measurement. ISO, Geneva. (ISBN 92-67-10188-9) (Reprinted 1995) Reissued as ISO Guide 98–3 (2008), also available as JCGM 100:2008 from http://www.bipm.org
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) International vocabulary of metrology—Basic and general concepts and associated terms (VIM), edn 3. Version 2008 with minor corrections also available as JCGM 200: 2012 from http://www.bipm.org/vim
4. http://www.eurachem.org
5. De Bièvre P (2011) Looking back at two decades of "metrology in chemistry". Accred Qual Assur 16:591–596
6. http://www.TrainMiC.org
7. http://eurachem2014.fc.ul.pt