CCQM 31st meeting

MWG-08 SIM Report (Chemistry and Biology)

Abstract

This report details the MWG-08's strategic initiatives to strengthen chemical metrology in the SIM region through a new communication website, regional capability diagnostics, and preventive tools designed to streamline CMC reviews.

SIM Metrology Working Group 8 (MWG-08)
Chemistry and Biology

Chair: Dr. Bryan Calderón Jiménez
LACOMET/COSTA RICA

Vice Chair: Dr. Patricia Grinberg
NRC/CANADA

CCQM 31st meeting MWG-08 SIM Report (Chemistry and Biology)

1. Strengthening Communication and Information: The New MWG-08 Website

During the last period, one of the most visible advancements of the MWG-08 has been the implementation of a new website, available on the official SIM portal. This new page represents a significant step towards modernizing the group's communication mechanisms.

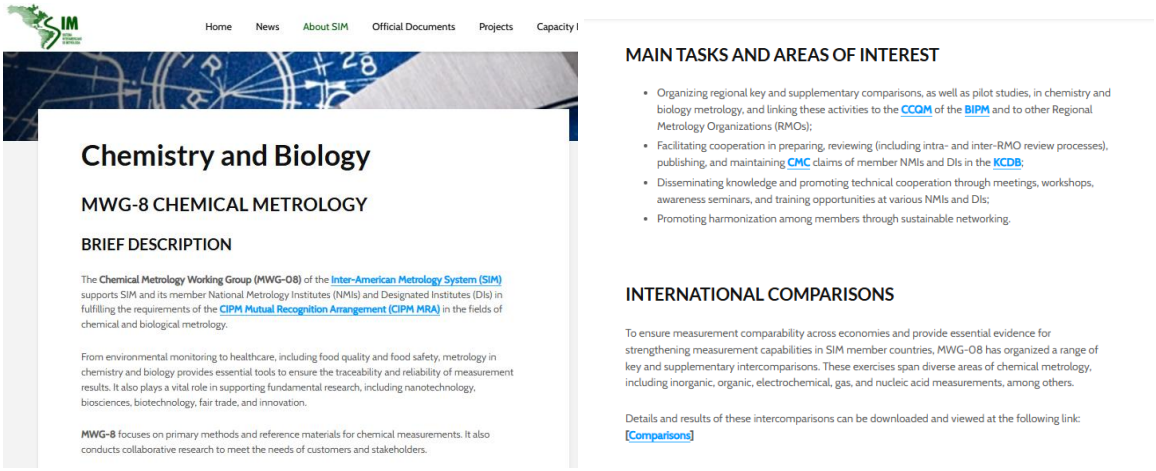


Figure 1. *New website of the SIM Chemical Metrology Working Group (MWG-08 web page link).*

In contrast to previous versions, the new structure presents a clearer and more hierarchical organization of information, allowing for the direct identification of the group's fundamental pillars, including:

- Organizational structure of the MWG-08
- Technical areas (IAWG, OAWG, GAWG, EAWG, among others)
- Strategic activities (comparisons, CMC development, regional projects)
- Key documentation and technical resources

SIM Comparison Report (Chemistry & Biology)

The following table presents the status of comparisons organized within SIM by the various working groups in the fields of chemistry and biology from 2009 to present.

Working group	Pilot Lab	Published Year	Identifier	Measurement Capability	Status	Number participants
OAWG	CENAM-INMETRO	2023	SIM.QM-S17	Ethanol in Water	KCDB (Published on)	13
IAWG	NRC	2012	SIM.QM-S2	Trace elements in water	KCDB (Published on)	11
	NRC-CENAM	2018	SIM.QM-S7	Trace metals in drinking water	KCDB (Published on)	16
	NRC	2021	SIM.QM-S10	Trace Elements in Skim Milk Powder	KCDB (Published on)	12
	LATU	Pending	SIM.QM-S11& P25	Trace of As, Cd, P and Na in Mate	KCDB (Published on)	16
	NRC	2023	SIM.QM-S12	Elements in Natural Water	KCDB (Published on)	21
	CENAM-INMETRO	Pending	SIM.QM-S13	Elements in Cu Concentrate & Ore	Draft B & Final Report (presented to IAWG)	11
	INMETRO	Pending	SIM.QM-S16	Metals in Water	Running	22
	NRC	Pending	SIM.QM-S18/P27	Cadmium and lead in cacao powder	Final Report	18
GAWG	NIST-CENAM	2009	SIM.QM-S1	Binary gas mixtures	KCDB (Published on)	2
	NIST-INMETRO	2025	SIM.QM-S3	Methane in air	KCDB (Published on)	2
	NIST-INMETRO	2025	SIM.QM-S4	Nitric oxide in nitrogen.	KCDB (Published on)	2
	CENAM-KRISS	2023	SIM.QM-S5	Natural Gas	KCDB (Published on)	7
	INMETRO	2023	SIM.QM-S6	Automotive Emissions	KCDB (Published on)	5
	INMETRO	2023	SIM.QM-S9	Biogas	KCDB (Published on)	4
	CENAM	Pending	SIM.QM-S14	Carbon Dioxide in Nitrogen	Draft A (under discussion)	4
	CENAM	Pending	SIM.QM-S15	Methane in Air	Draft B (under discussion)	4
NAWG	CENAM	Pending	SIM.QM.Pilot study	SARS-CoV-2 DNA Copy number quantification	Draft A (under discussion)	4

*CCQM Working groups: Electrochemical analysis (EAWG), Gas Analysis (GAWG), Inorganic Analysis (IAWG), Isotope Ratios (IRWG), Nucleic Acid Analysis (NAWG), Organic Analysis (OWAG), Protein Analysis (PAWG), Surface Analysis (SAWG), Cell Analysis (CAWG).

Figure 2. *Information provided by the new website regarding regional (supplementary) comparisons organized within SIM.*

This redesign not only improves the accessibility of information but also strengthens the transparency and visibility of the group's work at the regional and international levels. In particular, the new page provides greater clarity in defining the core activities of the MWG-08, facilitating the understanding of the group's role within the framework of the CIPM MRA and its interaction with the CCQM.

Finally, on a strategic level, this new page is positioned as a key element for regional harmonization, agile and centralized access to technical information, and capacity building, especially for areas that are still in the process of developing and improving their metrological capabilities. Specifically, the advantages offered by WordPress were utilized for the page design and general information, while Google Drive was used for the storage, custody, protection, and transfer of information in an agile, simple, and user-friendly manner among the different members, participants, and visitors to the website.

This is a vital structural aspect for proper traceability and centralization of information, as well as the correct transfer of knowledge between the group's leadership periods. This was one of the main barriers identified in previous versions that the new website has resolved, thereby strengthening the communication and information flow of this SIM technical group.

2. Building a Baseline: Diagnosis of Metrological Needs and Gaps in the SIM Region

Another major structural and strategic advancement of the MWG-08 was the development and implementation of a regional diagnosis conducted between November 2025 and March 2026, constituting one of the most relevant inputs for the strategic planning of the MWG-08. Specifically,

the regional diagnosis aimed to establish a clear baseline of the strengths and needs of the region in the field of chemical metrology.

To this end, a web form was designed in Google Forms (MWG-08 Diagnostic Questionnaire) that was concise enough to quickly and accurately capture and collect the information. The form included the participation of different NMIs in the region, with representation from the various sub-regions that make up SIM (NORAMET, CAMET, ANDIMET, and SURAMET), except for CARIMET, from which no information was received at the time this report was issued.

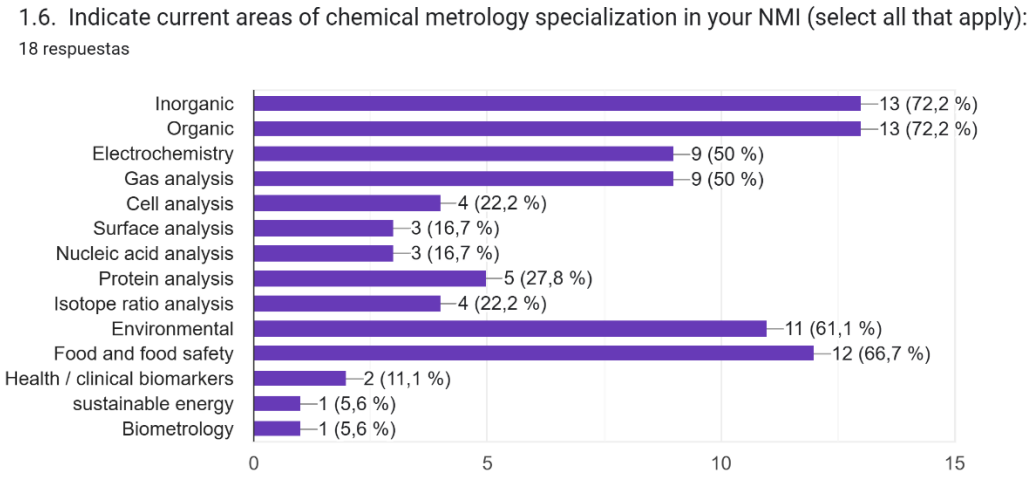


Figure 3. *Degree of specialization of the institutes that participated in the diagnosis (MWG-08 Diagnostic Questionnaire)*

Overall, the study showed that the SIM region has a solid foundation in chemical metrology, with 88.9% of institutions having published CMCs. However, analyzing the information leads to the conclusion that there are aspects to improve, as this development is not homogeneous and significant gaps were identified. Among the main findings, it can be observed that the fields of inorganic, organic, gas, and food analysis are among the areas showing the greatest strength and consolidation in the region.

Despite this, fields such as clinical biomarkers, bioanalysis, and biometrology show low growth or development at the regional level. The same occurs in other high-technology fields such as nanometrology and emerging technologies, where there is development in consolidated NMIs, but regional development is less homogeneous. Specifically, a misalignment can be observed between existing capabilities and emerging needs. While the region maintains strengths in traditional areas, there is a clear push toward new areas associated with climate change, health, and sustainability. Therefore, it is necessary to integrate activities through transversal mechanisms to progressively strengthen these new needs and capabilities in non-traditional subjects.

The diagnosis also served to identify structural barriers; specifically, participants highlighted various financial limitations hindering the advancement of greater capabilities, insufficient analytical infrastructure, and a lack of specialized personnel in certain measurement systems. In this context, the diagnosis confirms a trend observed in other analyses: the need to strengthen competencies in

subjects such as measurement uncertainty, statistical analysis, and the interpretation of results applied to international intercomparisons. This suggests that the challenges or gaps to be addressed in the MWG-08 strategy are not only technical-structural but also educational.

Finally, the diagnosis successfully identified priority needs highlighted by different NMIs in the region, prominently including gas analysis (H_2, refinery gases, GHGs), the measurement of stable isotopes (C, N in environmental matrices and food), the development of capabilities for emerging contaminants (Hg, microplastics, nanomaterials, among others), and the promotion of capabilities and topics in the field of food and environmental metrology. For more details on the diagnostic tool, the results, and the final report, you can access the following link (MWG-08 Diagnostic Questionnaire Report).

3. Lessons Learned: Analysis of KCDB Comments for the SIM Case

The new KCDB platform is a highly powerful tool that compiles a vast amount of technical information which can be used for analysis and decision-making. In this context, one of the advancements generated for 2025 was the creation of a tool capable of analyzing, classifying, and identifying trends in the comments, thereby establishing mechanisms and strategies that systematically reduce corrections in CMC declarations and consequently improve and streamline their regional and intra-regional review process.

To achieve this, through an RScript code (MWG-08 KCDB Comments - Rscript), the comments were classified into six technical and administrative categories using keyword analysis and contextual review. Subsequently, descriptive statistics and graphical visualizations were generated to facilitate the interpretation of the results, and an executive technical report was developed to provide more detail on these aspects (for more details, consult the MWG-08 KCDB Comments Report). The following figure displays some of the most relevant results:

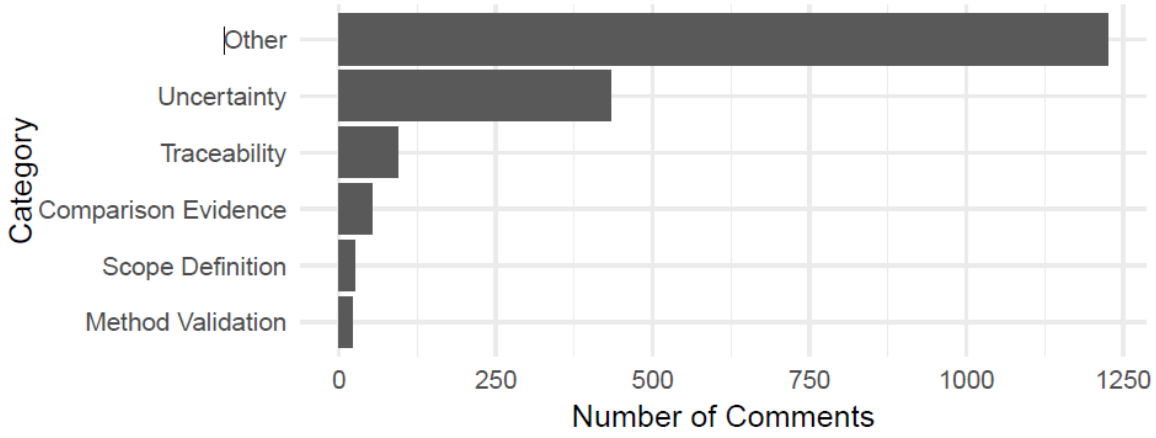


Figure 4. *Distribution of comments issued during the XXVI cycle (2025) review for CMCs submitted by SIM (MWG-08 KCDB Comments Report).*

The results of this exercise show a large presence of administrative comments; however, upon excluding them, very clear technical trends emerge. Specifically, within the predominant categories,

it was observed that 70% of the comments are related to uncertainty issues, 15% were related to metrological traceability, and 8% pertained to evidence of international comparisons, with measurement uncertainty playing a dominant or preponderant role.

In this context, the results show that measurement uncertainty is one of the main technical evaluation criteria, which must reflect a high level of consistency among the declared values, experimental evidence, and conventions used. Furthermore, it was observed that the opportunities for improvement are not isolated by country but could be considered a systemic aspect at the regional level, suggesting the need for coordinated interventions through workshops, awareness seminars, and other mechanisms that enhance the knowledge of those participating in the CMC writing and submission processes within the KCDB.

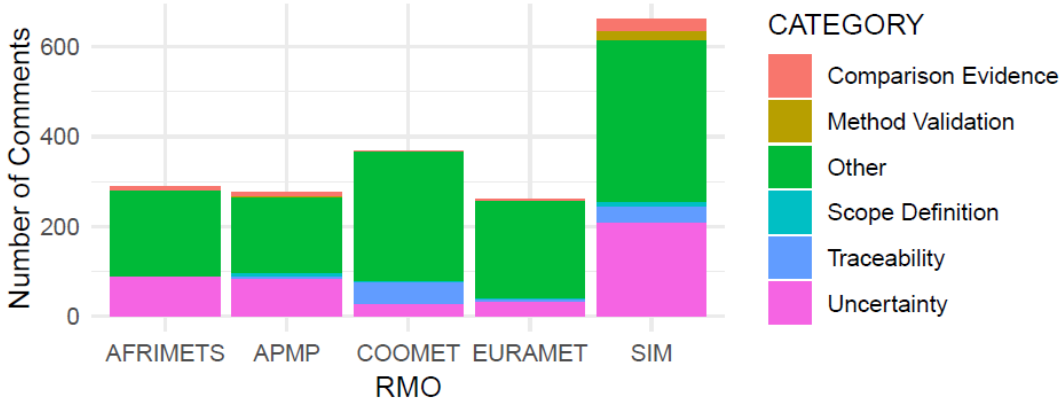


Figure 5. *Distribution of comments issued by the different RMOs.*

SIM presents a larger number of comments because it includes both intra- and inter-regional review comments. In addition to the above, the analysis conducted identified great consistency among the different RMOs (Figure 4), indicating a global alignment in evaluation criteria, which strengthens the robustness of the CIPM-MRA but similarly raises the level of demand for NMIs that are beginning or currently developing their metrological infrastructure. Future consideration must be given to what mechanisms can be utilized so that these types of institutes have the clear tools and knowledge prior to entering such scientifically rigorous yet challenging evaluation processes, depending on the type of economy or metrological advancement. For more details on this and other aspects, see the following report (MWG-08 KCDB Comments Report).

The exercise conducted reveals strategic implications, which are detailed below:

- *Implementing technical checklists prior to CMC submission:* Significant progress has been made in this area, as recently, an official MWG-08 document with a very robust checklist was updated and developed to help laboratories mitigate these types of observations and facilitate a smoother review (MWG-08 Practical Guide).
- *Reinforcing the documentation that links evidence, method, and declared measurement range:* In this regard, it is essential to hold workshops (preferably virtual) or training videos that allow the various National Metrology Institutes (NMIs) to understand the correct use of documents linked to the declaration of Calibration and Measurement Capabilities (CMCs), specifically in the field of inorganic metrology. Workshops providing examples of how to

correctly complete the Core Capabilities Table, properly present the Record of Practices (ROP), and highlighting the aspects to consider when presenting a core capability are vital for the harmonization of criteria and the correct presentation of CMCs, increasing clarity in the process and decreasing the percentage of observations seen in this exercise.

- *Developing internal guidelines on the application of uncertainty conventions:* It is evident that reviewers have a very clear understanding of these technical aspects; however, the same clarity is not observed among the experts submitting CMCs for review. Therefore, it is essential to standardize the criteria through knowledge transfer mechanisms.
- *Strategically planning participation in intercomparisons, including Model 2 studies:* Although various comparisons are currently planned, it is necessary to conduct a strategic planning process within SIM for the short-term (5 years) and medium-term (>10 years) covering the intercomparisons needed at the regional level, as well as prospective ones required to address new fields or areas of development in chemical metrology within SIM.

4. Building and maintaining capabilities: Analysis of CMCs – Cycle XXVII (2026)

As an integral part of the annual progress, the MWG-08 developed an executive report to analyze cycle XXVII, providing a vision or overview of the metrological development in the region for this cycle (MWG-08 CMCs Report). Specifically, a predominance of published CMCs can be observed in the field of inorganic metrology, alongside an increase in electrochemistry; this is primarily due to renewals and a decrease in organic chemistry participation compared to other periods (Figure 6A).

In this context, the most predominant matrices were water (natural, synthetic, drinking), acid solutions, food, and gas mixtures (Figure 6B). In addition, the main analytes declared in the cycle XXVII CMCs included various toxic elements (Cd, As, Pb) as well as major elements (Cu, Zn, Na, Fe) (Figure 6C). Due to the aforementioned, it is expected that the predominant analytical techniques are composed of spectroscopic methods, such as ICP-OES, ICP-MS, and ICP-SFMS, among others (Figure 6D). The above analysis was made possible by a new code developed to streamline the review and analysis processes of review cycles. To access this new code, simply click on the following link (MWG-08 CMCs analysis code)

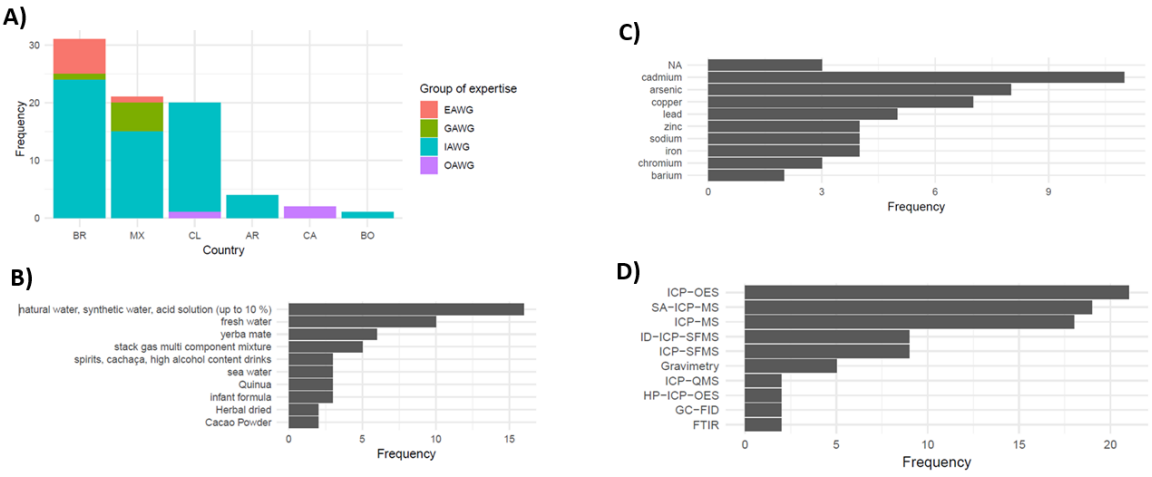


Figure 6. *A) Distribution by fields B) Predominant matrices, C) Main analytes, D) Predominant analytical techniques.*

Finally, this analysis (MWG-08 CMCs Report) confirms a strong prevalence of capabilities in inorganic metrology, which is consistent with the availability of comparisons, the technical maturity of this field in the region, and the regional demand for these types of capabilities. However, the low representation in organic chemistry reflects a potentially significant structural gap, which could be aligned with the results of the metrological needs diagnostic questionnaire. Likewise, the strong reliance on recent comparisons highlights the critical role provided by the CCQM and SIM as drivers of capacity development in the SIM region.

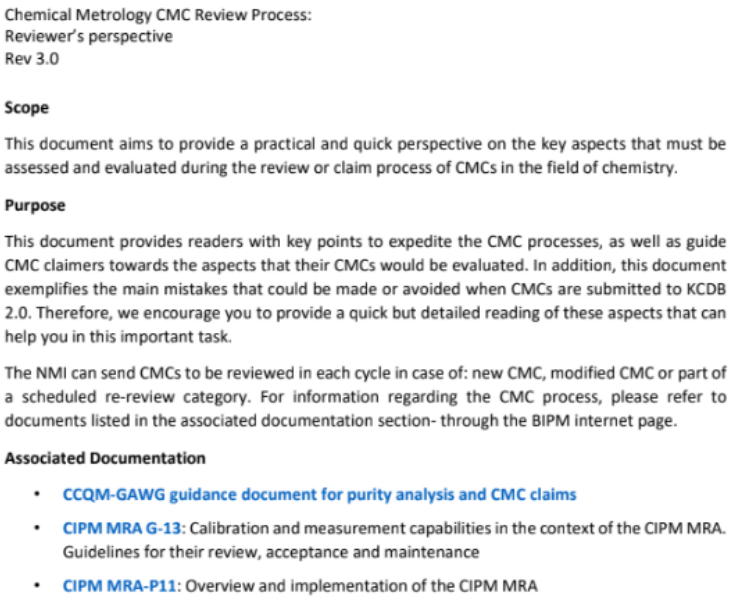
5. New Practical Guide for CMC Review: A Preventive Approach

As a direct response to the identified gaps, a practical guide for the review of CMCs has been developed and updated (MWG-08 Practical Guide). The document provides a clear perspective from the reviewer's point of view, focusing on:

- *Key technical criteria*
- *Frequent errors*
- *Documentary requirements*
- *Alignment with KCDB 2.0*

Additionally, among the critical elements incorporated to improve CMC declaration processes, aspects such as the correct use of uncertainty conventions, consistency between evidence and CMC scope, evaluation of metrological traceability, the relationship between CRM and CMC, and validation of comparison support were introduced, among others. Similarly, a checklist was incorporated into this new document to provide the review process with greater standardization, aiming to reduce review times and improve submission quality.

Therefore, this guide represents an important shift toward a preventive approach rather than a corrective one, directly tackling the root causes identified in the cycle XXVI analysis. Its implementation has the potential to significantly reduce the number of technical comments, improve the efficiency of the review process, and increase the CMC acceptance rate. This and other tools yet to be developed are essential for the proper functioning of the MWG-08.



Chemical Metrology CMC Review Process:
Reviewer's perspective
Rev 3.0

Scope

This document aims to provide a practical and quick perspective on the key aspects that must be assessed and evaluated during the review or claim process of CMCs in the field of chemistry.

Purpose

This document provides readers with key points to expedite the CMC processes, as well as guide CMC claimers towards the aspects that their CMCs would be evaluated. In addition, this document exemplifies the main mistakes that could be made or avoided when CMCs are submitted to KCDB 2.0. Therefore, we encourage you to provide a quick but detailed reading of these aspects that can help you in this important task.

The NMI can send CMCs to be reviewed in each cycle in case of: new CMC, modified CMC or part of a scheduled re-review category. For information regarding the CMC process, please refer to documents listed in the associated documentation section- through the BIPM internet page.

Associated Documentation

- CCQM-GAWG guidance document for purity analysis and CMC claims
- CIPM MRA G-13: Calibration and measurement capabilities in the context of the CIPM MRA. Guidelines for their review, acceptance and maintenance
- CIPM MRA-P11: Overview and implementation of the CIPM MRA

***Figure 7**. Image of the new guide generated for the presentation of CMCs at MWG-08*

General Conclusions and Recommendations

The set of initiatives developed by the MWG-08 reflects significant progress towards the consolidation of chemical metrology in the SIM region. Among the main achievements are the improvement in institutional communication (new website), the robust diagnosis of capabilities and needs, the systematic analysis of the CMC review process, the implementation of data-driven analytical tools, and the development of practical guides aimed at continuous improvement.

However, significant challenges remain that must be addressed in the coming years, such as gaps in emerging areas (bio, climate, nanometrology), as well as strategies to improve funding and infrastructure in the region; these, along with the continued strengthening of competence in the field of chemical metrology, must be addressed in the short and medium term. Because of the above, it is important and highly recommended to strategically strengthen regional training programs, promote strategic comparisons in emerging areas, drive digital tools for the continuous analysis of CMCs, consolidate regional collaboration mechanisms, and generate new documents.

References

Below are the links where reports, documents, tools, and codes (Rscript) can be consulted for more details:

1. MWG Web Site
2. MWG-08 Diagnostic (Questionnaire)
3. MWG-08 Diagnostic (Report)
4. MWG-08 KCDB Comments (Rscript)
5. MWG-08 KCDB Comments (Report)

6. MWG-08 CMCs Analysis (Report)
7. MWG-08 CMCs Analysis (Rscript)
8. MWG-08 Practical Guide (Document)