Metrology – an international endeavour

Andy HENSON
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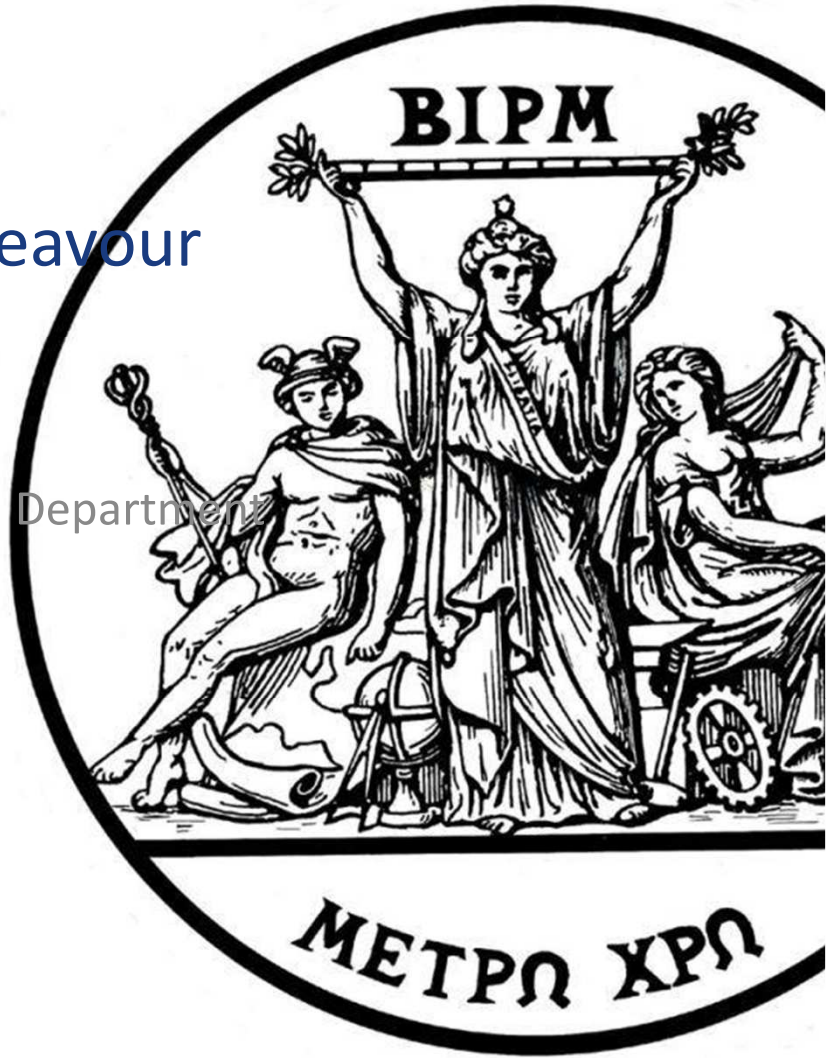
Varenna 2016

Bureau International des Poids et Mesures



Metrology – an international endeavour

There are many interesting things I could cover in a talk on this topic….

- The world system of metrology (the SI)
- CIPM MRA
- Research collaborations
- **Quality Infrastructure**

Quality Infrastructure (QI)

There are various definitions of quality infrastructure (sometimes referred to as the *technical infrastructure*)

All include (at least):

- **metrology**
- **documentary (written) standards**
- **(laboratory) accreditation**

National Quality Infrastructure

"The NQI are the national institutions that provide the framework and services to advance the quality and safety of products and services offered in local and foreign markets."

IAAC at the WTO

And internationally the QI is the sum of the NQI + the transnational institutions and systems that effectively link them

Metrology is a part of our lives from birth

Globalization

Safe treatment

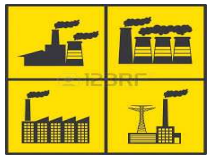
Climate change

Safe food

Innovation

Healthcare

Fair regulation



Manufacturing

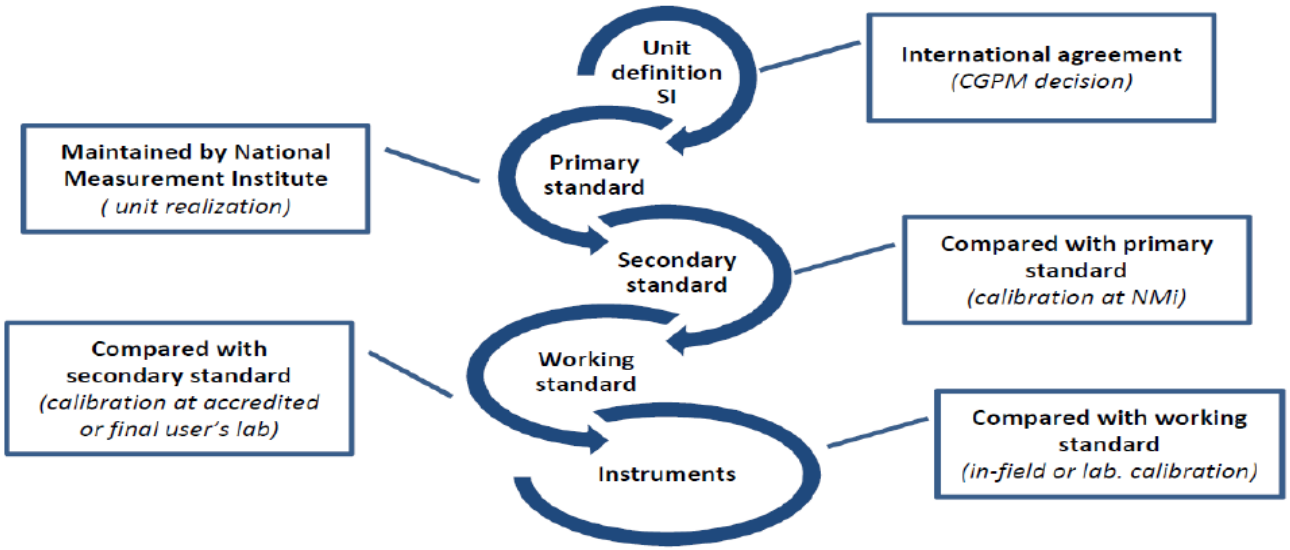
Technical evidence

Safe traveling

- *Without metrology, you can't discover, design, manufacture, process, test, maintain, prove, buy or operate almost anything safely and reliably.*
- *From precision machined parts on engines down to tiny structures on micro and nano components, all require an accurate measurement that is recognized around the world.*
- *From filling your car with petrol to having an X-ray at a hospital, your life is surrounded by measurements.*

Good measurement helps countries remain competitive, trade throughout the world and improve quality of life of their citizens.

The measurement “traceability chain”



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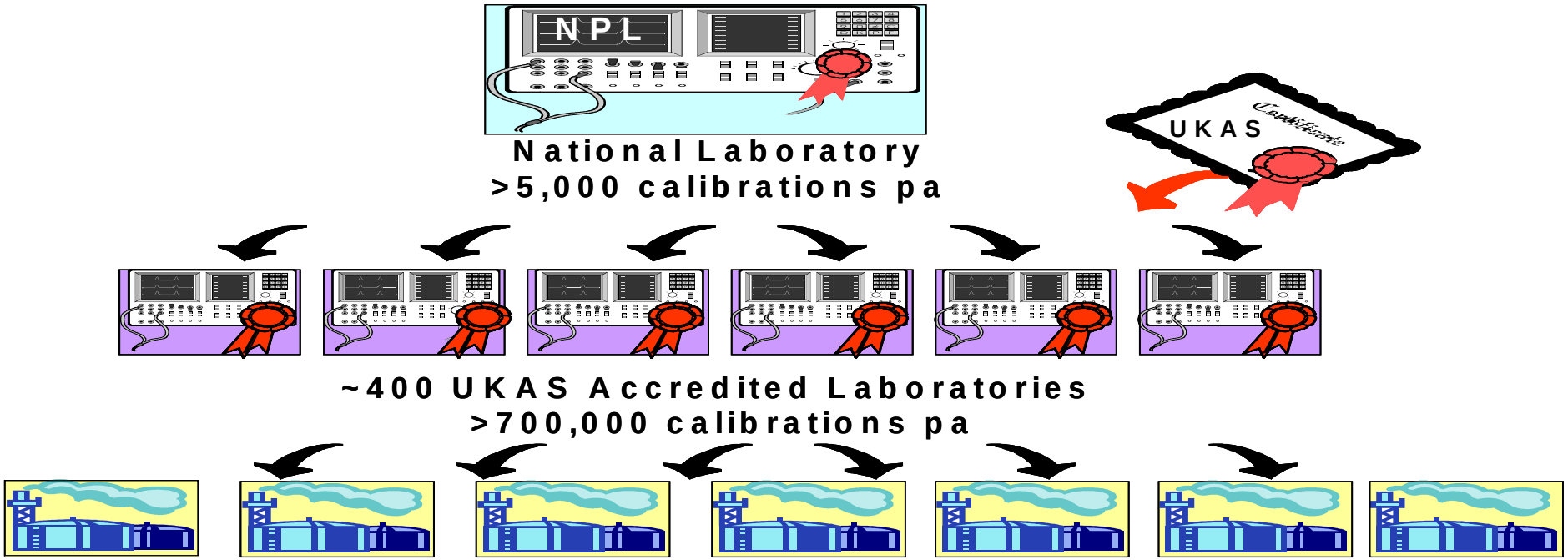
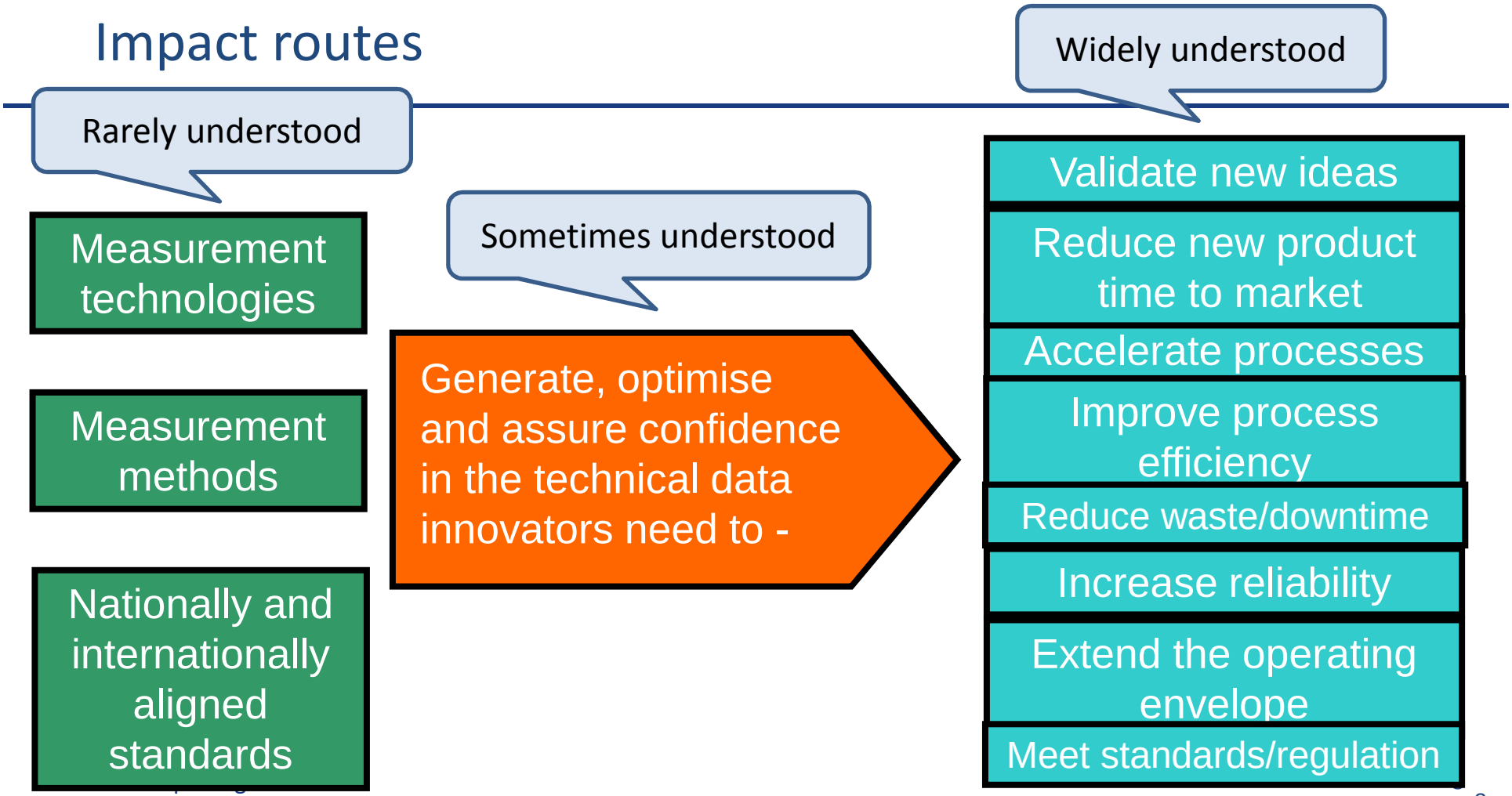
Slide courtesy
Dr S Davidson, NPL, UK

National ‘fan out’ of the metrological traceability chain



Impact routes



Impact routes

Measurement technologies

Measurement methods

Nationally and internationally aligned standards

Metrology is a key ***enabling technology****….*

Yet its (potential) ***contribution …….is often overlooked***

Validate new ideas

Reduce new product time to market

Accelerate processes

Improve process efficiency

Reduce waste/downtime

Increase reliability

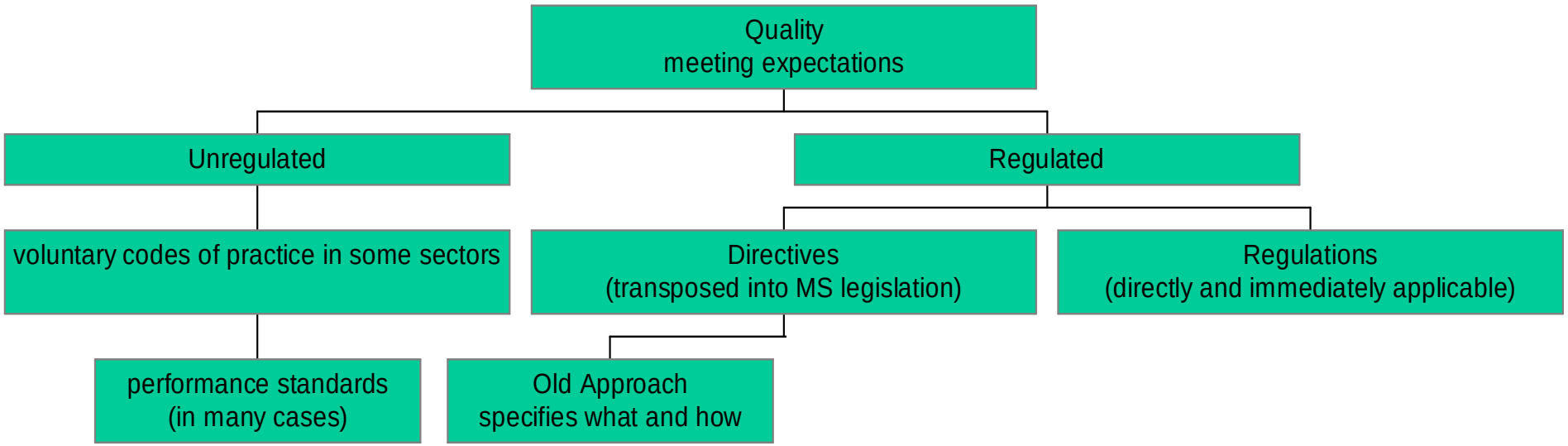
Extend the operating envelope

Meet standards/regulation

The role of Quality in trade (domestic and international)

EU example

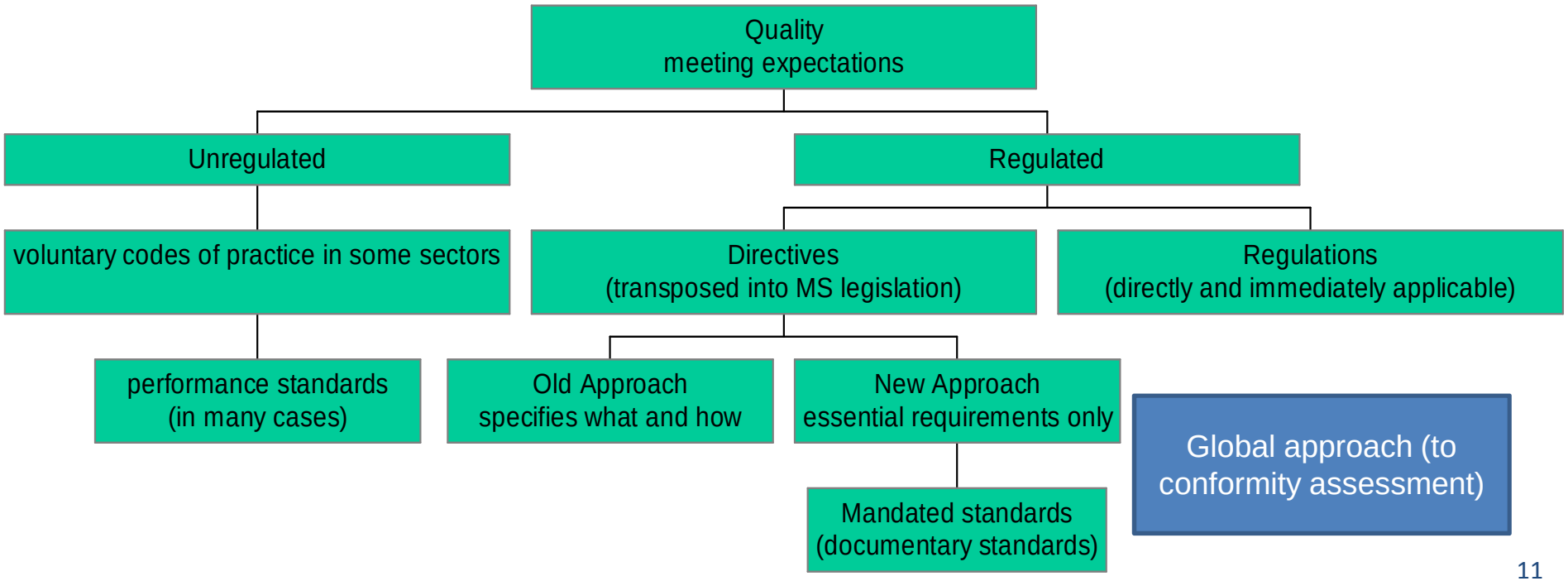
One way of looking at quality in trade - single market



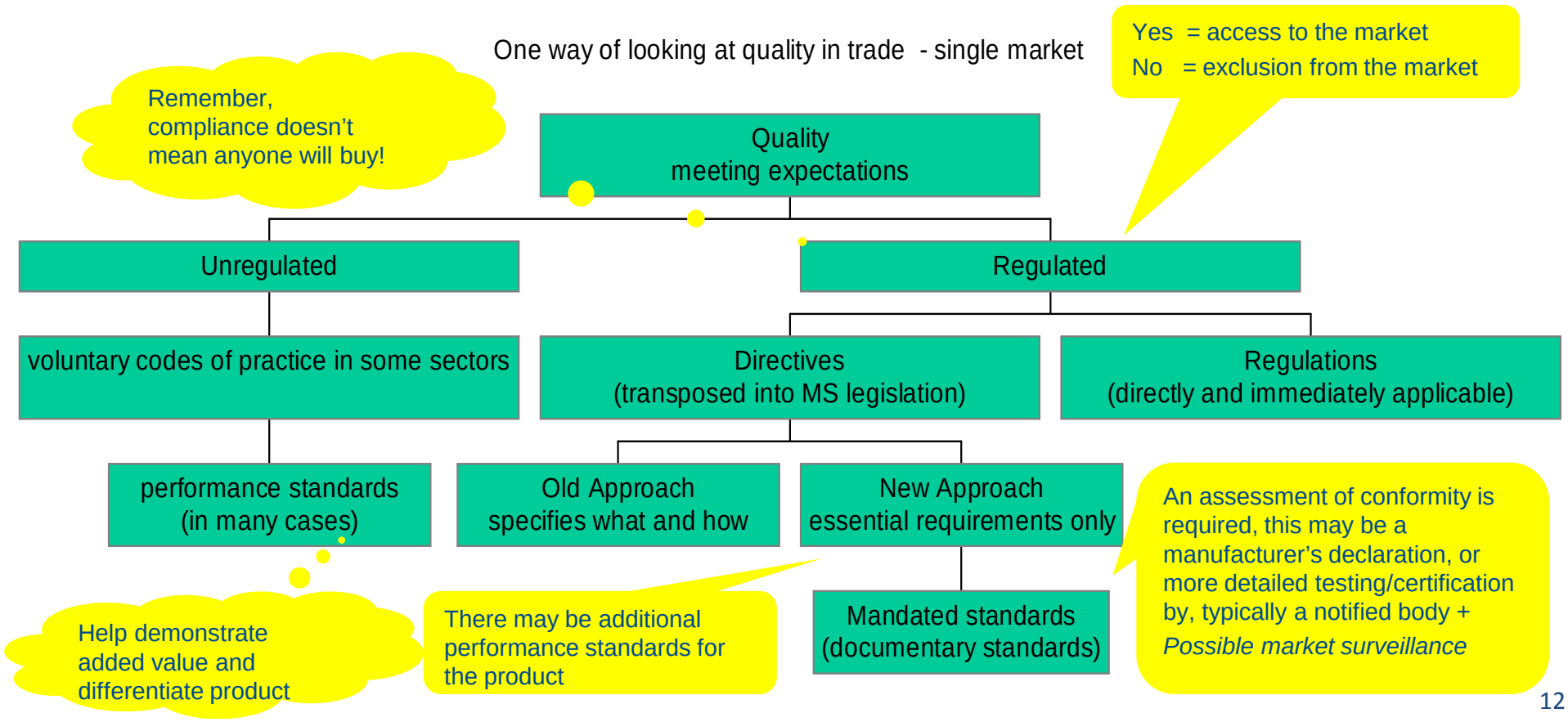
The role of Quality in trade (domestic and international)

EU example

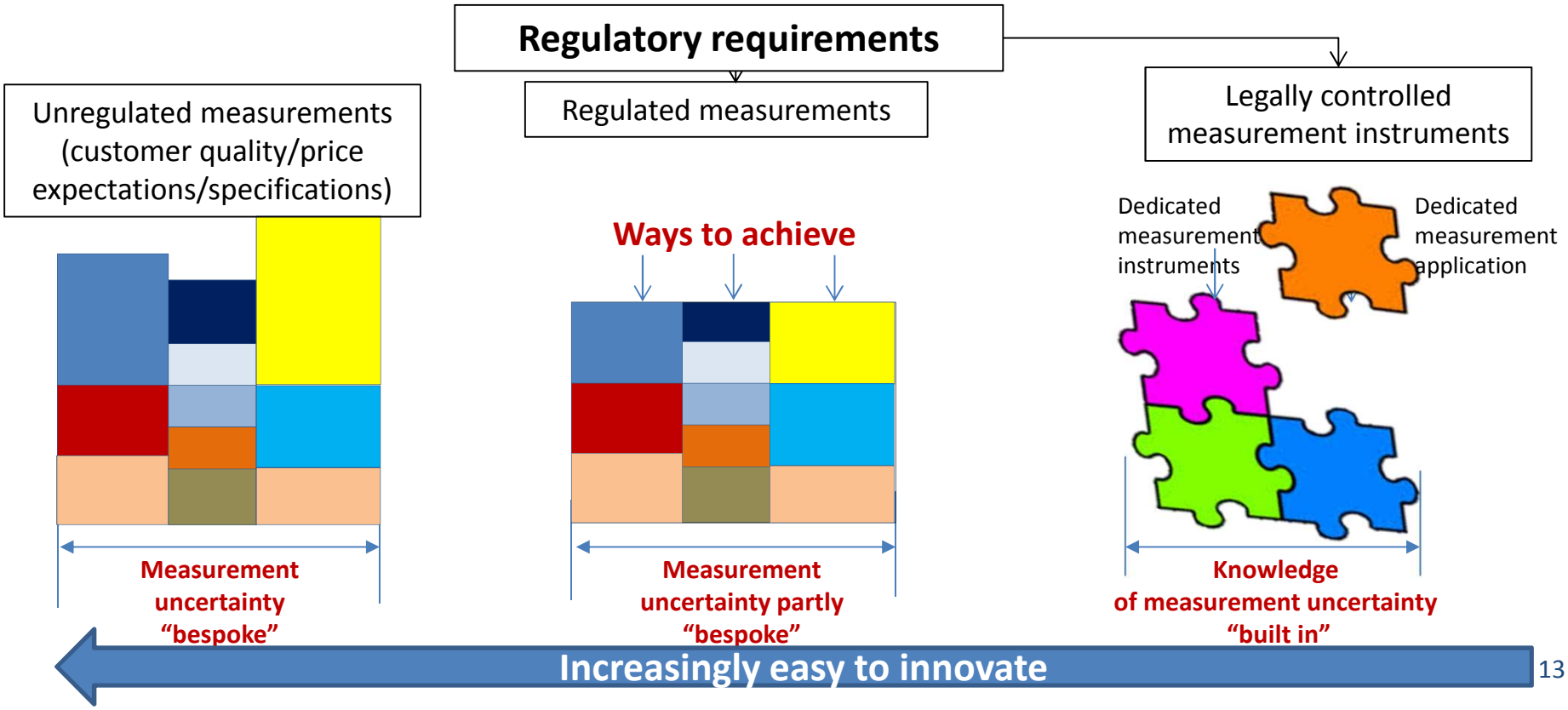
One way of looking at quality in trade - single market



The role of Quality in trade (domestic and international)



Traceability/measurement uncertainty in legal metrology



Trade - WTO Agreement on Technical Barriers to Trade (TBT)

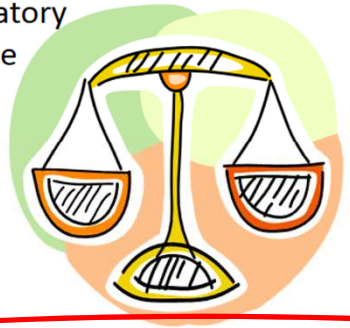
TBT Agreement

Pursuit of trade liberalization…

avoiding unnecessary/discriminatory barriers to int'l trade

Right of Members' to regulate…

allowing Members to pursue legitimate objectives at levels they consider appropriate



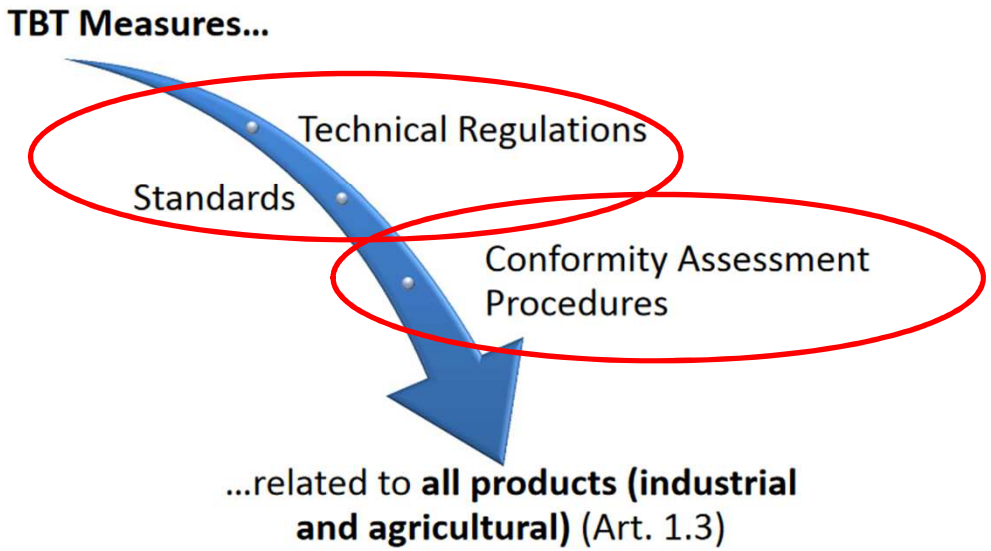
use of international standards
…as a basis for regulation

…Harmonization

Slide courtesy
L Locks WTO

WTO TBT

Scope of the TBT Agreement



Slide courtesy
L Locks WTO

WTO TBT

Conformity Assessment Procedures (CAP)

"Any procedure used, directly or indirectly, to determine that relevant requirements in technical regulations or standards are fulfilled.

Slide courtesy
L Locks WTO

WTO TBT

The value of documentary standards and accreditation is directly recognised

The value of metrology is indirectly recognised

Arrangements to facilitate CAP

(encouraged in TBT Agreement)

- International or regional systems for conformity assessment
  - "Members shall, wherever practicable, formulate and adopt international systems for conformity assessment"
  - Systems such as ILAC/IAF, IECEE CB are increasingly prominent in TBT Committee discussions
- Recognition of foreign conformity assessment results
  - "verified compliance, for instance through ***accreditation***, with relevant guides or recommendations issued by international standardizing bodies shall be taken into account as an indication of adequate technical competence"

Slide courtesy L Locks WTO

Do we all use the same definition of Quality Infrastructure?

- There are various definitions of quality infrastructure (sometimes referred to as the technical infrastructure)

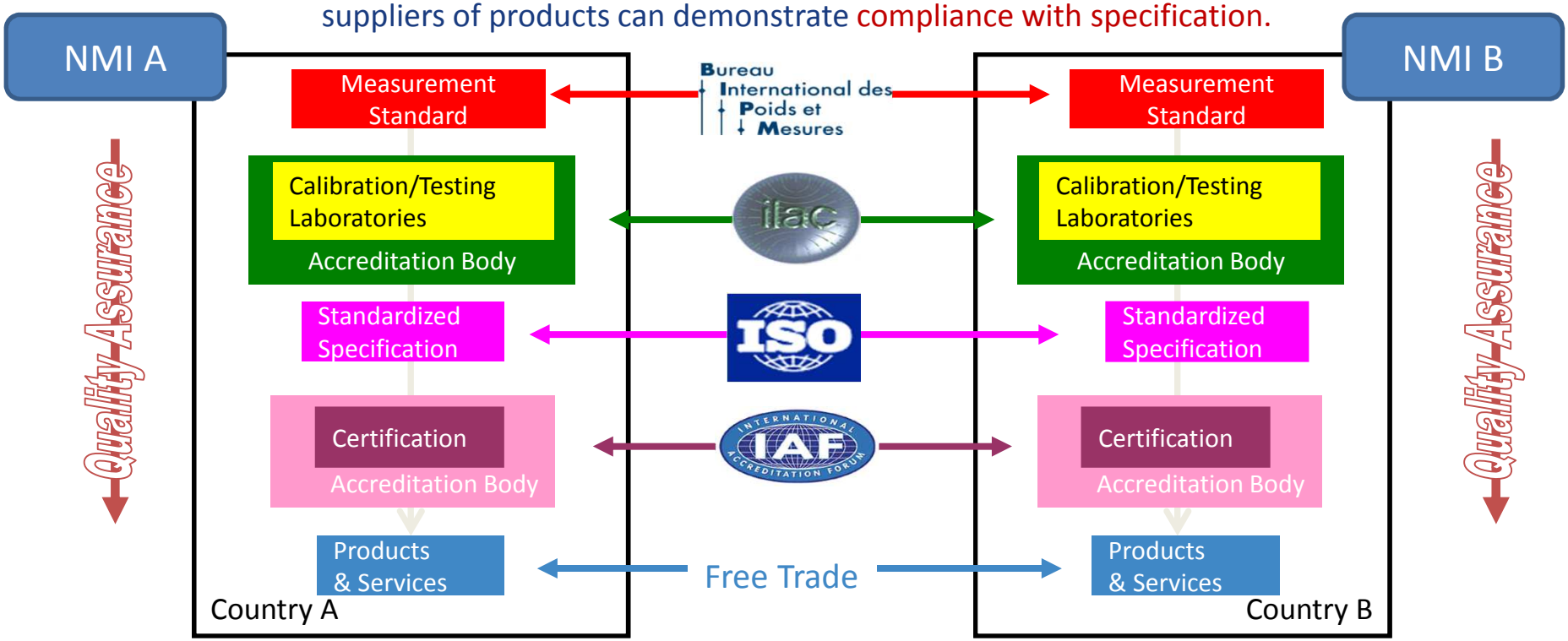
- All link **metrology, documentary (written) standards, and accreditation**

- They often also explicitly include conformity assessment in some way
  - At its simplest, "conformity assessment" means checking that products, materials, services, systems or people measure up to the specifications of a relevant standard.
  - So often that means testing, which means measurement

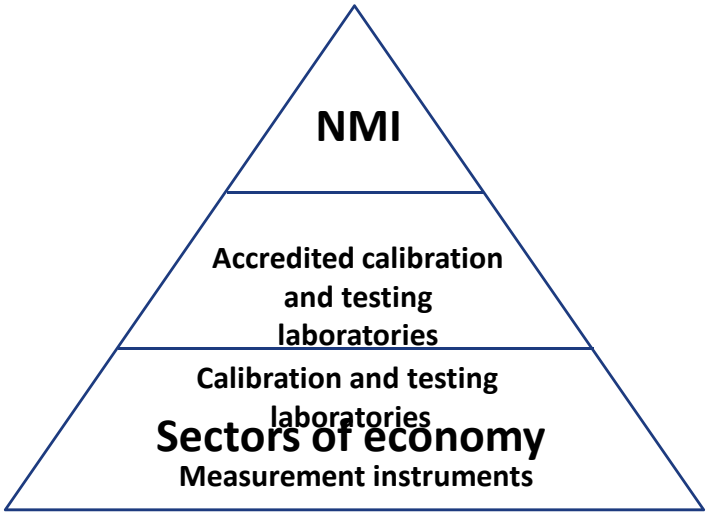
So lets take a look at a selection of the descriptions…..

QI - various models (1)

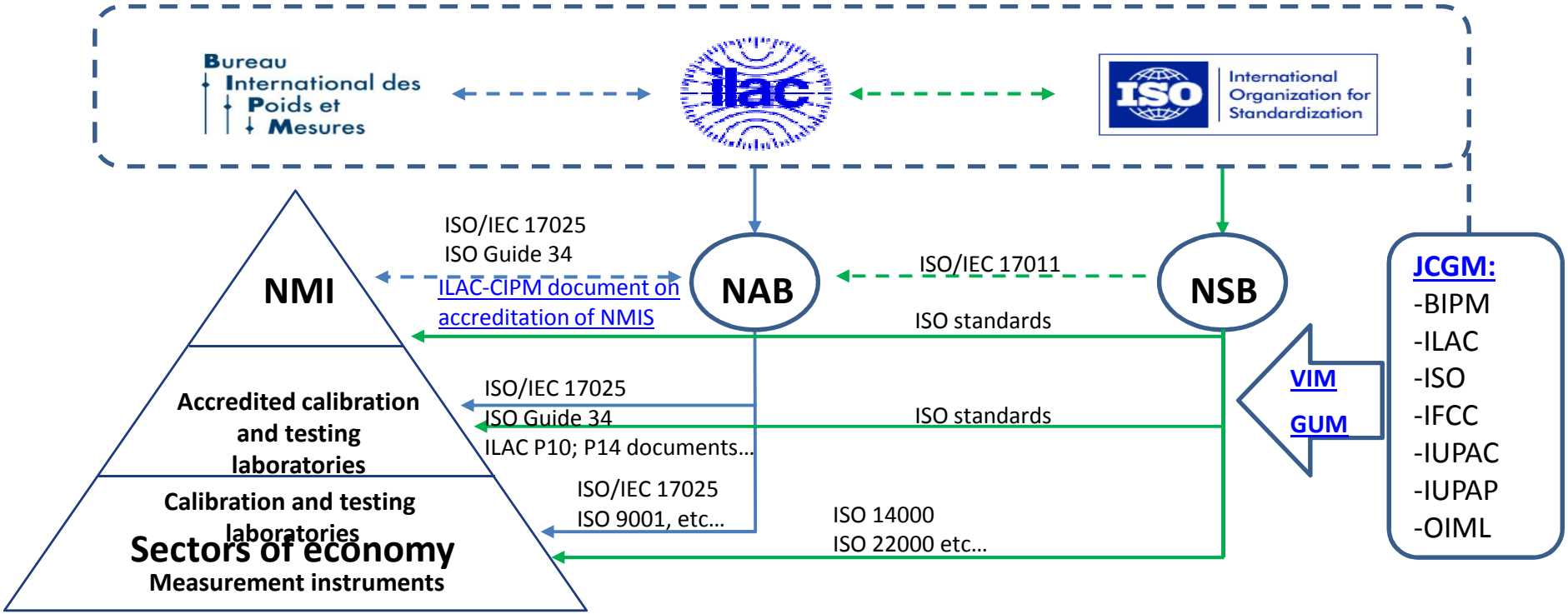
Measurement standards are provided through an internationally recognized framework through which suppliers of products can demonstrate compliance with specification.



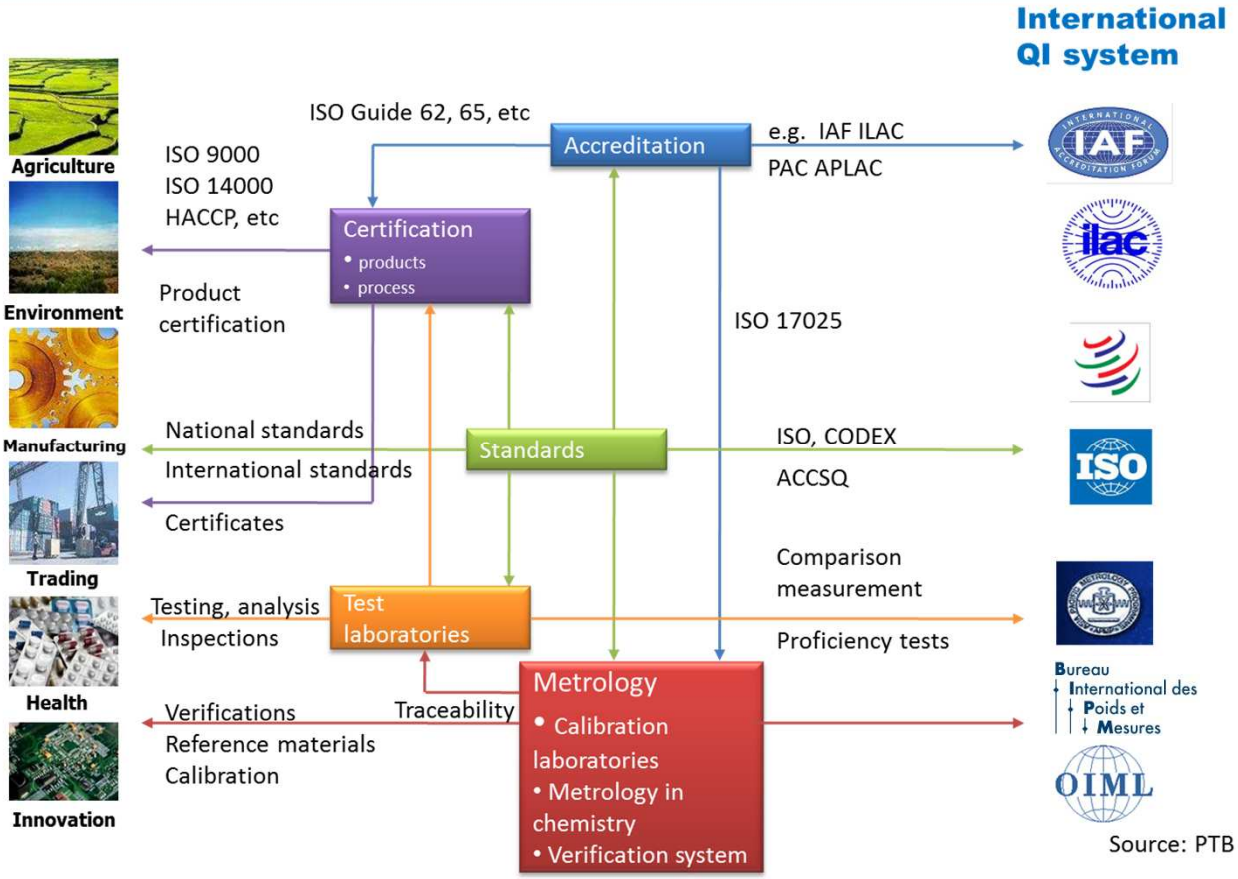
QI - various models (2)



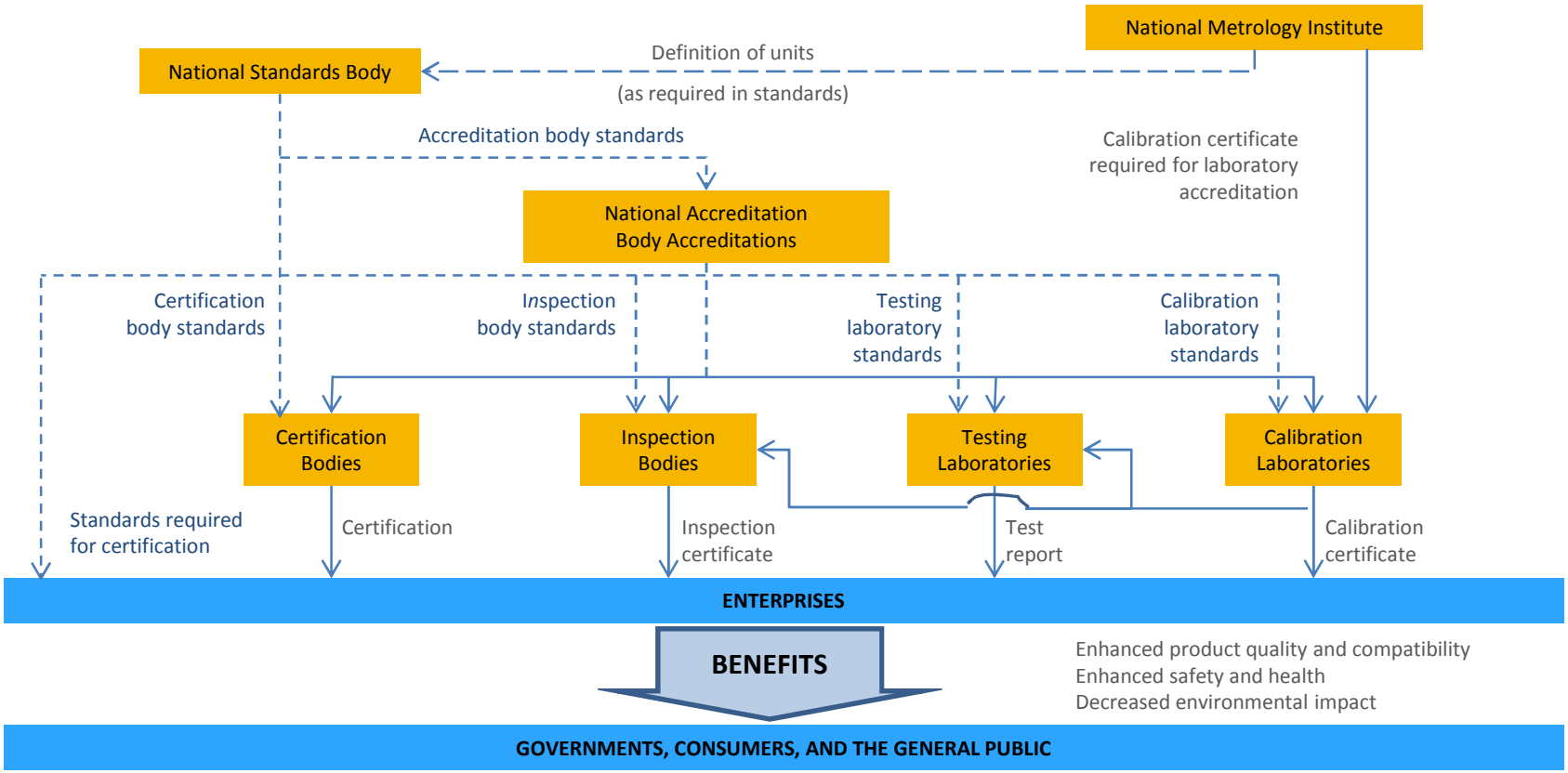
QI - various models (2)



QI - various models (3)



QI - various models (4)

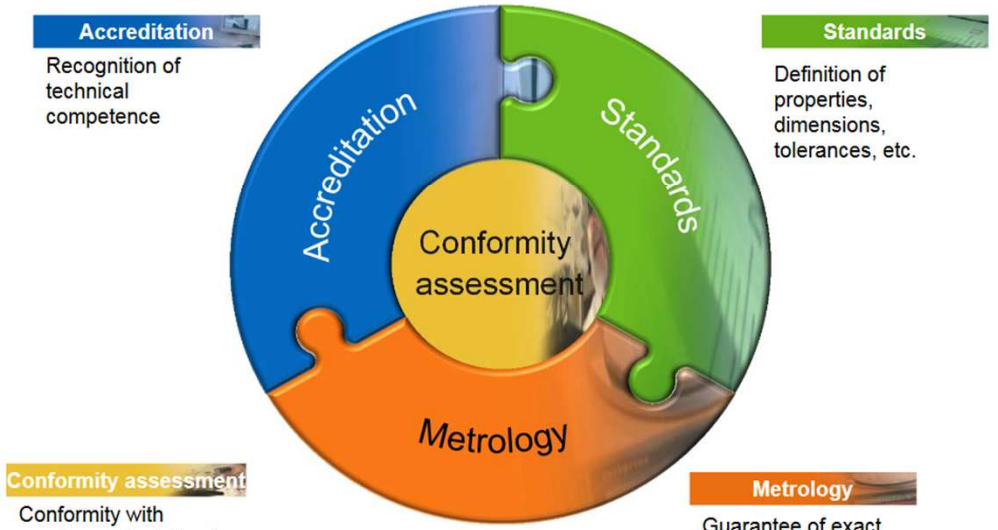


Source: World Bank, 2007, Quality Systems and Standards for a Competitive Edge, Washington D.C. Standards

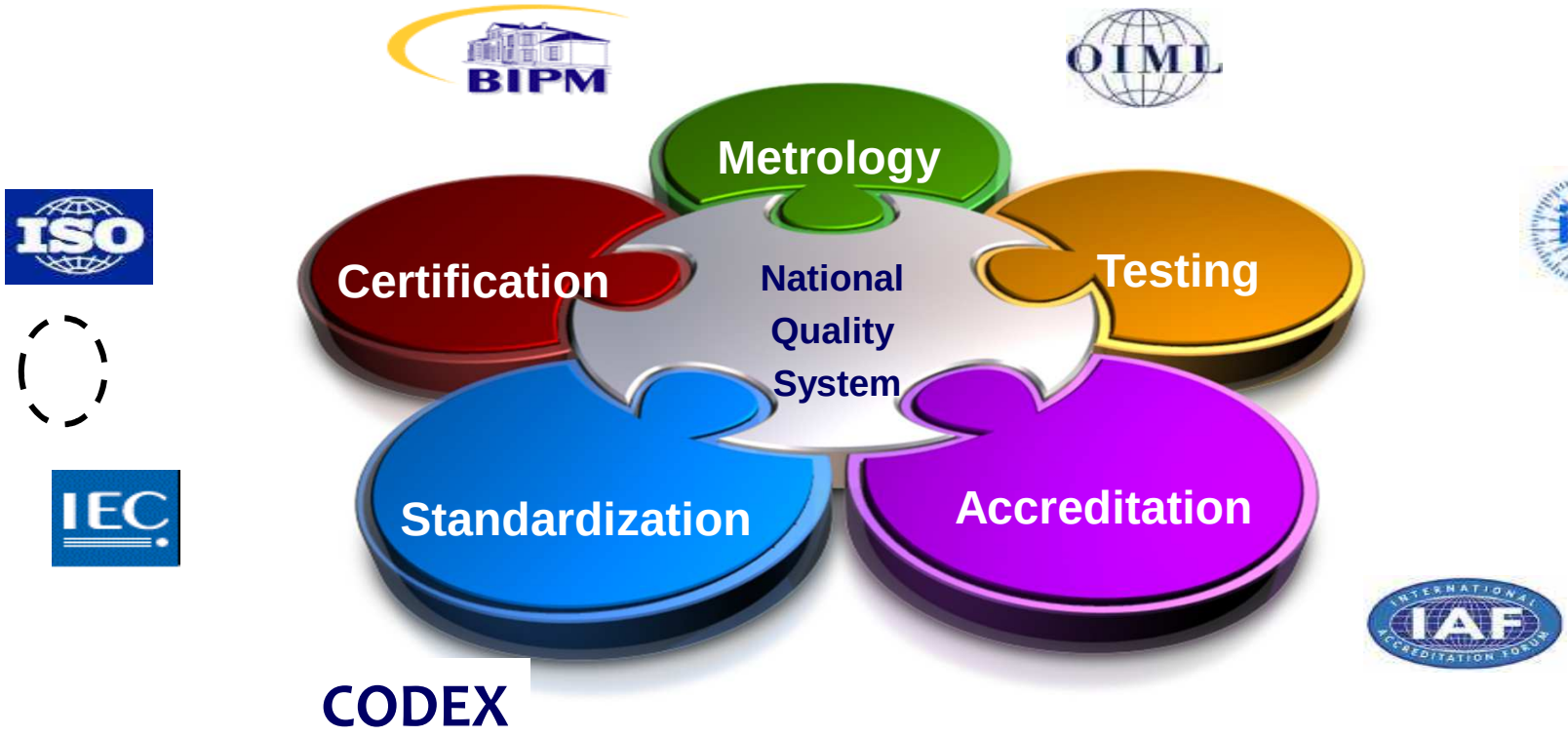
QI - various models (5)

African Quality Infrastructure has three key elements namely: metrology, standardization and accreditation of conformity assessment services such as certification, testing, calibration and inspection

These elements are independently managed however, they form a close network based on a technical hierarchy.



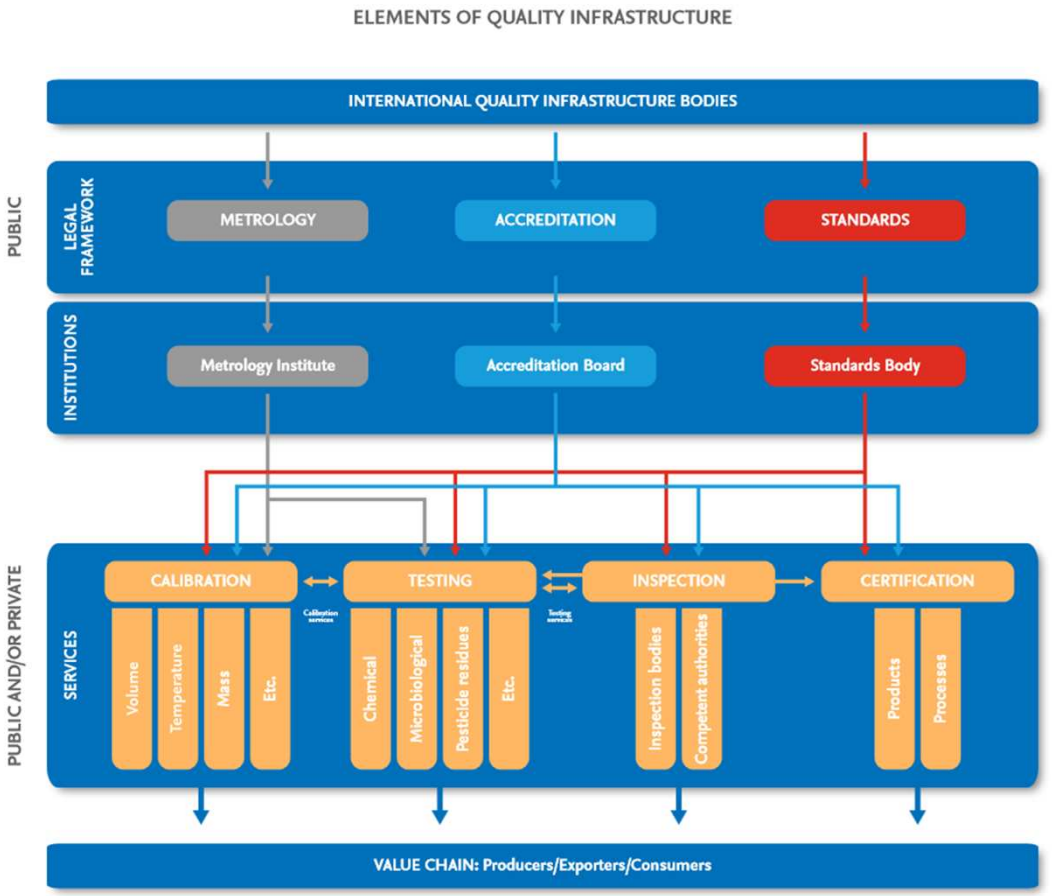
QI - various models (6)



QI - various models (7)

UNIDO
Quality Infrastructure is generally understood to be the totality of the institutional framework (public and private) required to establish and implement standardization, metrology (scientific, industrial and legal), accreditation and conformity assessment services (inspection, testing and product- and system certification) necessary to provide acceptable evidence that products and services meet defined requirements, be it demanded by authorities or the market place.

https://www.unido.org/fileadmin/user_media_upgrade/What_we_do/Topics/Competitive_and_trade/5_QI_highres.pdf

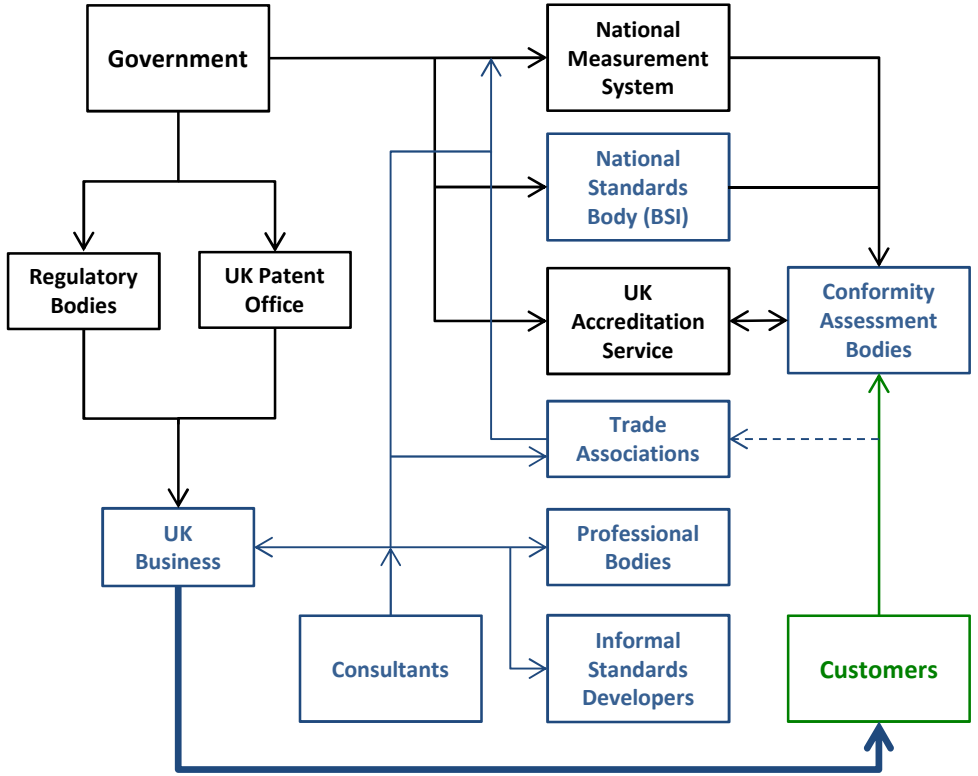


QI - various models (7)

The 'quality infrastructure' …comprises the physical facilities and the interrelated systems of organisations, structures and people that help organisations to implement quality practices and improve performance.

The principle parts of the infrastructure relate to:

- **regulation - government, regulators**
- **standards - documentary, physical/ reference, other codified intellectual property**
- **conformity assessment and accreditation**
- **economic operators and their collective representatives**
- **consumers**



http://www.thecqi.org/Knowledge-Hub/Knowledge-portal/Concepts-of-quality/Quality-infrastructure/

QI: Point to note!

…so many definitions and diagrams!

…IT DOES NOT MATTER!

Its fine to define QI in a way appropriate for the circumstance…

But the lesson to take away..

Metrology doesn't and can't work in a vacuum…!

Key QI players at international level

There are many, many other players!
….often sector or regionally focuses

QI links at national level

- National links
- Regional links
- International institutional links

Metrology and documentary standards

NMIs (and designated institutes) **Use and require within the CIPM MRA:**

- **ISO/IEC 17025**: '**General requirements for the competence of testing and calibration laboratories**' as their underpinning quality standard
- and, if involved in reference materials, **ISO Guide 34: 'General requirements for the competence of reference material producers**'
    - As do tens of thousands of calibration and testing laboratories worldwide

NMIs (and designated institutes) **Provide**

- Experts to national standards body
- Experts to regional and international standards body technical committees and WGs

Metrology and Accreditation

All laboratories, including NMIs must demonstrate their competence for international and national acceptability, at NMI level that is review via the CIPM MRA

About half of the NMI community also choose to be accredited

Beyond the NMIs, the main generic assurance is via accreditation by a accreditation body that participates in ILAC (usually via a regional arrangement)

- **Some 55 000 calibration and testing laboratories worldwide choose accreditation**

NMIs **provide** technical experts to the accreditation bodies to help review top level calibration labs and other NMIs.

- And of course other metrology organisations provide experts, especially for more routine accreditations

Metrology, Accreditation and Standards

Takeaway message……

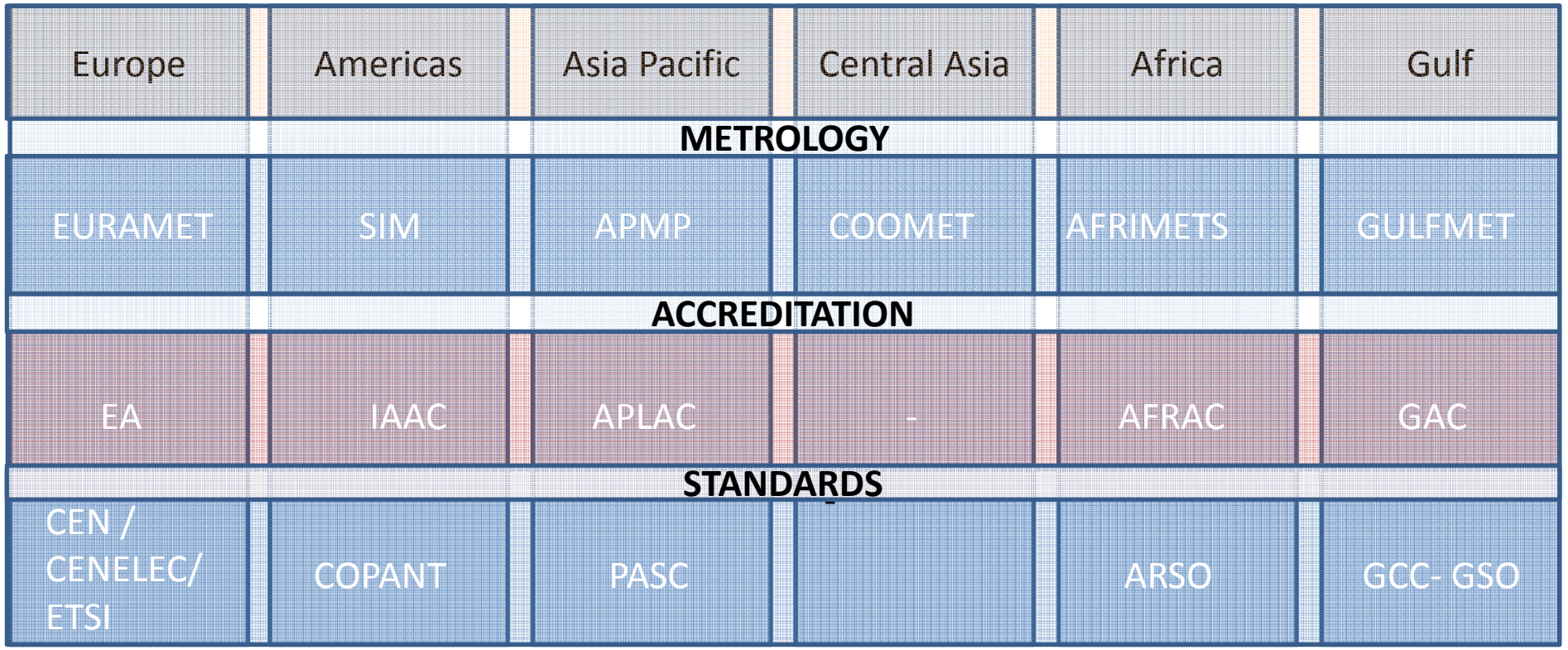
At national level the relationship between the NMI, the national standards body and the national accreditation body* is important….

If it isn't good….

FIX IT!

**Recalling that in some countries its not a single accreditation body, and there may be many standards developers too*

QI links at regional level



Not comprehensive!

Linking the QI elements at regional level - the Americas

AMONG

The Inter-American Accreditation Cooperation (IAAC)

AND

The Inter-American Metrology System (SIM)

AND

The Pan-American Standards Commission (COPANT)

ARTICLE I
PURPOSE

The purpose of this MOU is to create the *Quality Infrastructure Council of the Americas*, a partnership of peer regional organizations that provides a single point of contact for action and collaboration to support the expansion of National Quality Infrastructure in the Hemisphere. Cooperative activities will be explored and determined by the Parties within the framework of this MOU.

Linking the QI elements at regional level - the Africa

BUILDING QUALITY INFRASTRUCTURE IN AFRICA

Overview of Accreditation & Pan African Quality Infrastructure (PAQI)

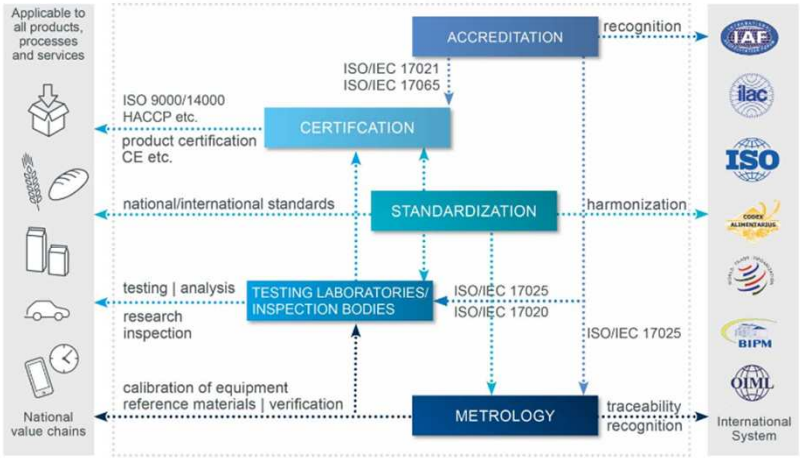
4 November 2014

By

Ronald Josias
AFRAC Chairperson
SANAS CEO

QUALITY FOR AFRICA

UNBROKEN CHAIN OF TRUST



www.bipm.org

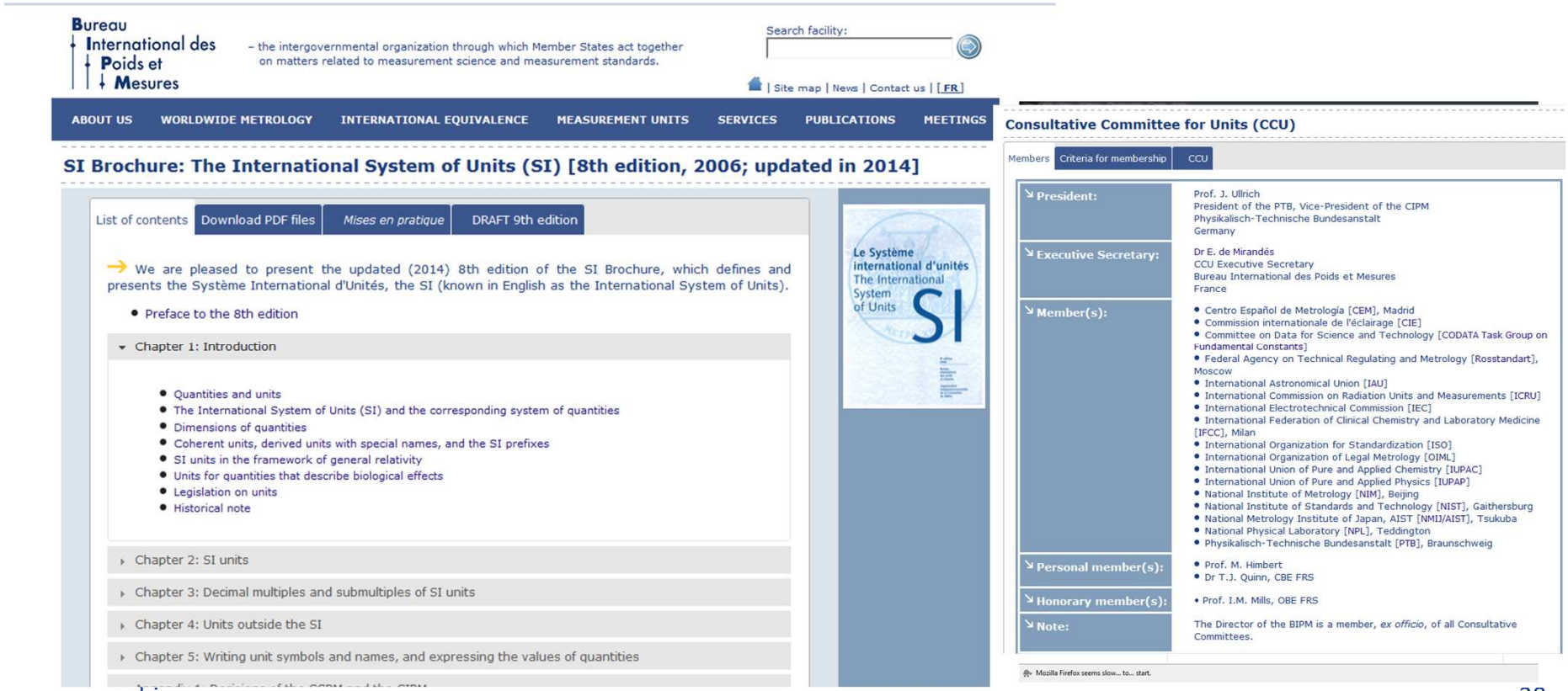
BIPM and the international QI

- BIPM promotes the interests of its Member states within the scope of the Metre Convention
  - Scientific coordination
  - International liaison

  And the BIPM and its NMI community have extensive QI links

  …. Lets take a look

The SI


Bureau International des Poids et Mesures
– the intergovernmental organization through which Member States act together on matters related to measurement science and measurement standards.
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ABOUT US
WORLDWIDE METROLOGY
INTERNATIONAL EQUIVALENCE
MEASUREMENT UNITS
SERVICES
PUBLICATIONS
MEETINGS
SI Brochure: The International System of Units (SI) [8th edition, 2006; updated in 2014]
List of contents
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Mises en pratique
DRAFT 9th edition
We are pleased to present the updated (2014) 8th edition of the SI Brochure, which defines and presents the Système International d'Unités, the SI (known in English as the International System of Units).
Preface to the 8th edition
Chapter 1: Introduction
Quantities and units
The International System of Units (SI) and the corresponding system of quantities
Dimensions of quantities
Coherent units, derived units with special names, and the SI prefixes
SI units in the framework of general relativity
Units for quantities that describe biological effects
Legislation on units
Historical note
Chapter 2: SI units
Chapter 3: Decimal multiples and submultiples of SI units
Chapter 4: Units outside the SI
Chapter 5: Writing unit symbols and names, and expressing the values of quantities
Le Système international d'unités
The International System of Units
SI
Consultative Committee for Units (CCU)
Members
Criteria for membership
CCU
President:
Prof. J. Ullrich
President of the PTB, Vice-President of the CIPM
Physikalisch-Technische Bundesanstalt
Germany
Executive Secretary:
Dr E. de Mirandés
CCU Executive Secretary
Bureau International des Poids et Mesures
France
Member(s):
Centro Español de Metrología [CEM], Madrid
Commission internationale de l'éclairage [CIE]
Committee on Data for Science and Technology [CODATA Task Group on Fundamental Constants]
Federal Agency on Technical Regulating and Metrology [Rosstandart], Moscow
International Astronomical Union [IAU]
International Commission on Radiation Units and Measurements [ICRU]
International Electrotechnical Commission [IEC]
International Federation of Clinical Chemistry and Laboratory Medicine [IFCC], Milan
International Organization for Standardization [ISO]
International Organization of Legal Metrology [OIML]
International Union of Pure and Applied Chemistry [IUPAC]
International Union of Pure and Applied Physics [IUPAP]
National Institute of Metrology [NIM], Beijing
National Institute of Standards and Technology [NIST], Gaithersburg
National Metrology Institute of Japan, AIST [NMIJ/AIST], Tsukuba
National Physical Laboratory [NPL], Teddington
Physikalisch-Technische Bundesanstalt [PTB], Braunschweig
Personal member(s):
Prof. M. Himbert
Dr T.J. Quinn, CBE FRS
Honorary member(s):
Prof. I.M. Mills, OBE FRS
Note:
The Director of the BIPM is a member, ex officio, of all Consultative Committees.
Mozilla Firefox seems slow... to... start.

VIM & GUM

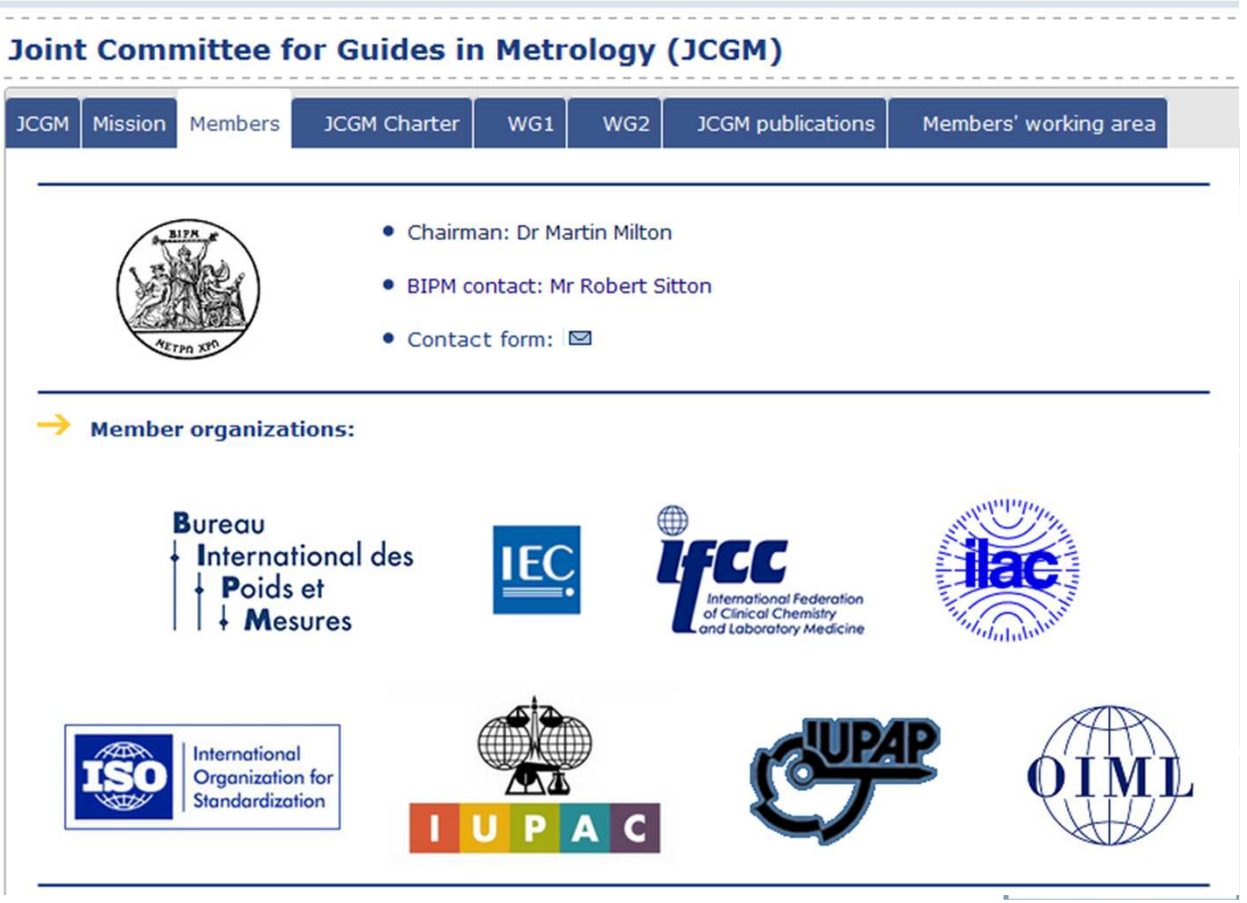
GUM

Guide to the Expression of Uncertainty in Measurement

VIM

International Vocabulary of Metrology

www.bipm.org



Joint Committee for Traceability in Laboratory Medicine (JCTLM)

BIPM
IFCC
ILAC
…….agree to cooperate to establish a Joint Committee for Traceability in Laboratory Medicine, with the acronym JCTLM.

'The goal of the JCTLM is to provide a worldwide platform to promote and give guidance on internationally recognized and accepted equivalence of measurements in Laboratory Medicine and traceability to appropriate measurement standards.'

DCMAS Network

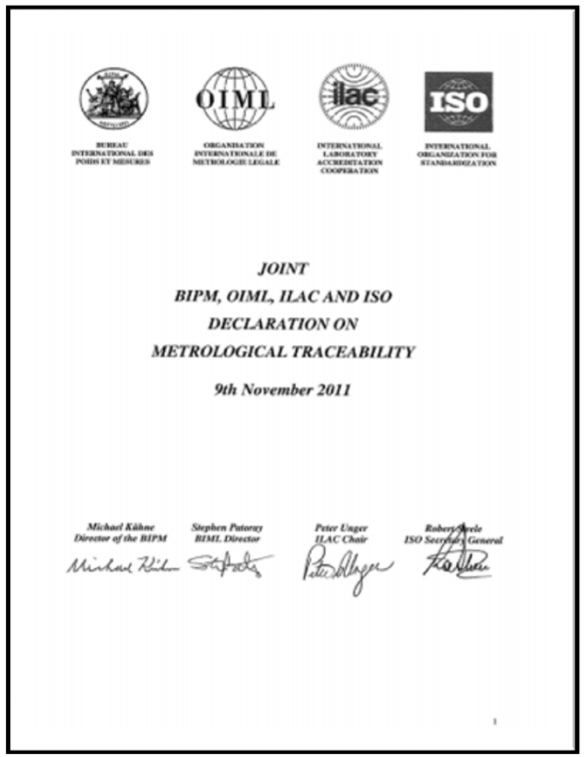
What we do?

DCMAS Network. A network on metrology, accreditation and standardization for developing countries
This initiative seeks to bring together all specialized organizations that operate at an international level and that are active in promoting and implementing MAS activities (metrology, accreditation, standardization and conformity assessment) as a tool for sustainable economic development.

Member Organisations

- **BIPM** Bureau International de Poids et Mesures
- **IAF** International Accreditation Forum
- **ILAC** International Laboratory Accreditation Cooperation
- **IEC** International Electrotechnical Commisssion
- **ISO** International Organisation for Standardisation
- **ITC** International Trade Centre
- **ITU** International Telecommunications Union
- **OIML** Organisation Internationale de Métrologie Légale
- **UNECE** United Nations Commission for Europe
- **UNIDO** United Nations International Development Organisation

Joint BIPM, OIML, ILAC and ISO declaration on measurement traceability (http://www.bipm.org/utils/common/pdf/BIPM-OIML-ILAC-ISO_joint_declaration_2011.pdf)



JOINT
BIPM, OIML, ILAC AND ISO
DECLARATION ON
METROLOGICAL TRACEABILITY

9th November 2011

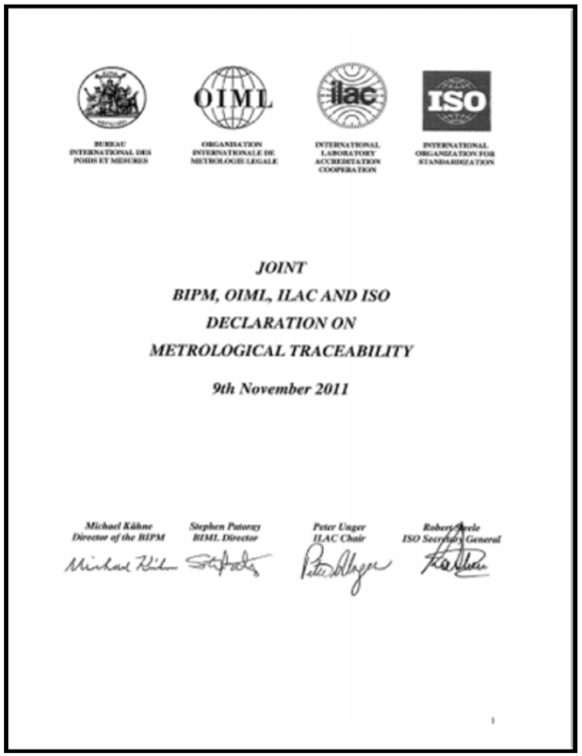
Michael Kühne, Director of the BIPM
Stephen Patoray, BIML Director
Peter Unger, ILAC Chair
Robert Steele, ISO Secretary General

The BIPM, OIML, ILAC, and ISO endorse the following recommendations:

- in order to be able to rely on their international acceptability, calibrations should be performed
  - in National Metrology Institutes who should normally be signatories to the CIPM MRA and have CMCs published in the relevant areas of the KCDB or
  - in laboratories accredited by accreditation bodies which are signatories to the ILAC Arrangement;
- measurement uncertainty should follow the principles established in the GUM;
- the results of the measurements made in accredited laboratories should be traceable to the SI;
- NMIs providing traceability for accredited laboratories should normally be signatories to the CIPM MRA and have CMCs published in the relevant areas of the KCDB;
- within the OIML's MAA, accreditation should be provided by bodies which are signatories to the ILAC Arrangement and the above policies on traceability to the SI should be followed;

The above principles should be used whenever there is a need to demonstrate metrological traceability for international acceptability.

Joint BIPM, OIML, ILAC and ISO declaration on measurement traceability
(http://www.bipm.org/utils/common/pdf/BIPM-OIML-ILAC-ISO_joint_declaration_2011.pdf)



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DECLARATION ON
METROLOGICAL TRACEABILITY

9th November 2011

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Peter Unger, ILAC Chair
Robert Steele, ISO Secretary General

Use of this Declaration

These principles underpin a world measurement system which provides a robust, internationally accepted framework within which users can have confidence in the validity and acceptability of measurements results. BIPM, OIML, ILAC and ISO strongly urge legislators and regulators to refer to the Arrangements described earlier in this Declaration and also to accept measurement results made within this system, thereby helping avoid technical barriers to trade. We also invite interested parties to endorse these principles and to make use of them in their own work.

BIPM, OIML, ILAC and ISO meet annually at senior level in a 'Quadripartite' informal discussion on issues of common interest

OIML – Legal Metrology OIML D 1

Art. 12: Traceability of measurement results

In the interests of free trade and the avoidance of issues that might be perceived by other countries or the WTO as technical barriers to trade, national requirements for traceability should be written carefully. Ideally, traceability should always be specified as conforming to the SI system, through realizations of the appropriate units and quantities at the NMI or at other countries' NMIs, rather than specifically to the NMI.

To establish whether foreign national standards meet the necessary requirements for traceability, reference may be made of the CIPM MRA. Under the CIPM MRA information is available in the KCDB, which is the publicly available database operated by the BIPM for that purpose. Inclusion in the KCDB provides a presumption of compliance with regard to traceability requirements. Where traceability cannot be established via the KCDB the CMA should establish the appropriate mechanism so that regulators have access to appropriate advice on whether alternative solutions are acceptable. Normally such advice would be provided by the NMI.

OIML – Legal Metrology OIML D 1

- Considerations for a Law on Metrology

Element no. 3

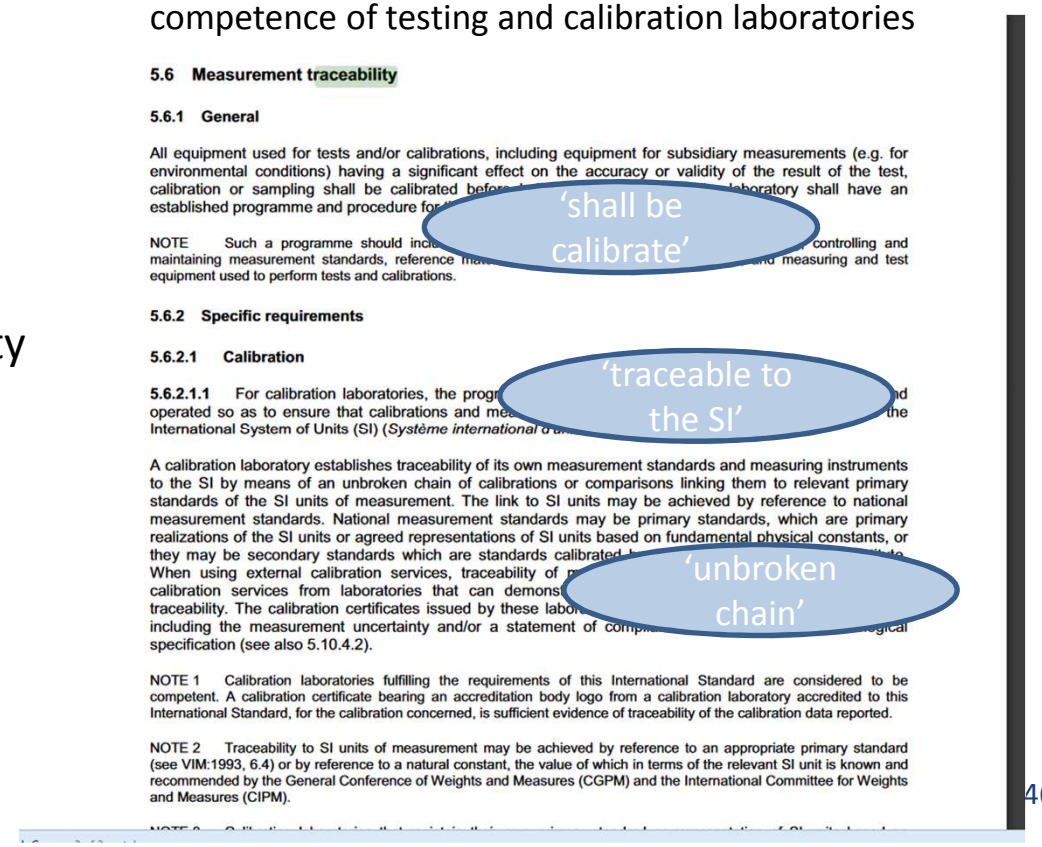
The Government shall designate the institute or institutes in charge of
- keeping and maintaining the national measurement standards and providing traceability to the International System of Units(SI),
- carrying out and/or coordinating the research work in metrology, and
- carrying out and/or coordinating certain tasks in legal metrology.

Documentary standards - measurement

ISO/IEC Documentary standards

- Use the International System of Units (SI)
- Require testing and calibration laboratories to be competent
- Embody measurement traceability
- …and thus measurement uncertainty
  - Use of the VIM
  - Use of the GUM

ISO/IEC 17025:2005 -General requirements for the competence of testing and calibration laboratories



5.6 Measurement traceability

5.6.1 General

All equipment used for tests and/or calibrations, including equipment for subsidiary measurements (e.g. for environmental conditions) having a significant effect on the accuracy or validity of the result of the test, calibration or sampling shall be calibrated before[…] laboratory shall have an established programme and procedure for[…]

'shall be calibrate'

NOTE Such a programme should incl[…] controlling and maintaining measurement standards, reference ma[…] and measuring and test equipment used to perform tests and calibrations.

5.6.2 Specific requirements

5.6.2.1 Calibration

5.6.2.1.1 For calibration laboratories, the progr[…] operated so as to ensure that calibrations and mea[…] the International System of Units (SI) (*Système international d'u[…]*

'traceable to the SI'

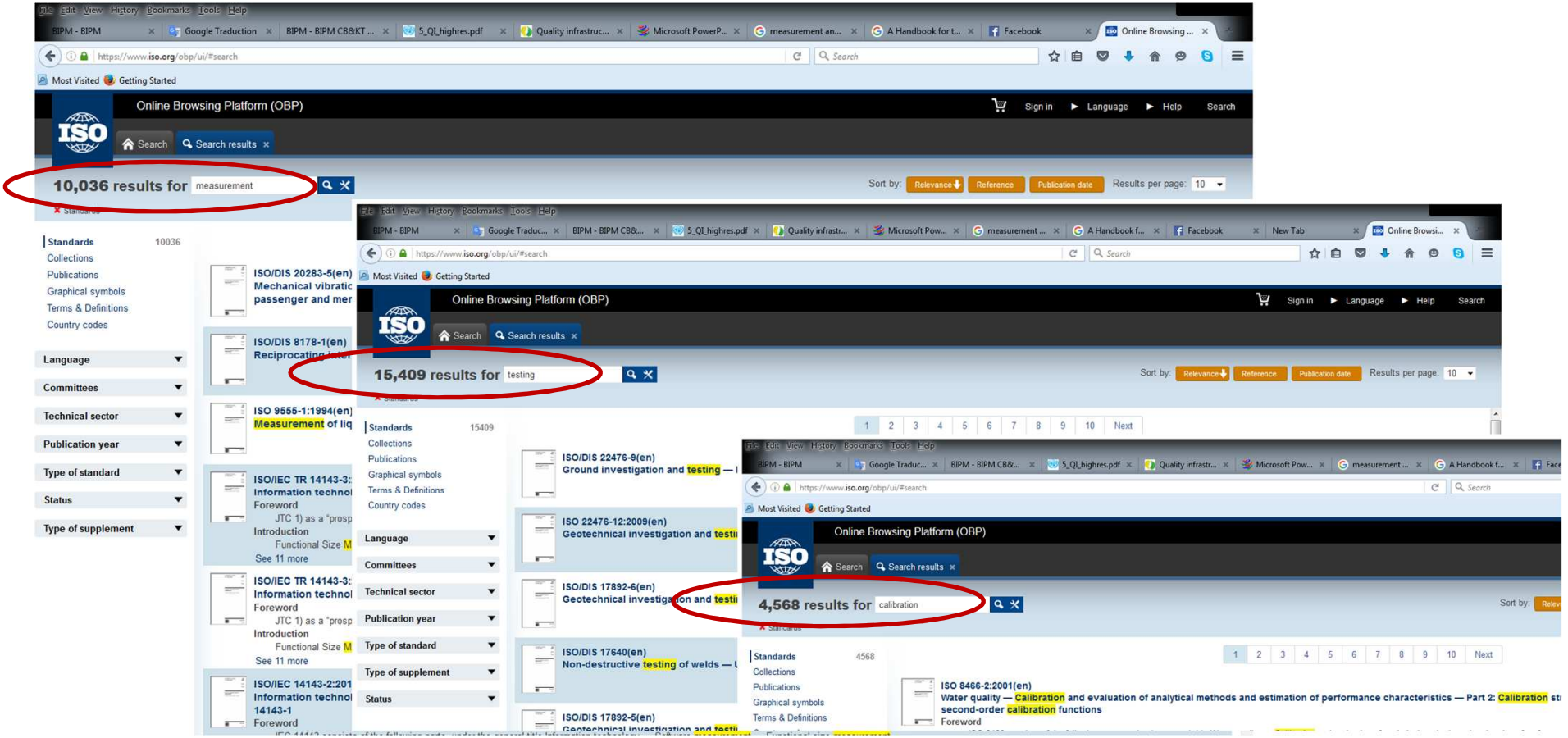
A calibration laboratory establishes traceability of its own measurement standards and measuring instruments to the SI by means of an unbroken chain of calibrations or comparisons linking them to relevant primary standards of the SI units of measurement. The link to SI units may be achieved by reference to national measurement standards. National measurement standards may be primary standards, which are primary realizations of the SI units or agreed representations of SI units based on fundamental physical constants, or they may be secondary standards which are standards calibrated […] When using external calibration services, traceability of m[…] calibration services from laboratories that can demonst[…] traceability. The calibration certificates issued by these labo[…] including the measurement uncertainty and/or a statement of compli[…]gical specification (see also 5.10.4.2).

'unbroken chain'

NOTE 1 Calibration laboratories fulfilling the requirements of this International Standard are considered to be competent. A calibration certificate bearing an accreditation body logo from a calibration laboratory accredited to this International Standard, for the calibration concerned, is sufficient evidence of traceability of the calibration data reported.

NOTE 2 Traceability to SI units of measurement may be achieved by reference to an appropriate primary standard (see VIM:1993, 6.4) or by reference to a natural constant, the value of which in terms of the relevant SI unit is known and recommended by the General Conference of Weights and Measures (CGPM) and the International Committee for Weights and Measures (CIPM).

Documentary standards - measurement



Accreditation – ILAC policy on metrological traceability of measurement results (ILAC P10)

- ILAC P10:01/2013 ILAC Policy on Traceability of Measurement Results
  This document describes the ILAC policy on metrological traceability of measurement results.

ILAC POLICY FOR TRACEABILITY COVERED BY THE ILAC ARRANGEMENT IN CALIBRATION

The general requirement for traceability in ISO/IEC 17025:2005 is:

5.6.1 All equipment used for tests and/or calibrations, including equipment for subsidiary measurements (e.g. for environmental conditions) having a significant effect on the accuracy or validity of the result of the test, calibration or sampling shall be calibrated before being put into service.

ILAC P10

5.6.2.1.1 For calibration laboratories, the programme for calibration of equipment shall be designed and operated so as to ensure that calibrations and measurements made by the laboratory are traceable to the International System of Units (SI) (Système international d'unités).

Clause 5.6.2.1.1 in ISO/IEC 17025:2005 further states that "*When using external calibration services, traceability of measurement shall be assured by the use of calibration services from laboratories that can demonstrate competence, measurement capability and traceability*".

ILAC P10

Clause 5.6.2.1.1 in ISO/IEC 17025:2005 further states that "*When using external calibration services, traceability of measurement shall be assured by the use of calibration services from laboratories that can demonstrate competence, measurement capability and traceability*". For equipment and reference standards that must be calibrated, the ILAC policy is that they shall be calibrated by:

1. An NMI participating in the CIPM MRA
2. Accredited lab covered by the ILAC Arrangement or by Regional Arrangements recognised by ILAC
3. Other possibilities:
   a) NMI outside the CIPM MRA
   b) Other lab

ILAC Policy for Uncertainty in Calibration (ILAC P14)

ILAC P14:01/2013 ILAC Policy for Uncertainty in Calibration

This document sets out the requirements and guidelines for the estimation and statement of uncertainty in calibration and measurement.

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ILAC P14

ILAC P14:01/2013 ILAC Policy for Uncertainty in Calibration

References

[1] EA-4/02:1999, *Expressions of the Uncertainty of Measurements in Calibration* (including supplement 1 to EA-4/02) (previously EAL- R2)
[2] ISO 15195:2003, *Laboratory medicine - Requirements for reference measurement laboratories*
[3] ISO Guide 34:2009, *General requirements for the competence of reference material producers*
[4] ISO/IEC Guide 98-3:2008 – *Uncertainty of measurement – Part 3, Guide to the expression of uncertainty in measurement* (GUM:1995).
[5] ISO Guide 35:2006, *Reference materials – General and statistical principles for certification*
[6] ISO/IEC Guide 99:2007, *International vocabulary of metrology - Basic and general concepts and associated terms (VIM)*
[7] ISO 80000-1:2009, *Quantities and units - Part 1: General* [8] JCGM 100:2008 GUM 1995 with minor corrections, *Evaluation of measurement data – Guide to the expression of uncertainty in measurement.* (Available from www.BIPM.org)
[9] JCGM 200:2008 *International vocabulary of metrology – Basic and general concepts and associated terms* (Available from www.BIPM.org)

Conclusions

- The value of metrology isn't easy for the everyday person to understand…..
- The metrology community needs mechanisms that help embed its principles and practices such that they are adopted (even if that adoption is often invisible)
- The international and national quality infrastructure plays a major role in ensuring good metrological practice is carried from the laboratory to the application
- At national level the relationship between the QI players is important
- The national and international quality infrastructure cooperates intensively
- Metrology is a major winner from the QI association

Thank you

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Acronyms are defined on slides that follow

Bureau International des Poids et Mesures

Acronyms used in this presentation

- ACCSQ — ASEAN Consultative Committee on Standards and Quality
- AFRAC — African Accreditation Cooperation
- AFRIMETS — Intra-Africa Metrology System
- APLAC — Asia Pacific Laboratory Accreditation Cooperation
- APMP — Asia Pacific Metrology Programme
- ARSO — African Organisation for Standardisation
- BIPM — International Bureau of Weights and Measures
- BSI — British Standards Institution
- CAP — Conformity Assessment Procedures
- CEN — European Committee for Standardization
- CENELEC — European Committee for Electrotechnical Standardization
- CGPM — International Conference for Weights and Measures

Acronyms used in this presentation

• CIPM MRA	CIPM Mutual Recognition Arrangement
• CMA	Central Metrology Authority
• CMC	Calibration and Measurement Capability
• COOMET	Euro-Asian Cooperation of National Metrological Institutions
• COPANT	Pan-American Standards Commission
• DCMAS	Network on Metrology, Accreditation and Standardization for Developing Countries
• EA	European Cooperation for Accreditation
• ETSI	European Telecommunications Standards Institute
• EU	European Union
• EURAMET	European Association of National Metrology Institutes
• EURO NCAP	European New Car Assessment Programme

Acronyms used in this presentation

• GAC	GCC Accreditation Center
• GCC	Gulf Cooperation Council
• GSO	GCC Standardization Organization
• GULFMET	Gulf Association for Metrology Gulf Association for Metrology
• GUM	Guide to the Expression of Uncertainty in Measurement
• HACCP	Hazard Analysis Critical Control Point
• IAAC	Inter American Accreditation Cooperation
• IAF	International Accreditation Forum
• IEC	International Electrotechnical Commission
• IECEE CB	IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components
• IFCC	International Federation of Clinical Chemistry and Laboratory Medicine

Acronyms used in this presentation

- ILAC — International Laboratory Accreditation Cooperation
- ISO — International Organization for Standardization
- IUPAC — International Union of Pure and Applied Chemistry
- IUPAP — International Union of Pure and Applied Physics
- JCTLM — Joint Committee for Traceability in Laboratory Medicine
- KCDB — BIPM key comparison database
- LDC — Least Developed Country
- MAA — OIML Mutual Acceptance Arrangement
- MoU — Memorandum of Understanding
- NAB — National Accreditation Body
- NMI — National Metrology Institute
- NQI — National Quality Infrastructure

Acronyms used in this presentation

- NSB — National Standards Body
- OIML — International Organization of Legal Metrology
- PAC — Pacific Accreditation Cooperation
- PAQI — Pan African Quality Infrastructure
- PASC — Pacific Area Standards Congress
- QI — Quality Infrastructure
- SI — International System of Units

Acronyms used in this presentation

- SIM — Inter-American Metrology System
- TBT — Technical Barriers to Trade
- UNIDO — United Nations Industrial Development Organization
- VIM — International Vocabulary of Metrology
- WG — Working Group
- WTO — World Trade Organization