International Organization of Legal Metrology

OIML Seminar

What Will Legal Metrology Be In The Year 2020

- Complete Set of Presentations -

Thursday 26 – Friday 27
September 2002

Espace Olano
Saint-Jean-de-Luz, France

OIML Secretariat:

International Bureau of Legal Metrology

11, rue Turgot - F-75009 Paris - France
Tel.: +33 1 48 78 12 82 / +33 1 42 85 27 11
Fax: +33 1 42 82 17 27

E-mail: biml@oiml.org
Web Site: www.oiml.org

Introduction

Today's legal metrology is quite different from what it was some twenty years ago, both at national and at international levels. However, this evolution is accelerating and has to be anticipated both by legal metrology authorities as well as by manufacturers of measuring instruments, and of course by the OIML.

Legal metrology is, in fact, facing multiple developments:

- Globalization of economies and international trade,
- Free circulation of products,
- Geopolitical changes,
- The emergence of regional structures and simultaneously the fragmentation of countries or decentralization,
- Liberalization,
- Privatization and redefinition of the role of the State,
- Citizens' demand for better health and environmental protection,
- The possibility of measuring increasingly numerous aspects of everyday life,
- The considerable technological progress of measuring instruments, rapid development in information technologies and in the issues concerning security of information systems,
- And many more.

A number of countries are revising their law on metrology, reorganizing their legal metrology structures, reconsidering the scope of legal metrological control, and studying technical regulations adapted to new technologies. Such projects will determine the orientation of legal metrology for the coming decades and must be based on a long term perspective.

The OIML has developed a "Long Term Action Plan" with the objective of monitoring its activities for the next five years. A five-year term is indeed within the reach of most of those in charge of legal metrology services, but does not provide enough perspectives for the fundamental evolutions of legal metrology.

This Seminar was the opportunity for those in charge of legal metrology and industry to meet, step back from the "day to day" issues of legal metrology, and focus on the real long term views, 2020 being far enough away for participants to "disconnect" from today's constraints, but close enough to have a realistic view of the future.

The event was held in conjunction with the 37th CIML Meeting and was open to all interested specialists from legal metrology services and industry.

Saint-Jean-de-Luz: Coast path

Saint-Jean: Louis IX Square

Ciboure: View from the Fort

Presentations

Note from the Editor concerning this transcript

The BIML contracted a local company to record the Seminar proceedings on audio cassette, including the question and answer sessions.

Unfortunately, the company concerned did not accomplish this task in a professional manner and as a result, parts of certain presentations and discussions were not recorded and can therefore not be transcribed in this report.

The BIML apologizes for this incident, which as readers will appreciate, was out of our control and the problem was only discovered after the event was over.

… and a Personal Note from the Editor

The Editor would like to express his most sincere thanks to Mr. Bernard Athané for his work in transcribing certain of these presentations from the audio cassettes and for ensuring that all the remaining texts were submitted on time by the Authors. His commitment and assistance are very much appreciated.

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Opening

The Seminar was organized and chaired by Mr. Bernard Athané, former BIML Director, who welcomed participants and then briefly explained the aims of the event and the way in which he intended to chair it. He then gave the floor to Mr. Gerard Faber, CIML President, for a more detailed introduction.

1 GENERAL INTRODUCTION TO THE SEMINAR

Gerard Faber, CIML President

The first question that springs to mind at the outset of this Seminar is "Why choose the year 2020?" Well, one of the advantages of choosing such a date is that it is absolutely impossible to extrapolate from what we are doing now. It is really a matter of using our sense of logic based on past experience, and then develop this logic by using our *feeling* to identify the trends we notice in the evolution of society.

At the outset of this event I would like to say "For those of you who will be contributing to the Seminar as speakers or when you take part in discussions, please don't simply voice your "official" opinion, but rather we would encourage you to listen to and express your *feeling*". In the year 2020 we will doubtless have new governments, new policies, perhaps other kinds of organizations, nobody knows. But we all have a kind of *feeling* about the trends we observe in our daily lives. So that is why I hope that everybody will express his or her own *feeling* and not the official positions of countries or organizations.

I believe that what we are going to be discussing is a kind of mix between what is going to happen in 2020 and what we *hope* will happen. It is very difficult to distinguish between these two aspects and it is also true that most developments are not influenced by us. We have to be very realistic. Let me give you an example: when you look at the trends in, for instance, deregulation or privatization, very often the reason for entering into this kind of discussion is not a reason with a metrological background. It is very often part of a general policy discussion in a country; governments speak about the possibility of privatization and then say to metrologists "please take part in the discussion". So very often, trends cannot be influenced by us; they just "happen" and we have to react.

However, sometimes we are able to influence the outcome. I feel that in the future, all of us involved in metrology should be active not only in listening to our colleagues and attending seminars like this one, but also in trying to influence what is happening in our governments and our ministries. But it is not only a question of *waiting* for trends, we can also try to be "trend-setters" just as the OIML is trying - and will continue to try in the future - to be a "trend-setting" organization.

Let me now offer you some remarks to start off the think process during these two days.

What will the importance of legal metrology be in 2020? My own feeling is that the importance of legal metrology is growing and that, for international trade in a global society and for reasons of public health, safety and the environment, the need will be much stronger than it is today for well organized and well documented legal metrology policies.

I believe that the role of the state in legal metrology will, in 2020, be different from what we see in general today. In my view, the state will have four responsibilities in legal metrology and metrology: (i) creating and maintaining a national metrology

system; (ii) drafting legislation and ensuring that it is implemented; (iii) defining a general policy for metrology and accreditation; and (iv) global and regional cooperation.

I mentioned the words "national metrology system". In my view this is an official description of a coherent system of laws, regulations, organisms, structures, etc. with one mission: to improve and maintain credibility in measurements. I think that the trend in the future will be to speak less about measuring instruments and more in terms of *credibility* in measurement. Credibility in measurement is helpful for international trade, for protection of the environment, etc. and is therefore a key word for the future.

Concerning the responsibilities of states, let me add that in my view, in the future the state will increasingly act as the monitoring organism for a national metrology system, rather than actually itself carrying out all the technical work that has to be done. I strongly believe that in the future, within the state "machinery" there will be a small unit for metrology comprised of highly trained legal and technical specialists, with people also coming from industry and universities, to form a kind of think-tank for metrology and to monitor the national measurement system. Much practical work will be done by independent organizations, including industry itself. I also believe that this development is not a bad one. It is absolutely not necessary that verification, testing for type approval, and even maintaining national standards should by definition be done by people from government. The government and the state should monitor the system and ensure that everything is organized in the right way. My view is that in the future, type approval will be completely in the hands of independent laboratories and industry and that initial verification, as we know it today, will disappear.

This makes it necessary that in the coming years, we allocate much more attention to what we call "market surveillance". Some time ago, we started discussions about this subject but we did not pursue these. However, in my opinion when we speak about credibility in measurement, the main thing to do in the future is to make sure that by organizing a good system of market surveillance, this credibility is there permanently and consistently.

I also hope to see that in the year 2020 we have one global organization for metrology and accreditation. You know that we already enjoy cooperation, we speak with each other from time to time, but this is only at an early stage, and we are not making much progress. My feeling is that the development of further cooperation culminating in the creation of a *world center for metrology and accreditation* under which each organization can do its own job is a logical goal and I feel that we should not be afraid of that.

I have made some remarks about the national metrology system; I feel that the job of the OIML is to further work on a global measurement system together, in my view, with our colleagues from the BIPM. At the regional level, people should work on regional measurement systems so that, in the end, there would be national measurement systems, regional measurement systems and a global measurement system, all fitting together.

So those were my remarks to set the scene for this Seminar. I will end my introduction here but I would like to note that over the last years - and I have tried to encourage this - the OIML has been changing gradually from an organization producing harmonization documents (called International Recommendations, which is still our core business of course) to one that is speaking more in terms of strategy and policy. I feel that this

Seminar is exactly fitting in the context of this development. We are increasingly able to produce very good documents and papers which can be used. We already have the *Birkeland Study*: my recommendation is for us all to read it again, as it is still very topical.

We are currently working on a study about the *Social and economic impact of legal metrology*, conducted by John Birch, which will be finished by the end of this year or perhaps early next year; it will also be a very helpful document. And in addition of course, we will work on the conclusions that arise out of this Seminar. I hope that it will be a challenging one, not only for our organization in order to define a modern metrology policy, but also for every individual country.

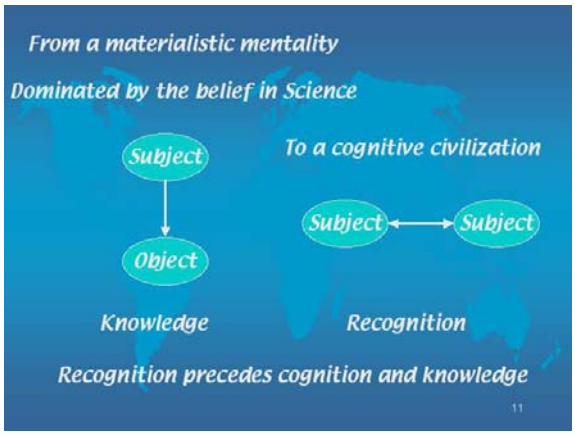
Thank you for listening to these opening remarks and may I wish you a very good Seminar.

Following this introduction, the floor was given to the various lecturers successively, starting with Mr. Thierry Gaudin, Member of the Conseil Général des Mines (France) and founder and chairperson of the association 2100 Odyssée de l'Espèce.

2 THE ROLE OF METROLOGY IN A COGNITIVE SOCIETY

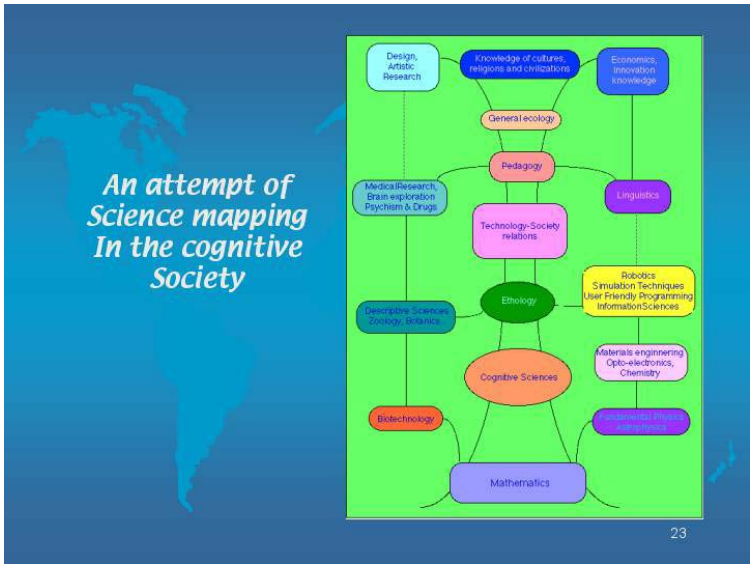
Thierry Gaudin

Most of the work I will present has been made for the French Ministry for Research in order to have a foresight on the 21st century. The first point I will stress is the speed of change. We don't believe in acceleration in history. Let me take an example. At the time of the French revolution, there were balloons going for the first time with man in the air. It was the flight of man which was a dream for millenniums that at last realized itself. Of course next year there was an enthusiastic production of plates, of garments, of tissues for skirts but you had to wait for one century and twenty years to have dirigeables, Zeppelin in Germany and Santos-Dumont in France and you have to wait one hundred year more to take its place into useful industry which is the project of cargo-lifter in Germany, the dirigeable used as a crane which can transform of course all rescue processes and may be the building industry.



So the time lag of a change in the technical system is more than two centuries. A technical system transition takes this time lag and when you look at the past, twelve centuries or six centuries before Christ when you had a global change in the technical system, it was the case.

In the case of industrial revolution, we have also the four poles of the technical system: materials, energy, but also time scale and man-biosphere relationship. In the industrial time, materials are still in cement, combustion for energy, and the measurement of the second or tenth of a second, and microbiology from Pasteur at the end of the XIX century. But this industrial revolution which started around 1750 is not yet completed at the scale of the planet nowadays and we have the signs of a new technical system revolution which we have called the cognitive revolution. The four poles are changing: materials, energy, but also the time scale which is the nanosecond now, and will be the femto-second in some ten or twenty years from now, and also biotechnology which goes deeper and thinner into the exploration of living matter.



So this is a global change which is a change not only in technology but also a change in civilization. We will explore that change saying first that it goes from a materialistic mentality which was the one of the industrial age dominated by the believe in science with this knowledge system, subject and object, to a cognitive civilization which is a relationship between subjects and also the recognition process and not only the knowledge system. It is not an information society, it will be a recognition society, which is quite different. Of course this leaves place to very small enterprises and values are autonomy and recognition ad of course the infrastructure is made of telecommunication.

The networking of this civilization deals with an amount of information much bigger than the former one. A language, when we speak normally, would be of 60 000 words. To describe modern science and technology, you need 6 millions references which is one hundred time a language. So no expert can dominate totally the modern science and technology. Intelligence at all levels is necessary and of course you have the phenomenon of the Babel tower. We are not living in an information society but in a disinformation society because no brain can handle the totality of the knowledge and so everyone is the victim of disinformation processes. The classical economic theory is no

more valid because this theory assumes the necessity of perfect information and, in this ocean of information, information is mostly imperfect. The basis touches daily life. This is of course a characteristic. Fat-pride conference is a persuasion therapy which is contradictory to the weight-watcher effect which is the go-back to measurement.

You can find on Internet medical images modeling the brain: it gives the amount of knowledge which is immediately accessible. But of course technology creates a distance between human beings. All sciences now, and in the past also, have relied on metrology. But now, we have the femto-second system.

As you know the recent Nobel price Cohen Tanuggi demonstrated that everything now is under the model of vibration. This changes the way we are looking at the universe and the way we are looking at ourselves. The other difference is that, in the time of industry, mines and crude oil were the basis on which you can build industry and nowadays, in a cognitive society, measurements are the basic input. This is the center of my message: industry relies on mines and crude oil, cognitive society relies on measurements.

We need also measurements for nature because the anxiety for nature is growing. The second world summit in Johannesburg, held some weeks ago, shows how things are growing just now. Let us talk also about globalization. If we look at a world map made ten years after Christopher Columbus trip to Cuba and other islands, it shows that the will at that time was to make a world map in order to organize world trade. But the first globalization was much older than that: it was the silk way from Mediterranean region to China. Silk way started during the 6th century before Christ and it was operational at the second century before Christ. The center was Samarkand in Uzbekistan.

The second globalization was the maritime one, with Vasco de Gama, Columbus, etc. and the third globalization is nowadays electronic. But the idea of globalization very ancient. It goes back to the Mesopotamian civilization which created metrology for trade. They invented trade, accounting, school, courts, business and the first recorded measurement inspector was living 2700 years before Christ in Ur in the center of Mesopotamia.

In the agricultural civilization, the territory is the lands. In the industrial civilization, it is the capital and the property of the machines. In the cognitive civilization, it is

intellectual property and the place you can in the mind of the people: patents, brain, copyright. This is an acceleration of competition with the rule 'the winner takes all'. You have or you do not have the pattern. This an acceleration of capitalist concentration in the first stage which hardens the forecasts of the next coming twenty years. There is another phenomena: when a new technical system comes on, it marginalizes the work force of the ancient technical system. You have a slow period of exclusion which started in the 1980s and is now worldwide a very important phenomena creating all sorts of disorder.

The responses can be of many kinds. The first one would be to create local moneys instead of global moneys like you have nowadays in Argentina because of the crisis.

But in the nineteenth century, when you had this crisis and the European revolution of 1848, what occurred is that the ruling class started a new policy, a very hard and voluntary policy, with education and public works like the Suez canal and all the urbanism like Haussmann made.

So we can guess that the following years will be of that kind. The first stage between now and 2020 will be the disarray of the show-business society. The second stage will be education and public works society. And may be, the third stage will be a creation society at the end of the XXI century. To sum up my presentation, I will say that the result of that is that the transition to the cognitive society will be a transition from homo cocacolansis that we have now to homo sapiens.

The discussions that followed Mr. Gaudin's presentation - as well as all that was said before and after the coffee beak - were unfortunately not recorded.

3 TRENDS IN LEGAL METROLOGY TOWARDS A GLOBAL MEASUREMENT SYSTEM

Manfred Kochsiek,
Vice-President of PTB and CIML First Vice-President

The key nations of the past such as the Greeks, Romans, Incas, Chinese and others had all recognized the importance of a uniform metrology system and had consequently implemented it in their empires. The decisive step towards a worldwide uniform system of units was however accomplished in 1875 with the signing of the Metre Convention in Paris by seventeen countries. Its aim was to secure international agreement on and improve the Metric System; this agreement was finally reached in 1960 with the introduction of the International System of Units, the SI. Unfortunately, although most countries have since joined the Metre Convention, the SI is still not yet fully implemented some 125 years after it was instigated.

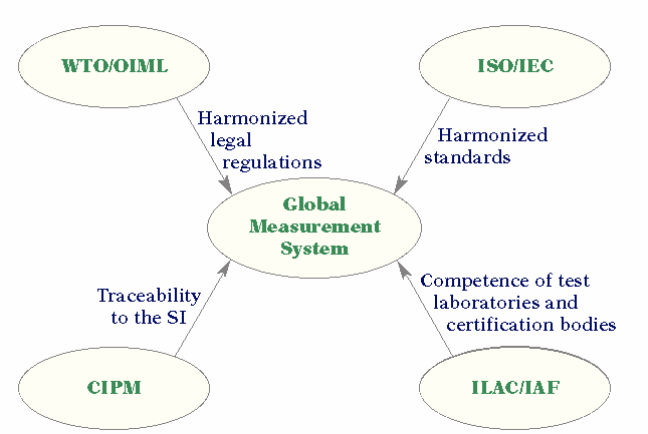
The second important step towards a global measurement system - which was far from a uniform system of units - came from the WTO which called upon the governments of its member countries to remove non tariff barriers to trade (TBT Agreement, Technical Barriers to Trade). This indirectly entails the requirement that national technical regulations in the field of metrology should be transparent and comprehensible and that they should not discriminate against any side so that they apply in the same manner to all those directly or indirectly involved in commercial transactions. This can be achieved only if the trade agreements are based on harmonized or, if possible, even on the same standards. These can be applied by the certifying bodies - usually test laboratories - to issue conformity certificates recognized, if possible, by all those having adopted the system. At this stage, it has of course to be mentioned that for nearly fifty years, the OIML has significantly contributed to the worldwide harmonization of requirements and test procedures in the special field of legal metrology. It is now reasonable to consider some definitions and basic elements of what a global measurement system and what legal metrology are.

A global measurement system is a kind of network in which a metrological task is solved according to the same criteria worldwide, i.e. the same physical units, internationally accepted standards and procedures and the same calculation of the measurement uncertainties. Legal metrology according to the *International vocabulary of terms in legal metrology* (VIML) is defined as “the part of metrology relating to activities which result from statutory requirements and concern measurements, units of measurement, measuring instruments and methods of measurement and which are performed by competent bodies”.

Now, what are the steps towards a global measurement system?

Not only the Comité International des Poids et Mesures (CIPM) and the OIML but also ILAC/IAF have made great efforts to set up a globally operating metrology and testing system. In detail four elements have to be considered, which constitute a global measurement system:

- A uniform system of harmonized national regulations in the field of legal metrology;
- A uniform system of harmonized standards in the field of non-regulated metrology;
- Worldwide recognition of the traceability of measurement results on the basis of the SI; and
- Worldwide harmonization of the requirements concerning the competence of test laboratories and certification bodies.



The various international organizations make the following contributions to these four elements within the global measurement system (see Fig. 1):

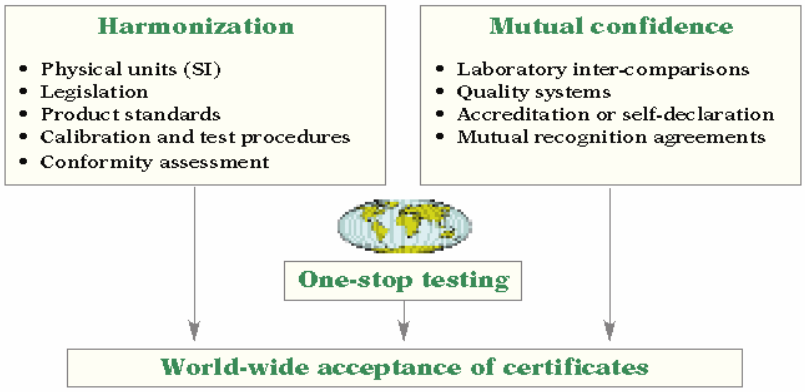
- The WTO and the OIML are responsible for harmonized legal regulations;
- ISO and IEC for harmonized standards;
- The CIPM for traceability to the SI; and
- ILAC and IAF for the competence of test laboratories and certification bodies.

In the field of legal metrology, an important contribution to the removal of technical barriers to trade is the development of the *OIML Certificate System* which helps to better respond to the needs of manufacturers for type approval and to develop procedures for acceptance or equivalence agreements in the years to come. As of today, 36 categories of measuring instruments are applicable within the *System* and nearly 1000 certificates of conformity for 13 categories of instruments have been issued to a total of 260 applicants. Millions of measuring instruments are manufactured following these certificates. Mutual cooperation, mutual confidence and mutual recognition are three steps towards achieving international harmonization in legal metrology.

Mutual confidence in the testing and metrological competence of those involved, which is an absolute prerequisite for the system to function, can be created in different ways. Some bodies are satisfied when they know that the partner institution has been notified for its task by officially authorized bodies or that it operates a recognized quality system complying with international standards. Other bodies require that the laboratory should have been accredited by internationally recognized bodies or they consider both measures to be necessary prerequisites for the mutual recognition of test certificates,

and they often even add the requirement that the laboratory should be a signatory to a regional or international *Mutual Recognition Agreement*. In the last analysis, these measures are, however, in a certain sense only subsidiary systems (subsidiary criteria), for the proof of technical competence actually desired is furnished by participation in metrological intercomparisons allowing for traceability and assessment of the uncertainty of measurement.

For society and the manufacturers of measuring instruments in particular the mutual recognition of certificates has the advantage that in international trade, further tests and conformity assessments can be dispensed within the importing country (see Fig. 2).



The ideal situation for a manufacturer would be to achieve worldwide acceptance of a certificate by one-stop testing of his product in just one laboratory of his choice.

On the global scale, different trends of a politico-economical nature are observed in legal metrology:

- While in the leading industrialized countries legal metrology was further developed and supported until the early nineties, a fundamental change took place in the last years. Due to political requirements in some European countries, legal metrology was gradually entrusted to private bodies and the exclusive supervision by the state was gradually cut back. Examples of this are The Netherlands and France. Other countries - among them Germany - may certainly follow;
- The development in the former Socialist countries is characterized by the adoption of the principles of market economics. This entails the development of a metrology system exclusively regulated by the state into a system making a distinction between areas under legal control and areas which are not subject to legal control; and
- Another trend is the regionalization of the economy. As a result of this development, the realization of the Single European Market since 1992 has set new general conditions. As a result, access to the market is also dependent on new politico-economical decisions which also affect legal metrology.

In addition, technical trends also exert an influence on development.

Fast innovation cycles and short times of adjustment make new forms of conformity demonstration necessary. Traditional type approvals have lost some of their importance.

In the field of economics, a strong trend towards globalization can be observed also as regards the methods of production and distribution, especially where large batch sizes are concerned. Establishing virtual fabrication (design, manufacture and distribution with alternating subcontractors) is only a matter of time.

The developments and trends in legal metrology can be summarized as follows:

- Removal of barriers to trade by the adaptation of national regulations and standards to regional or even International Recommendations (of the OIML) and Standards (of ISO and the IEC);
- Replacement of detailed technical product requirements by more general and flexible essential requirements ("new approach" of the European Union);
- Mutual recognition of test results, test reports or even test certificates, the prerequisites being comparable technical equipment, know-how, experience, regular exchanges of information and test data;
- More responsibility on manufacturers, including participation in different conformity assessment procedures depending on the quality management system, the background being decreasing innovation time for developing new products and the need for quick access of new products to the global market; and
- Transfer of formerly governmental tasks to private institutes, for example type approval of measuring instruments.

So for the future I expect two possible scenarios. On the one hand one can observe a strong current trend that is characterized by the slogans "deregulation, liberalization, less governmental influence, more privatization". This trend, which is due to the increasing metrological competence of partners in industry and trade, leads to a decreasing importance of former proofs of recognition which can already be seen for instance for large groups of companies. International cooperation between National Metrology Institutes (NMIs), verification authorities and private conformity assessors has already started and is being examined. The responsible bodies increasingly see that regional - in addition to national - market supervision must be ensured. A global policy for consumers and environmental protection is needed and is under discussion. With this scenario, legal metrology might be integrated completely into a general global measurement system. If today's trend (i.e. political restraint) continues, then there will be a further decrease in governmental influence on legal metrology, a further increase in manufacturers' responsibilities and a further increase in the number of private or semi-private test laboratories and certification bodies. That means that in the year 2020 governmental influence will have been reduced to an absolute minimum and restricted to specific areas.

On the other hand, there are also indications (especially during the last two or three years) that legal metrology will remain independent, with a focus on intensified market surveillance. There are some remarkable examples of scandals that make a second scenario possible due to a general loss of trust in a liberalized system. The second possible scenario is therefore that today's trends will reverse due to an increase in scandals such as BSE or frauds such as the contamination of foodstuffs by nitrate compounds. That means that in the year 2020 legal metrology will have practically kept a kind of special status, even under the conditions of a global market.

So what is my conclusion? The global measurement system and the worldwide acceptance of certificates is still a vision. From today's point of view and if all countries further follow the globalization strategy of the WTO, legal metrology will experience a strong development and be integrated by 2020. In the other scenario, legal metrology could remain independent with a focus on intensified market surveillance. What will legal metrology be in the year 2020 and which role will it play within a global measurement system? Some important aspects are summarized as follows.

Today, it cannot be predicted whether the first or the second scenario will occur because there are too many unknown parameters and unpredictable political influences.

I should also mention here that some years ago we considered a merger between the Metre Convention and the OIML but the time was not right.

Certainly one important factor will determine whether legal metrology still exists in the year 2020: the influence of new technologies such as the worldwide use of the Internet for all kinds of network, software control, remotely operated and remotely controlled measuring systems.

If governmental control and legal metrology are still necessary in the year 2020, it will be quite a challenge to maintain an effective surveillance system in a global market. New technologies are very demanding as regards both the drawing up of sufficiently flexible harmonized regulations and the competent checking of compliance by well educated, well trained and highly motivated civil servants.

Discussion

Comment: What about self-declaration or self-certification and its possible application in the field of legal metrology?

Reaction: The PTB is rather in favor of self-declaration based on a quality management system in the field of calibration. However, owing to the great number of countries which might participate in an OIML system of mutual acceptance, a kind of third party accreditation or certification system would be necessary.

Comment: It has been said that consumers should be better associated in legal metrology activities. This may just be a matter of information. In France, state controls are carried out to check whether metrology activities are adequately performed but the results of such controls are not publicized.

Reaction: This is quite right. In many countries citizens trusted the old verification systems; it should be the responsibility of the OIML and of CIML Members to clearly demonstrate to citizens the benefits of legal metrology as carried out now.

Comment: How is it possible to reconcile totally free circulation of goods, the WTO rules and the needs for a certain degree of verification at national level?

Reaction: Up to now, the problem has not been solved; the OIML is discussing the possibility of a quality mark to make sure that countries not only apply the same regulations but also have the same confidence in the system. But this is far from being an operational system at the international level.

4 HOW WILL THE DEVELOPMENT OF REGIONAL AND LOCAL AUTHORITIES AFFECT INTERGOVERNMENTAL ORGANIZATIONS SUCH AS THE OIML?

Jean-François Magaña, BIML Director

Globalization in legal metrology has been on its way for centuries

Historically in feudal organizations taxation depended on local authorities, on the definition of measurement units, and on the systematic prosecution of fraud-related offences concerning the quality and quantity of products traded. Originally, legal metrology was a consistent system locally within each feudality, using the definition of measurement units as a basis and extending to that of good measurement practices. But the downside of this local consistency was that important discrepancies were witnessed from one region to another. Traders had to travel with their own measures and instruments, and had to deal with significant differences in units and/or in measurement standards from one city to another.

The formation of states, which brought these feudalities together into "merged federations", was accompanied by a number of harmonization measures: the language of the ruling bodies became the national language, currencies were unified and were managed by central government, local taxes on the transit of goods were progressively abolished, and the measurement units in use in the central capital city became the national measurement standards. The prosecution of fraud-related offences concerning the quality and quantity of goods generally remained within the scope of local regulations and jurisdictions. As the centuries passed, each country established its own national measurement system, but local units sometimes survived and were used locally as customary units.

By the end of the 18th Century, the situation of metrology in most countries had already become quite complex. The uniformity and consistency which had existed in the feudalities had sometimes given way, at national level, to the coexistence of national and local units bearing the same name, but having different values. In France for example, one could have to deal with the pound of Paris (the national one), but also with the pound of Bordeaux or of other cities. The local jurisdictions, in charge of fair trading, practiced legal metrology at their level, but no authority was in charge of unifying measurements and legal metrology regulations at national level.

During the 19th Century, the development of energy and technologies resulted in the emergence of industry and in the acceleration of trade. The systems of units were unified in each country, in order to answer the new needs of science, technologies and the economy. These systems were extended to new fields of measurements, giving rise to new units. A singular country, whose scientists and philosophers had cooperated together for decades, made a political decision at the very beginning of the 19th Century to abolish the old unit systems and to introduce a new scientific-based system. In so doing, France anticipated the future needs of unification and consistency and proposed

the metric system to other nations. However, this new system was only generalized when the economy and industry felt there was a real need, some decades later.

The rapid development of national trade during the 19th Century convinced most governments to introduce some degree of consistency into their regulations related to measuring instruments used in trade, thus rebuilding a national legal metrology system. However in a number of countries, and especially in federal states, the prosecution of fraud-related offences and the implementation of legal metrology controls remained the responsibility of local authorities. Legal metrology was then often rebuilt in a bivalent way, where measurement units and measurement standards, and most often technical requirements, were the responsibility of the central authority or government, while the implementation of legal metrology controls was the responsibility of local authorities or governments.

Very soon, the necessity to harmonize measurement standards at international level appeared and this resulted in the adoption of the Metre Convention in 1875. The international situation at the end of the 19th Century (and up to the middle of 20th Century) reproduced on a larger scale the situation which had prevailed nationally at the end of the 18th Century: a fairly good harmonization of measurement units and of measurement standards at international level, but diverging national legal metrology requirements and sometimes even specific custom-designed units.

At the end of World War II, a number of Inter-Governmental Organizations – among which the OIML – were founded. All these Organizations had for objective to set up (by consensus) mechanisms for regulation in fields in which countries previously acted individually: international relations (UNO), health (WHO), alimentation (FAO), development (UNDP, OECD), finance (IMF), trade (GATT then WTO), etc. The OIML's objective is to contribute to setting up a *Global Measurement System*, as described in the report published by CIML Immediate Past President Knut Birkeland.

Everything could have continued to progress within the OIML, as in other Organizations, in a steady and foreseeable way. Based on the legitimacy of states and on their competence, the OIML developed model regulations on the basis of which Member States would voluntarily harmonize their national regulations and recognize each other's measuring instruments and measurement results. In this way, the dialogue between states would have been a simple way to provide the intended regulations, if the end of the 20th Century had not brought about a number of new transformations which also had to be taken into account.

The construction of new economical and political blocks

In the second half of the 20th Century the industrial, commercial and financial structures developed in a transnational way, having developed in a national way during the 19th Century. This globalization is sometimes considered as a totally new phenomenon, but in fact it is a simple and logical continuation of the globalization pattern started one century before, which led these structures to develop naturally from local to national level. This globalization is of course now considerably accelerated by the development of information technologies.

During the 19th Century, local governments found themselves increasingly unable to regulate their respective economies and to face this growing trend towards globalization, and national governments had to take over this mission. Today, in a similar way, individual states are no longer able to achieve the required economic regulation and they are organizing themselves into regional structures (political and/or economic): the European Union, APEC, SADC, etc.

This construction is still under development, and in particular has neither abolished nor politically merged the individual states - which are in fact the only entities which may legally participate in intergovernmental Organizations such as the OIML. However, in the fields of activity of these Organizations, the Member States are also transferring an increasingly significant part of their power to the regional structures, which deal with support to the economy, technical regulations, taxes, social protection, etc., and which are players in the fields covered by the International Organizations, without being able to be members thereof.

It is possible to come to a consensus on a model regulation within the OIML, while a diverging model regulation would be adopted by consensus in a regional structure. As regional structures are not necessarily bound by the OIML Convention, they may issue diverging regional regulations and make them binding for their Member States. Those OIML Member States which are also Members of a regional structure may therefore lose a part of their autonomy and scope of responsibility, and may not be able to fulfill all their obligations towards the OIML. This power transfer from individual states to regional structures is a loss for the OIML, if the regional structures do not themselves participate in the OIML.

The fragmentation of states

When the United Nations was founded in 1945, there were initially 51 UN Member states. Today there are 189.

From the middle of the 20th Century onwards, an explosion was observed in the number of independent states, sometimes of a small size. This evolution resulted from a considerable demand for a return to specific cultural identities. A number of states which existed before the middle of the 20th Century were split into several smaller states corresponding to these cultural identities. Other states evolved towards a decentralized organization, in which a large autonomy was granted to local authorities. Local parliaments were sometimes installed, with quite far-reaching powers. Many states evolved towards a more federal organization, or split up into different states.

A question may be raised when states are fragmented into several smaller independent states: will technical structures be viable in each of these independent states? Is it appropriate - and possible - to develop Metrology Institutes and Legal Metrology Institutes in each of the smaller states which are similar to those which existed in the original country? What is the minimum population or gross national product necessary to be able to afford such institutes, and what capacity may be envisaged for them?

Federal organization raises a number of questions to Organizations such as the OIML. In the same way as the regional structures mentioned above do not have the status of a state and are not Members of the Organization, neither the local structures in a

decentralized state nor the states of a federation can individually participate in the OIML, while at the same time their increasing power may raise new technical barriers to trade.

The development of these federal or decentralized schemes transfers power to the local structures. Does this transfer, added to the transfer of power to the regional structures mentioned above, contribute to decreasing the power of the states? Shall we in the years to come, see most regulatory activities disappear at the level of states and be transferred partly to regional structures, partly to local authorities? What would then be the meaning of intergovernmental treaties such as the OIML Convention?

The trend towards privatization

Another evolution affects the role of the states in legal metrology: the present trend to privatize or to delegate the technical tasks of legal metrology to private bodies. Other lectures in the 2020 Seminar present the consequences of this evolution on the role of the states, but the consequences on the international activity of legal metrology may also be important.

A number of bodies in charge of important legal metrology tasks such as type approval and initial verification, are already private bodies. The technical competence required for OIML work for the most part lies in these private bodies and they play an increasing role in the Member State representations in the OIML structures. Is the OIML moving towards a more specialized allocation of competences and work, where the Member States would be essentially present in the Conference and where the Committee would essentially be composed of increasingly private technical bodies?

Considering the perspective of several states sharing resources, any institute that owns costly equipment used by several states will enjoy, *de facto* if not *de jure*, competence in legal metrology in each of these states.

In this evolution towards privatization or delegation to private bodies, it could happen that a given private body be designated for type approval by several countries, that several private bodies from different countries merge or take on mutual shares, or that a private body becomes a major shareholder in other countries' bodies.

The international technical control bodies, who are active in the fields of security control, product certification, bulk quantity certification and quality systems certification, and who already provide measurement and calibration services, could quite rightly wish to play a specific role in national and international legal metrology.

Such evolutions, which are simply the continuation of the ongoing increasing tendency towards globalization, raise the crucial question for the OIML of the relevance of having formal relations with private transnational or international bodies, and having such bodies play a specific role in the global legal metrology system that the OIML has to develop.

Which evolutions can the OIML expect in this context ?

The above considerations do not question the utility of the OIML. The need for regulation mechanisms (at international level), compatible metrology systems, and a

Global Measurement System, become more and more evident as globalization progresses.

A possibility was conceived some years ago by observers from outside the OIML: to consider the OIML as a "plain" international standardization body and to transfer most of the OIML's work to the general international standardization bodies. But this would be an error. Indeed, the OIML deals with technical issues using methods close to those employed by standardization bodies, but the essential purpose is to harmonize regulations and legal requirements, and the legal aspects - the issues related to law implementation - are of major importance in the Organization's work, including that which seems to be of a purely technical nature. In addition, such an evolution would be contrary to the goals and efficiency of the OIML, as the commitment of Member States would disappear. The strength of the OIML, as a harmonization body, directly stems from the legal authorities of the member countries.

The Members of the OIML are states, and can legally only be states. In the future it will be necessary to improve the implementation of the obligations specified in the OIML Convention, and to make sure that these obligations are taken into account by the Regional Organizations as well as by the local authorities.

This requires a constant dialog between the OIML and the Regional structures in order to take account of their policies, to answer their needs and to encourage them to make use of the OIML in their policies. It is not foreseeable under the present Convention that regions become members of the OIML and participate in the formal process of decision making, nor in the adoption of Recommendations. On the other hand, regions could be more formally associated in the preparation of the OIML Action Plan and priorities. To accomplish this, it is essential that those regions that are already structured become or continue to be partners of the OIML, and that the OIML encourage the development of structures in those regions which are not yet organized.

An example of relations between regional structures and Intergovernmental Organizations must be noted. In the World Trade Organization, the members are states. However, the members of the European Union decided to delegate their powers in negotiations as well as their votes, to the European Commission. This is a very efficient way to better involve a Regional Organization in international work, and benefits at the same time the Regional Organization, its Members and the International Organization. This shows that establishing links between an International Organization and a regional structure is not only the task of the International Organization, but also that of the participating states. The development of relations between the OIML and Regional Organizations will not be done against the Member States' will, but in harmony with them.

To prevent subnational authorities from drawing up local regulations which diverge from OIML Recommendations is a difficult task for the OIML and can only be done by each Member state. The role of the OIML may only be one of monitoring, communicating information, and maintaining updated databases on national and local regulations. This function is an extension of the role of the OIML Documentation Center mentioned in the OIML Convention. This requires a very important reform of the principles of this Documentation Center, in particular using new information technologies.

The information society

A phenomenon which has appeared over the last few years may play a prominent role in the political and social evolution at international level, and in the future of International Organizations.

Globalization advances using the communication tools that technology and the economy provide it with. In the 19th Century, such communication tools were the railways, newspapers and telegraph. In the 20th Century, airplanes, radio, television and telephone were used and now - since the last few years - the Internet. These are the tools for the globalization of economies, trade and political organizations. They have different geographical ranges and have successively permitted globalization at the level of countries, then continents, and now worldwide. However, the use of these tools is not restricted to industry, banks and governments, now they are readily available to the general public. After a short period of diffusion and appropriation, these tools allow public opinion to be globalized, i.e. they allow the emergence of public opinion within their specific geographical range: a country, a continent, or the world.

Today we can observe the beginnings of an international public opinion, whose expression is just starting. International associations are expressing general concern about environment protection, durable development, food safety, and the need for mechanisms to regulate the globalization process. This international public opinion is still anarchic, it has no clear representation, it may not yet be democratic, but it is appearing and growing, it has a notable influence on national public opinions, and it will probably be a major political fact in the coming years.

This international public opinion needs counterparts to dialog with. Political counterparts are governments, collectively (G8 summits) or individually. But it also needs to have a dialog with Intergovernmental Organizations, who work on specialized issues on behalf of governments. It will be essential in the future that International Organizations be as transparent as possible for public opinion, that they provide all necessary information about their objectives and their work, and that they listen to the needs and concerns of this international public opinion.

Until now, the OIML did not have any direct communication with the public, all dialog went via the CIML Members. In the future, some direct communication on the part of the OIML with the public has to be envisaged, and a policy must be developed by the CIML for this. The awareness of governments on metrology and legal metrology will depend on the awareness of the public, and the OIML must help governments to answer the needs of the public in metrology.

Discussion

Comment: What is the situation with regard to the European Union?

Reaction: There is a general policy governing the relationship between the OIML and regional organizations (and not only the EU). When a region develops metrological regulations, the OIML must have close links with that region. There is perhaps not a unique way for developing and maintaining such links. In the case of the EU, the OIML must maintain links with the European Commission and with the Member States of the EU which must discuss between themselves the best way for Europe to be associated with their obligations as OIML Members. A solution has been implemented at the WTO level: for certain matters, a Member of the European Commission speaks on behalf of EU countries. But other approaches may be envisaged.

Comment: The world is perhaps not going in the direction of a worldwide government, but it is going in the direction of specialized worldwide organizations (WTO, WHO, OIML, etc.). Concerning judicial power, its internationalization is developing as well, which does not mean that each country will have the same laws, but that a supreme worldwide court might exist to solve problems including those relating to the fairness of international commercial exchanges, thus with an impact on OIML activities.

Reaction: This is of course an evolution which has to be carefully observed by the OIML.

Comment: In his introductory presentation, the CIML President evoked the possibility of a single worldwide center for metrology (including legal metrology) and accreditation. What is the situation about this?

Reaction: There is a global coherence between metrology, legal metrology and accreditation and in any case, the actions of the three international bodies that are competent in these fields must be closely coordinated. Today, their status is different mainly because national accreditation bodies often have a private or commercial status. A merger of ILAC and OIML cannot be envisaged in the short term. However it is possible not only to have close links between the three organizations but, why not, to decide on a ‘geographical’ rapprochement so that their bureaus/secretariats are located on the same ‘campus’ which would allow daily contacts. If we consider only the BIPM and the OIML, a merger would be possible owing to the intergovernmental status of both organizations.

Comment: It should be noted that in certain countries, there is a unique national body for metrology, legal metrology and accreditation. This permits close relations; however, the goals of the three activities and especially their ‘spirit’ are different.

Reaction (by the CIML President):

The concept of credibility in measurement is based on good legislation, market surveillance, traceable measurements, measuring procedures, quality systems, etc. which means that the three organizations responsible for these aspects at the international level should work more closely together and have a kind of common 'roof' if it is not possible to merge them into one body. An additional argument is that a unique organization (or three well coordinated organizations) would offer a better profile to governments and to the public.

Comment: Accreditation deals with conformity assessment. If type approval or verification in legal metrology are considered just as conformity assessment procedures, then it is possible to include them under the 'roof' of accreditation. But then legal metrology as such might disappear.

Reaction: This introduces the question 'What is legal metrology?'.

5 LEGAL METROLOGY AND THE METRE CONVENTION

Lev K. Issaev, CIML Second Vice-President,
Deputy Director, VNIIMS, Russian Federation

One can say that OIML was established initially in 1937 because the First International Conference on Practical Metrology which had been convened that year by the French government had created a Provisional Committee of Legal Metrology instead of the intended Permanent International Consultative Committee for Practical Metrology acting as an advisory body to the CGPM (Conférence Générale des Poids et Mesures). This was the proof that at that time it was considered appropriate to create a new international body, independent from the Metre Convention, to deal with legal metrology. This new body was in fact finally established in 1955 and in 2005 we will celebrate the fifty-year anniversary of the establishment of the OIML.

Some years ago (March 1995) there was a proposal from the French government to study the possibility to merge the two intergovernmental metrology bodies which are located in or close to the same city, Paris. After long discussions, it was decided that a merger was not appropriate (at least for the time being) but that regular contacts between the two organizations should exist. A joint Metre Convention/OIML working group was established and meets every year in February. This group has recently been enlarged in order to associate ILAC.

The participants in the Metre Convention activities are the National Metrology Institutes (NMIs) with a main focus on national measurement standards. For legal metrology, these national measurement standards are important but not at the first place because legal metrology is related to other activities. Therefore, the participants in the activities of the two intergovernmental metrology bodies are quite different, with the exception or perhaps five or six countries for which the representatives on the OIML are the Directors (or their Deputies) of NMIs. I suppose that it is quite clear that the two organizations have different and well defined fields of activities. In addition, I would like to repeat my opinion that metrology is not only the science of measurements: it also includes specific activities related with measurements, this second aspect of the definition of metrology being closed to our legal metrology activities which include type approval testing and verification, as well as procedures related with metrological supervision and control.

The Metre Convention bodies (including the International Committee of Weights and measures of which I am a Member) are mainly responsible for the highest level of accuracy and for the traceability at the level of the national measurement standards whereas legal metrology is close to the measuring instruments, their usage and the requirements applying to such instruments. In fact there is a gap between matters of traceability and matters of usage of measuring instruments with no specific international body responsible for this part of metrology. So I suppose that this gap is covered by bodies which are not explicitly related to metrology, e.g. bodies which are close to standardization, certification, accreditation, etc., which means that step by step we are loosing our metrological position in this field. Sometimes we are trying to say that type approval testing is some type of conformity assessment, and that verification is not a

very important procedure because it is close to calibration or may be it is some type of certification. This is a dangerous situation for us which is not acceptable.

Some years ago, Prof. Kind who was at that time President of the International Committee of Weights and Measures, had made a classification of our activities with the following three groups of activities: measurement standards, measurement related regulations, and applications by users. The widely recognized need for quality of products and services is more close to the application by users. The classical scheme has several parts:

- NMIs, which are responsible for establishing and maintaining national measurement standards, for disseminating the size of these units, and for acting as centers for expertise in measurements.
- Calibration networks, calibration laboratories and laboratory accreditation.
- Regulations and specifications, including governmental regulations, legal metrology, and voluntary and regulatory standards.
- Users of metrology (including metrological information, measuring instruments, etc.): these are manufacturers and other industries, bodies involved in trade and commerce, health and safety, environmental protection, science, communication, transportation, enforcement of government regulations, production and distribution of energy, military services, etc.

For certain of these activities there exist international bodies: the Metre Convention bodies for units and calibration, including the CIPM MRA; ILAC is active for laboratory accreditation , the OIML for type testing land verification laboratories, etc. However it is not clear where the responsibilities of NMIs stop. It is possible for the OIML to be between the NMIs and the users of metrology since this field of work may be empty in many countries and since it involves regional bodies with which the OIML has good relations. The OIML should increase its membership so that all UN countries participate, directly or indirectly, in its activities. This could be achieved through an increased participation of regional organizations in the OIML so that the OIML might increase its influence on all over the world.

When comparing the situation of the OIML and that of the Metre Convention in relation with certain trends of our modern world, in my opinion the OIML is in a better position especially with regards to relation with WTO since the OIML has a status of observer the WTO. Therefore, the OIML is more close to the UN family, more close to WTO and more close to practical life. It seems to me that its is not possible to envisage, even in the future, a merger between the two international metrology organizations since both have very well defined and clear responsibilities. However, it is necessary that the OIML activity fills the gap, at the international level, between users of metrology, thus establishing a worldwide measurement system.

6 PATTERN APPROVAL AND PATTERN COMPLIANCE IN AN AGE OF GLOBALIZATION – THE AUSTRALIAN APPROACH

Judith Bennett, CIML Member, Executive Director, NSC, Australia

and

Adrian Caster, Manager, Pattern Approval Laboratory, NSC

1 The changing political and economic climate

The manufacture of legal measuring instruments is becoming concentrated in highly industrialised countries, and increasingly controlled by multinational companies who are supplying the world market. Despite the fact that our client base has 'globalised' we (legal metrology authorities) still operate within our own strict national or 'economic community' boundaries, and impose our own legal and administrative requirements. National pattern approval requirements represent a significant regulatory barrier to international trade. In small markets like Australia, they impose significant costs on manufacturers and reduce market competition and product choice. The net result is an increase in consumer prices and slow adoption of new products and technologies.

This is a situation which will not be tolerated in the global economy of the 21st century. It seems inevitable that we will all be living and working in a climate of economic rationalism and market deregulation. This is a dangerous climate for legal metrology authorities. The fundamental nature of our regulatory role is not well understood by governments or by the community in general, and we are in danger of being dismissed by the younger generation of bureaucrats, as old-fashioned technocrats who create unnecessary barriers to trade.

Unless we, the international legal metrology community, start to respond to the challenges of globalisation and the associated political and economic imperatives, our prospects of surviving until 2020 do not look good.

2 Globalisation of legal metrology

In essence, our proposal is that the OIML needs to make the transition from a 'harmonisation and coordination' approach, to an integrated global system of legal metrology. The globalisation of legal metrology should reflect the globalisation of industry and trade, whilst still respecting the sovereign rights of individual Member States.

The key elements of a global system would be:

- Mutual acceptance arrangements for type approval test reports based on OIML Recommendations;

- Pattern approval testing by a small number of specialised laboratories, located in major manufacturing countries and regional centres;
- A coordinated international pattern compliance program.

Mutual Acceptance Arrangements

A "Framework for a Mutual Acceptance Arrangements on OIML Type Evaluation" has been developed by the members of TC 3/SC 5 and has now reached its 9th Committee Draft. This has been a difficult process, but now appears to be close to reaching general acceptance. This will be a watershed decision in the life of the OIML, which will have a major impact on the future operations of all individual Member States and on the BIML.

Rationalisation of pattern approval facilities

The introduction of mutual acceptance arrangements will inevitably lead to a gradual rationalisation of pattern approval testing laboratories. It is anticipated that a small number of laboratories, located in the major industrialised countries and regional centres, will specialise in providing this industry service, and their reports will be accepted by most other Member States.

The main benefits of this approach would be:

- Economies of scale in providing industry testing services;
- A single international testing process, avoiding multiple testing and associated costs and delays for manufacturers;
- Reduction in regulatory barriers to trade;
- Maintenance of a high level of competence and quality systems within specialised laboratories;
- Ability of specialist laboratories to invest in new equipment and keep pace with new technologies.

However, there will be some critical issues to be addressed, in particular:

- The rationalisation of pattern approval testing facilities could mean that many Member States may lose their technical capabilities; and
- A single pattern approval test is unlikely to be acceptable as an adequate basis for international confidence in the long-term performance of an instrument; so
- A 'safety net' will be required, in the form of an international pattern compliance program.

An international pattern compliance program

For some time, there has been a recognition amongst CIML Members that there is a strong focus of resources on pattern approval testing, but very little focus on ensuring that production instruments conform to type. This leaves the whole system vulnerable to the selection of so-called "gold plated" instruments by manufacturers seeking pattern approval, who often openly acknowledge that they have difficulty in consistently achieving the standard in their production plants. This practice is perpetuated in an environment in which there is little market surveillance on the part of legal metrology authorities. With the implementation of mutual acceptance arrangements, it will become

even more important for Member States to ensure that the instruments released onto their markets comply with the appropriate pattern approval standards.

It is apparent that many countries are not in a position to carry out national pattern compliance programs, as such programs are essentially in the public interest and must be funded by government. With the decrease in global industry revenue from pattern approval testing, under an OIML MAA, many national governments will face a critical decision: to pay the full cost of maintaining testing facilities and operating an effective national market surveillance program, or to close their laboratories and to trust in manufacturer declarations that production instruments consistently comply with the approved pattern.

The National Standards Commission has chosen the former option, with the support of the Australian government, because we have a legal responsibility to ensure pattern compliance, and because we believe in the deterrent value of a random surveillance program. However, this is an expensive option. On an international scale, a multiplicity of national compliance programs would be a very inefficient approach - given that many laboratories would be testing the same population of instruments.

Consistent with a global approach to pattern approval, we see the opportunity for a *global* approach to pattern compliance testing. We propose, for the consideration of Members, that participants in each Mutual Acceptance Arrangement establish a cooperative pattern compliance program for the instruments which are covered under the MAA. A coordinated program of sampling and testing of instruments, and the sharing of results, would provide an effective global surveillance program at a very small cost to individual Member States.

Of equal importance would be the opportunity for participants to develop joint policies and take collective action against non-compliant manufacturers. The risk of losing global market approval would be a major incentive for manufacturers to deliver compliant products to all markets at all times.

Figure 1 illustrates a possible global approach to pattern approval and pattern compliance by the members of a Mutual Acceptance Arrangement for a single OIML Recommendation. This model assumes that the BIML would employ a Data Manager for each MAA. That person would manage and disseminate information, and use the database to determine a sampling plan for pattern compliance testing. MAA members would pay an annual fee to cover the cost of pattern compliance testing and data management.

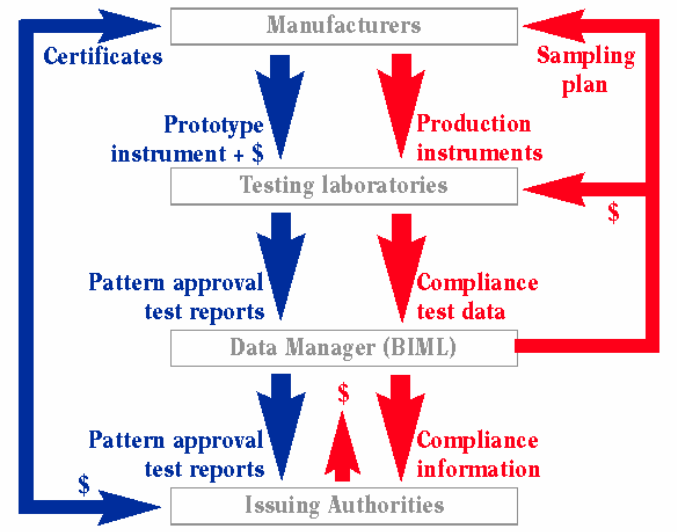


Fig. 1 A model for 'global' pattern approval and pattern compliance within an OIML Mutual Acceptance Arrangement

We recognise that this proposal is a radical concept, which would require considerable trust between the OIML Member States, and careful planning and design. There may always be some Members who will retain national responsibility for pattern compliance, for legal or strategic reasons. However, with a 2020 horizon in view, we present the global model for debate and consideration by the OIML.

The Australian approach to a national pattern compliance program, and our early experiences, may be of interest in this debate, and are outlined in section 3 below.

3 The Australian experience

Strategies adopted in 2001

In 2001, the National Standards Commission entered into its first bilateral Mutual Recognition Agreements - with NWML in the UK, NMi in the Netherlands, and the Ministry of Consumer Affairs in New Zealand. The key elements of these agreements are:

- Acceptance of test reports which conform to OIML formats (for the selected instrument categories);
- Mutual confidence in test results based on third party accreditation to ISO/IEC 17025 by a signatory to the ILAC MRA;
- A focus on agreements which will facilitate trade between Australia and its major overseas trading partners, and optimise benefits for Australian manufacturers and importers.

In parallel with the introduction of mutual recognition arrangements, the NSC also announced that it would implement a national pattern compliance program. Our objective in doing this was to make all manufacturers aware that we have an effective market surveillance system in place, and we expect production instruments to meet the approved pattern, whether they are initially tested in Australia or accepted under mutual recognition arrangements.

Early experiences with mutual recognition arrangements

In the early stages of processing pattern approval applications under our mutual recognition arrangements, we have encountered a number of issues.

- There are slight differences in interpretation and application of OIML requirements between testing laboratories. There is an ongoing need to discuss and resolve points of interpretation, to ensure uniformity of practice, and this is a constructive process for all concerned. However, this experience suggests that the implementation of an OIML MAA could involve a major exercise in clarification and alignment of procedures. It will be important to ensure that agreed interpretations are systematically incorporated into revisions of OIML documents by the relevant Technical Committees.
- There are some differences in methods of testing and the design of testing equipment between laboratories. In some cases these can lead to differences in test results and performance evaluations. This is an area which warrants further investigation.
- It is a practice of some OIML Issuing Authorities to outsource some components of pattern approval testing to third parties, including instrument manufacturers. This practice compounds the problems of uniformity of interpretation and methodology, and raises significant questions of confidence in the capabilities of the third party and the independence of test data. At the present time, the NSC does not accept third party data under its mutual recognition arrangements.

The design of the Australian pattern compliance program

All pattern approval examinations include tests of an instrument's performance under different influence factors, particularly temperature, humidity, voltage, and electromagnetic radiation. These aspects of performance cannot readily be assessed under normal operating conditions, and problems may go undetected during trade use. The NSC has implemented a systematic pattern compliance testing program to address this issue. The steps in this process were as follows:

- A complete listing was made of all instruments with a current Australian pattern approval, indicating all models included on each approval certificate.
- It was decided that each instrument would be subjected to each of the 'influence factor' tests over a 5-year period. The program commenced with temperature testing, as this was considered to be the most critical.
- A pattern compliance database was designed. This allows for a planned testing schedule to be entered for each instrument, and for the progressive recording and analysis of test results.
- Two non-compliance categories were defined, to assist in interpreting and reporting the findings of the program:

    - Minor failure: less than or equal to 1.5 X MPE
    - Major failure: greater than 1.5 X MPE

- Consultations were held with manufacturers and agents, to seek their voluntary participation in the program for a trial period. They agreed to supply randomly

selected instruments from stock, on request, and we agreed to advise them of the results of the test and discuss any non-compliance issues without penalty.

Early experiences with the pattern compliance program

The program is in its very early stages, and has so far been limited to nonautomatic weighing instruments.

However, some significant issues have already emerged.

- Australia does not have many manufacturers of weighing instruments, so the majority of instruments are imported via local agents. In some cases the local agents have been cooperative, but in some cases we have had to wait for overseas manufacturers to supply a 'suitable' instrument, as stocks are not always held in Australia. This leaves the process open to selection of a 'gold plated' instrument, which defeats the purpose of the program.
- Although this initial program is voluntary, we would expect to take action against non-compliant manufacturers after the trial period. As the majority of instruments are distributed through agents, it will be very difficult to have any impact on instruments already sold into the marketplace, so that any rectification will only apply to new instruments. Unilateral withdrawal of approvals in Australia could prove controversial, and would have limited impact on manufacturers, unless supported by other OIML Members. We are not aware of any simple mechanism for sharing information or taking collective action.
- The results of 27 tests scheduled for stage 1 of the program are shown in Figure 2. In summary:

    - 9 instruments complied with the test requirements;
    - 9 instruments had a minor failure;
    - 1 instrument had a major failure;
    - 4 instruments are no longer manufactured; and
    - 4 instruments have still not been supplied by manufacturers.

Instrument N°	Pass	Fail	Comments
1		x – Major	Failed -10, TEOZ all Temps
2		x – Minor	Failed 40
3	x		
4	x		
5		x – Minor	Failed TEOZ 20 - 40
6	x		
7		x – Minor	Failed TEOZ 20 - 40
8			No longer made
9	x		
10			Out of business
11		x – Minor	Failed TEOZ 20 - 40
12		x – Minor	Failed -10 and 40
13		x – Minor	Failed -5, +5
14			No longer made
15	x		
16			Nothing supplied
17			Nothing supplied
18 (LC)		x – Minor	Failed MDLOR -10, 20
19 (LC)	x		
20			No longer made
21 (LC)			Nothing supplied
22 (LC)		x – Minor	Failed -10, +5
23 (Ind)	x		
24		x – Minor	Failed 40 and V_{min}
25 (Ind)			Nothing supplied
26	x		
27 (Ind)	x		

Fig. 2 Results of 27 tests scheduled for stage 1 of the program

- Incidents of non-compliance have been discussed with the relevant manufacturers. In all cases they were surprised and concerned by the findings, were keen to discuss the results in detail, and have initiated remedial action. This has been a very constructive outcome.

These preliminary findings suggest that there could be a significant level of non-compliance of nonautomatic weighing instruments, particularly at the extremes of the temperature range. The sample size is small and most failures are minor, but this limited evidence is sufficient to justify the ongoing allocation of resources to this work. The program will be extended to other instrument categories, to build an overall understanding of compliance issues and to identify issues which need to be raised with manufacturers, and/or with the relevant OIML Technical Committees.

4 Summary

In our view, the International Organization of Legal Metrology should respond to the economic and political imperatives of the 21st century by developing a global system for the pattern approval and pattern compliance testing of legal measuring instruments.

Mutual Acceptance Arrangements will be the first important step in this process. Such arrangements will significantly reduce technical barriers to trade, but are also expected to lead to a major rationalisation of technical facilities, resulting in a few large specialist laboratories in major manufacturing countries and regional centres.

We have proposed, for the consideration by the OIML, that a pattern compliance program be introduced as part of each MAA, to provide an effective market surveillance function for the global marketplace, on a cost-sharing basis. Early Australian experience with pattern compliance testing suggests that such a program is necessary.

Discussion

Comment: A European manufacturer agreed with a number of views expressed in the Australian presentation (needs to develop international type approval and compliance systems, greater usage of OIML certificates, etc.) but disagreed with certain other views, especially the fact that the specimens which were submitted for type testing were carefully prepared for this examination by the manufacturer and were not really representative of the instruments which would thereafter be commercialized.

Reaction: It is true that mutual recognition based on OIML certificates already operates correctly between certain countries but it is not yet a global system.

Comment: What is, in Australia, the meaning of 'testing laboratory'? Is it a laboratory that performs only tests, or tests and examinations? If it is a laboratory that performs only tests, then examinations have to be done by another body. Which one? If it is a laboratory that performs tests and examinations, then ISO 17025 will apply to that part of the laboratory which performs tests, not to the part that performs examinations. This is an important problem which exists as well in the future MAA which is being drafted by OIML TC 3/SC 5. The situation should be clarified.

Reaction: The agreement between Australia and certain other countries is an agreement between Issuing Authorities of OIML certificates. NSC examines test results which have been used as a basis for issuing the relevant OIML certificate. So at this stage NSC is dealing only with laboratories which are associated with OIML Issuing Authorities and the third party accreditation is simply an additional requirement for mutual confidence. It should also be noted that test reports have to be established according to OIML Recommendations.

Comment: What will be the fate of pattern approval in the long term? The necessary equipment is more and more expensive. In addition, the instruments submitted for approval by manufacturers are most often good instruments. Therefore, that is a possibility that, within ten or twenty years, pattern approval will just be a confirmation of actions already undertaken by manufacturers in order to design and produce good instruments.

Reaction: It is quite possible that in the future, manufacturers do their own self-assessment and consequently, there will be a need for an independent pattern compliance program as proposed in the presentation, in order to give the community a level of confidence concerning the assessment of

the quality of instruments that are being produced. So self-declaration by manufacturers will be reinforced by an independent assessment.

Comment: It has been mentioned that, possibly, there will in the future be fewer but more specialized laboratories. Will this appear through a sort of survivorship or Darwinian process, or a well organized process?

Reaction: At the very end, market forces will decide. However, governments may look at the situation of their own labs and decide about what to do concerning their future activities in relation to the anticipated revenues.

Comment: Accuracy of measuring instruments is no longer a problem. The problem is: 'What is an instrument'. This question is connected with software since if we do not know what software is, we do not know what the instrument is. The future will be about identifying what the instrument is, identifying what the software is, and 'sealing' the instrument in such a way that we have clarified what is the instrument under legal control.

Reaction: This comment is quite right. In Australia there are already lots of shops where the consumers' transactions (pricing, etc.) are monitored by software, the control of which has to be addressed in the very near future.

7 THE FACE OF LEGAL METROLOGY IN SOUTH AFRICA AND ITS POSSIBLE INFLUENCE IN AFRICA SUPPORTING THE NEW PROGRAM FOR AFRICAN DEVELOPMENT (NEPAD)

Stuart Carstens - Director, Legal Metrology Department, SABS (South Africa)

1 Overview and current situation

1.1 South Africa

Weights and Measures was introduced in South Africa by the Dutch during their occupation in the 1600's. During the British occupation acts were passed in all the colonies and in 1923 a National Department was established in the Department of Mines and Industry. In 1991 the function was transferred to the SABS.

With this transfer, a decision to develop into legal metrology was made. A position plan was drawn up and submitted to Government and two reviews were undertaken to establish the exact position of legal metrology and make any recommendations deemed necessary.

In South Africa the legal metrology arena is presently only regulated in the trade sphere by the Trade Metrology Act and Regulations. The structure at present is as below.

1.1.1 Legal / legislative process

Figure 1 depicts the legislative framework that is used in South Africa; this framework is internationally acceptable. The legislator in South Africa is the Department of Trade and Industry.

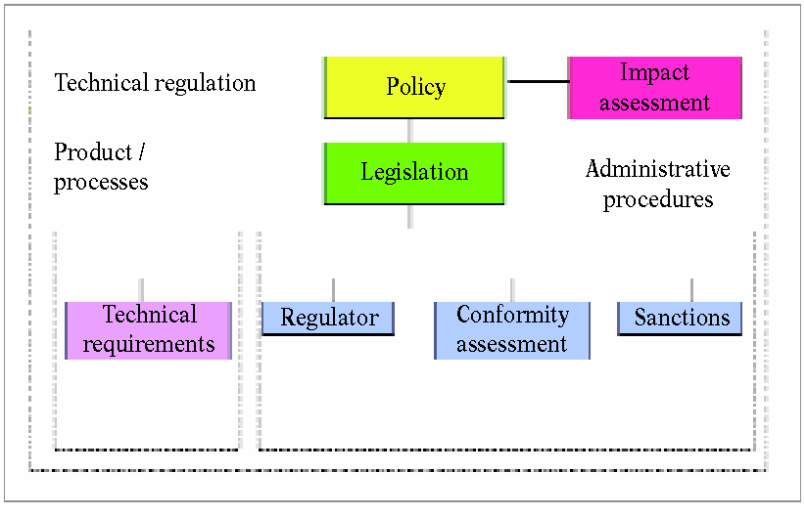


Fig. 1 The legislative framework used in South Africa

Legal metrology obtains its mandate through the SA Constitution, Trade Metrology Act and Regulations and National Measuring Units and Measuring Standards Act. The Regulator is the South African Bureau of Standards (SABS), which in turn is appointed

by the Minister of Trade and Industry as the national responsible body for legal metrology.

1.1.2 Administrative processes

Type Approval

The Type Approval Issuing Authority is the SABS. Type approval testing is also conducted by the SABS in its ISO 17025 accredited test laboratory but test results from competent laboratories are accepted.

Verification

The verification function is undertaken by private companies accredited by the National Accreditation Body to SABS 0378 which relates ISO 17025 to legal metrology. The approval to verify is granted to these laboratories by the Director of Trade Metrology in terms of the Trade Metrology Act after the accreditation certificates are evaluated to establish conformance to legal metrology requirements.

In South Africa we have not only allowed private companies to perform initial verification, but have also allowed them to do subsequent verification which to the best of our knowledge is not common practice internationally.

The SABS also carries out verification, primarily in areas/types of instruments not serviced by the private sector to ensure a holistic and comprehensive service is provided.

Calibration of verification standards

The calibration of verification standards may be done by any accredited laboratory (ISO 17025) with an acceptable best measurement capability.

The SABS has five accredited laboratories for calibration of mass and volume verification standards, situated in Pretoria, Cape Town, Durban, Port Elizabeth and Bloemfontein and there are presently four private laboratories that carry out calibration on verification standards of mass and one for volume, besides the National Metrology Laboratory (NML).

Inspections

Inspection of commodities and measuring instruments is done by the SABS and the inspection function performed by the regional offices is accredited to ISO 17020 by the National Accreditation Body.

International and Regional liaison

This function is undertaken by the regulator on behalf of government. South Africa is at present an OIML Member State and a founder member of SADCMEL.

South Africa is presently actively involved within SADCMEL with the harmonisation of legislation, as required by the SADC Trade Protocol, to enhance cross border trade within the area.

South Africa is also actively involved in the acceptance of OIML Recommendations as South African Technical Regulations to bring us into line with international requirements.

The co-operation will ensure harmonised technical regulations and effective implementation to give effect to the NEPAD aims.

Training

The functional training is presently done in house as there is no institution that offers a course in legal metrology due to the small numbers being recruited at present. We are currently looking at having courses registered with the South African Qualification Authority. The entrance level for verification officers and inspectors is Grade 12 with maths and science and for Type Approval Officers, a National Diploma.

Maintenance of legislation

The regulator advises the Minister on any changes that need to be made to legislation after it has consulted with all role players. Technical Regulations are developed in the form of National Standards in line with WTO requirements. Technical Committees are in place to adopt OIML Recommendations wherever possible.

	SABS Regulator	Private verification laboratories accredited to ISO 17025	SABS regional offices ISO 17020 & 17025	SABS calibration laboratories ISO 17025	Private calibration laboratories ISO 17025
Type approval	x				
Verification		x	x		
Inspection			x		
Calibration of verification standards				x	x
International/ Regional liaison	x				
Training	x	x	x		

Matrix 1 The various administrative processes

Matrix 1 gives various administrative processes and the institutions responsible for their implementation, and Figure 2 shows the present administrative processes.

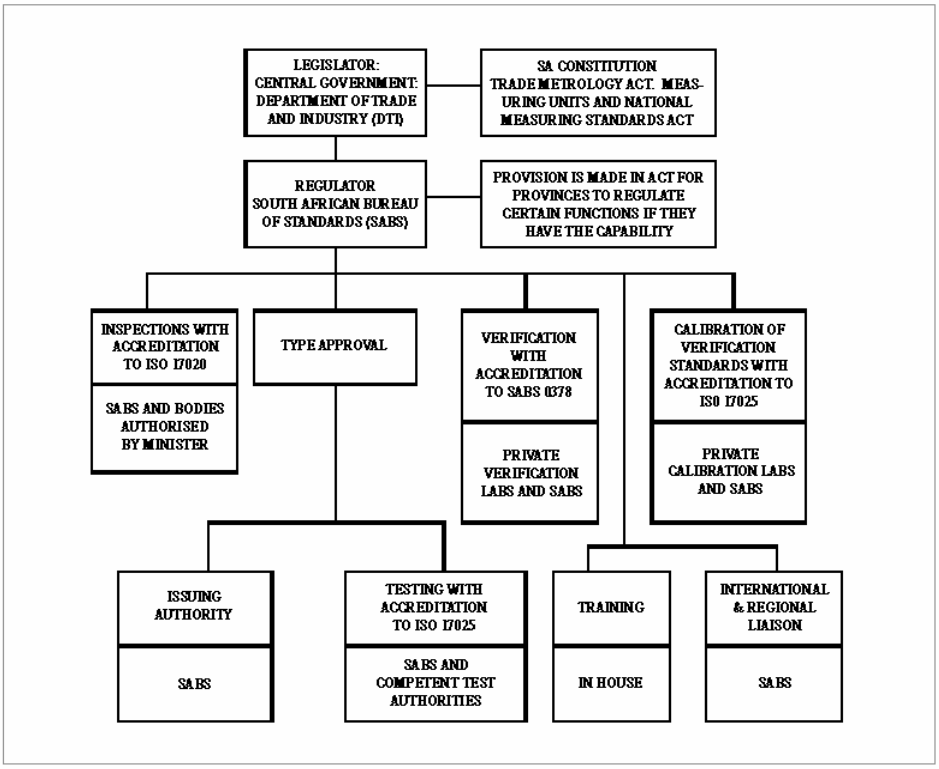
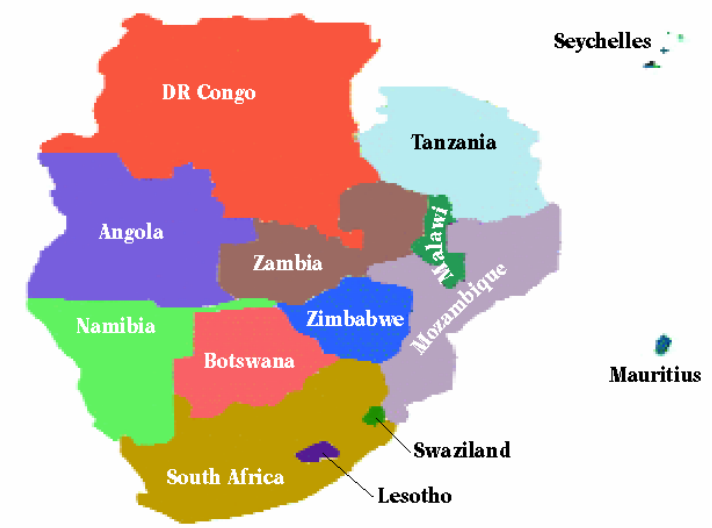


Fig. 2 The present administrative processes in South Africa

1.1.3 Economic overview

South Africa is regarded as an emerging first world economy and has a developed country infrastructure in the following areas:

- Telecommunications;
- Electricity (lowest industrial electricity rates in the world);
- Roads and ports;
- Railroad;
- Air transport.



Southern African Development Community (SADC) Map

The seven ports handle in the order of 13 000 vessels and 500 million tons of cargo per year.

The value of exports and imports with the EU and SADC are as follows:

- Imports from EU R68 122 million;
- Exports to EU R66 312 million;
- Exports to SADC R14 418 million.

1.2 Situational overview in Southern Africa

A map of the Southern African Development Community (SADC) is shown below, and the current status of the structures in each country are indicated in Matrix 2.

Present status	Countries
Almost no legal metrology legislation or infrastructure	Angola Lesotho Mozambique
National legislation (not SADC harmonised) and regulatory control of simple/basic instruments for mass, volume, and length and of goods	Botswana DRC Malawi Namibia Seychelles Swaziland Tanzania Zambia
National legislation (not SADC harmonised) and regulatory control (inspection and verification) of more sophisticated instruments for mass, volume and length of goods	Mauritius South Africa

Matrix 2 SADC - Overview

Most SADC countries still have the legal metrology system originally entrenched in the colonial era with predominantly Central Government control and no use of accredited inspection, verification or conformity assessment bodies.

2 Drivers for change

The drivers for change that are indicated below will result in South Africa progressing from the present trade metrology infrastructure to a full legal metrology infrastructure which will result in us including things such as:

- Medical measuring equipment;
- Utility meters;
- Environmental measuring instruments;
- Speed measuring device;
- Breath alcohol measuring devices.

A decision to regulate the whole spectrum of legal metrology was made in principle in 1998 and the SQAM review (Standards, Quality Assurance, Accreditation and Metrology) reaffirmed this decision. A draft of the new Legal Metrology Act is to be submitted to government and it is envisaged that it will be promulgated in 2003.

2.1 Standards, Quality Assurance, Accreditation and Metrology (SQAM) Review

The SQAM Review commissioned by the Minister of Trade and Industry was tasked to investigate the status of the four SQAM disciplines and then to make recommendations to the Minister on what interventions need to be taken to bring the SQAM structures within South Africa in line with international norms. The review identified areas in need of attention, the most important being the control of the measuring instruments indicated above.

The SQAM Review made far reaching recommendations for legal metrology, namely:

(i) The creation of an Office for Regulatory Reform. The purpose of this proposed Office is to: (i) review existing approaches for formulation of technical regulations contained in legislation and legislative instruments, and develop a best practice approach for technical regulation formulation; (ii) conduct a comprehensive review of existing technical regulations contained in legislation, including legislation relevant to trade and legal metrology; (iii) require that regulatory impact assessments be compulsory for all future formulation of technical regulations; (iv) establish the principles for any regulatory marks used in South Africa; and (v) monitor any potential abuses of such regulatory marks and conformity assessment marks in both the voluntary and mandatory sectors.

(ii) A legal metrology framework embodying international practices for control of measurements be established by the proposed Office of Regulatory Reform as part of the general framework of technical regulations.

(iii) Responsibility for enforcement of trade metrology be returned to national government, and the function not be devolved to provincial governments until such time as they have the necessary resources to address the responsibilities.

(iv) A Trade Metrology Unit be established within DTI to take responsibility for coordination of the national system of trade metrology, including overall administration of the Trade Metrology System.

(v) The proposed Office of Regulatory Reform to advise on the necessary legislative changes to implement a re-distribution of trade metrology functions.

(vi) OIML Recommendations be adopted wherever applicable to satisfy the provisions of legal (including trade) metrology. Specifications from other sources be used only in exceptional cases where the OIML Recommendations do not cover particular South African requirements.

(vii) South Africa must continue to participate in the drafting of OIML Recommendations, including attending the international meetings of committees that are drafting Recommendations of direct relevance to South Africa. These national interest activities be funded.

(viii) The proposed Trade Metrology Unit of the DTI undertake an urgent review of funding requirements to restore trade measurement inspection functions in the Provinces, and sufficient funds immediately be allocated by Government to re-establish this function under centralized control.

2.2 SADC Protocol on Trade

Objectives

- To further liberalise intra-regional trade in goods and services.
- To ensure efficient production within SADC.
- To contribute towards the improvement of the climate for domestic cross-border and foreign investment.
- To enhance the economic development, diversification and industrialization of the Region.
- To establish a Free Trade Arena in the SADC Region.

To achieve the objectives of the SADC protocol the following interventions are needed within the legal metrology arena:

- All technical barriers to trade (TBTs) are to be removed.
- Standards and Technical regulations are to be harmonised.

To ensure that the above is achieved SADC formed a SQAM forum and each discipline formed its own regional organization. The legal metrology cooperation forum SADCMEL was formed in 1996. The other forums are SADMET (NML), SADCSTAN (Standards) and SADCA (Accreditation).

2.2.1 SADCMEL

The aims of SADCMEL are:

(i) Harmonisation of legal metrology legislation to promote and ensure compatibility with international requirements. Specific areas for harmonisation include:

- Labelling, tolerances and standard pack sizes for prepackages.
- Requirements for instruments and adherence to OIML Recommendations wherever possible.
- Instrument verification and calibration techniques.
- Type approval testing and issuing of approval certificates.

(ii) Organisation of training programmes.

(iii) Arranging of inter-comparisons to ensure uniformity.

(iv) Exchange of metrology related information and assistance where possible.

2.3 WTO/TBT Agreement

The WTO/TBT agreement requires - amongst others - the following:

(i) Technical regulations be placed on the web for international comment.

(ii) One stop type approval testing by approved test house (OIML MAA scheme).

(iii) Use of international standards as technical regulations wherever possible.

2.4 Advance in technology

New techniques require new and expensive test equipment, which may not be economically viable, for each country to purchase. This will involve using management systems to reduce costs to governments and using other countries in the region to perform certain tests for the other SADC members.

2.5 Developments in Africa

(i) The development of other trading blocks similar to SADC, Comesa and the East African Union which will all need to be linked if NEPAD is to succeed.

(ii) The dissolving of the OAU and the creation of the African Union.

2.6 New Program for African Development (NEPAD)

The New Program for African Development was developed out of the Millennium Africa Project and is intended to lift Africa out of its present socio-economic plight and to place countries both individually and collectively on a path to sustainable development and at the same time to participate actively in the world economy. To meet the NEPAD objectives it is also important that the socio-political aspects be considered and that countries practice good governance ensuring a sound base on which to build.

The objectives and outcomes are as follows:

- Objectives:
    - Eradicate poverty.
    - Place countries of Africa both individually and collectively on a path of sustainable growth and development.
    - Halt the marginalisation of Africa in the globalisation process.
- Expected outcomes:
    - Economic growth and development and increased employment.
    - Reduction in poverty.
    - Diversification of productive activities, enhanced international competitiveness and increased exports.
    - Increased African integration.

To achieve the objectives of NEPAD an action plan was devised encompassing the following:

- Ensuring conditions for sustainable development.
- Identification of sectoral priorities.
- Mobilisation of resources.
- Establishment of new global partnership.
- Implementation of the new partnership for Africa's development.

2.6.1 The role of legal metrology in support of SADC/Africa developmental goals (NEPAD)

There are many areas within the NEPAD action plan in which legal metrology will have to play a vital role and they are listed below.

Energy
Legal metrology needs to become involved in the sale of energy domestically as well as within Africa. Examples of this are the proposed gas pipe line from Mozambique to South Africa and Eskom, the South African electricity supplier's expansion into Africa to utilize energy sources such as Cahora Bassa hydroelectric scheme in Mozambique and to improve the electricity network in Africa using all available resources.

Transport
Legal metrology's involvement in this area would be to ensure that legislation is in place to control the overloading of vehicles. These technical regulations, which would require weighbridges used for weighing road vehicles to be approved and verified at regular intervals, will ensure the national road network is not damaged due to the overloading of vehicles which is a problem at present. Breath alcohol and speed measurement instruments will also be covered in the proposed regulations. These regulations give confidence in the measurements made, resulting in a reduction in the number of disputes.

Water and sanitation
The legal metrology involvement in this area will be the instruments used in the sale of water. Domestic water metering is already regulated within South Africa and we will have to concentrate on the pre-pay systems now being developed which include communal standpipes for rural water supply. We foresee this will become the norm in Africa. A standard for electronic pre-pay systems has already been written and these instruments will be approved and verified.

The supply and sale of water in irrigation schemes is also an area which will have to be addressed in a similar manner.

Health
In this area the involvement is the same as elsewhere, namely the creation of technical regulations and the approval and verification of medical instruments.

Agriculture
Ensure that technical regulations are in place to give confidence in the measurement of agricultural products assuring farmers of a fair deal and creating a sound basis for government to collect excise duties reducing the burden on the fiscus. Instruments for quality related measurements such as moisture meters will be included.

Environment
This area is a politically sensitive area at the moment due to the pollution generated by industry and if rebates are to be considered as reward for countries who reduce emissions or sanctions are imposed, then legal metrology needs to be involved in the measurement of such emissions.

Mining
The same applies here as under agriculture.

Manufacturing
The manufacturing arena is most probably the most important.

The aim of NEPAD is to encourage cross border trade, improve competitiveness. Technical regulations need to be in place to ensure that commodities are correctly filled and that measurements are accurate and traceable to National Standards.

By putting in place a Technical Regulation framework which meets international best practice and ensuring a uniform implementation which will in turn ensure an effective trade measurement system, Legal Metrology Departments in Africa will have assisted greatly in creating a solid basis from which NEPAD can grow.

The same can be said for legal metrology's role in fields such as mining, agriculture, the environment, etc.

It is my belief that without the support of an effective legal metrology framework, NEPAD will have difficulty realizing its objectives.

3 The face of legal metrology in South Africa by 2020

With the implementation of the recommendations of the SQAM review, South Africa will have a legal metrology infrastructure that will be able to meet the challenges placed on it by all the different drivers for change mentioned above.

3.1 Legal metrology legislative structure and systems

3.1.1 Legislative structure

The legislative process will have promulgated a Legal Metrology and Consumer Protection Act and the Technical Regulations required to cover all aspects of Legal Metrology by 2020.

The legislative framework will be in accordance with the legislative framework shown in Fig. 1 which will meet the requirements of the WTO and will be in line with international best practice.

3.1.2 Legal metrology system

- In line with the OIML MAA on type approval for certain instruments there will be agreements amongst countries to accept instruments type approved in countries with the capability to type approve such instruments.
- The proposed OIML "I" mark for prepacked goods will be adopted and implemented to promote cross border trade.
- The accreditation system for verification of measuring instruments will be adopted as a means of reducing government's costs of regulating.

3.1.3 Legal metrology functions (Administrative processes)

3.1.3.1 Type approval

- Testing done once in the world (OIML MAA on acceptance of test results).
- SA to participate in OIML Certificate System for a number of instruments within own capabilities.
- If any member states of the SADC are not OIML Members they will have regional, bilateral or multilateral agreements in place to accept results.
- Private laboratories accredited to ISO 17025 or peer reviewed for the applicable tests and approved by the National Regulator will undertake type approval testing.
- The National Regulator will retain the role of issuing authority.
- More use will be made of component approval to allow the mix and match of components to construct instruments according to customer requirements. Compatibility tests and documentation evaluation will be done.

3.1.3.2 Verification

Verification will be privatised within South Africa by means of accreditation by the national accreditation body to SABS 0378 which is a standard based on ISO 17025 or current equivalent and tailored for use in legal metrology.

The privatisation of the verification of instrument function reduces the financial burden on the national regulator by reduction of personnel and equipment.

It is also envisaged that, with this accreditation process being applied uniformly throughout Africa using a common legal metrology standard against which accreditation takes place e.g. SABS 0378 (adopted as an African Union Standard) or current equivalent, verification officers will operate across borders where economically viable.

3.1.3.3 Inspections

All inspection bodies such as the SABS and Provincial authorities will be accredited to ISO 17020 or current equivalent, using harmonised legislation in the form of Technical Regulations published as Regional Standards based on OIML Recommendations.

An early warning system to alert other countries of nonconforming product or instruments, will be in place.

3.1.3.4 Calibration of verification standards

The calibration of verification standards will be done by laboratories accredited to ISO 17025 and that have an acceptable best measurement capability.

3.1.3.5 Training

South Africa through its process of having courses registered at the South African Qualification Authority (SAQA) will have an established training program in place.

3.1.3.6 International and regional legislation

South Africa will remain an active member of OIML and SADCMEL.

South Africa will have ensured that the Indian Ocean Legal Metrology Forum (IOLMF) has developed to its full potential and the creation of the South Atlantic Legal Metrology Forum (SALMF) in support of the OIML's aim to have regional organizations in place which will link the whole world.

3.1.4 Management processes

The management processes will be in line with international norms. This will be achieved by using ISO standards in management systems and OIML Recommendations.

3.1.4.1 ISO 17025

Laboratories undertaking the following processes will be accredited to ISO 17025:

- Type approval testing.
- Calibration of verification standards.

3.1.4.2 ISO 17020

The following administrative processes will be accredited to ISO 17020:

- Inspection of prepacked goods.
- Inspection of measuring instruments.

3.1.4.3 SABS 0378

Laboratories undertaking the following processes will be accredited to SABS 0378:

- Verification of measuring instruments.

3.1.4.4 SAQA (South African Qualification Authority)

All training will be registered with the South African Qualification Authority.

3.1.4.5 OIML MAA Scheme

The South African National Responsible Body will partake in the scheme. The SABS Type Approval laboratory and private laboratories will be designated as competent test laboratories.

3.1.5 Harmonisation

All legal metrology technical regulations in South Africa will be harmonised with international standards as is expected of OIML Member States.

4 The possible influence of developments in South Africa on SADC and Africa in 2020

The following can be seen as possible areas of influence of SADC and Africa in 2020:

- Legal metrology legislative structures put in place in South Africa could be accepted by other African Union member states.
- SADC member states have harmonised legislation in place.
- Legal metrology regional organizations such as Euro Mediterranean Legal Metrology Forum (EMLMF), Southern African Legal Metrology Cooperation (SADCMEL), Indian Ocean Legal Metrology Forum (IOLMF) and any others formed to include countries not affiliated to the above-mentioned should have finalised harmonisation of legislation in all the areas mentioned as vital to NEPAD's success.
- The administrative and management processes put in place in South Africa, which reduce the cost to government, will be accepted as an effective means of ensuring the effective implementation of legal metrology requirements throughout Africa.
- Technical regulations will be published as Regional or African standards in line with OIML Recommendations.
- Type Approval testing be run under the OIML MAA scheme.
- It is envisaged that there will be several training institutions providing courses in legal metrology such as the Tanzania College of Business Education and the SADC Resources Centre for Metrology Education. A uniform curriculum would be in place to ensure the same standard in all countries. It is additionally envisaged that a distance learning project will also be in place.

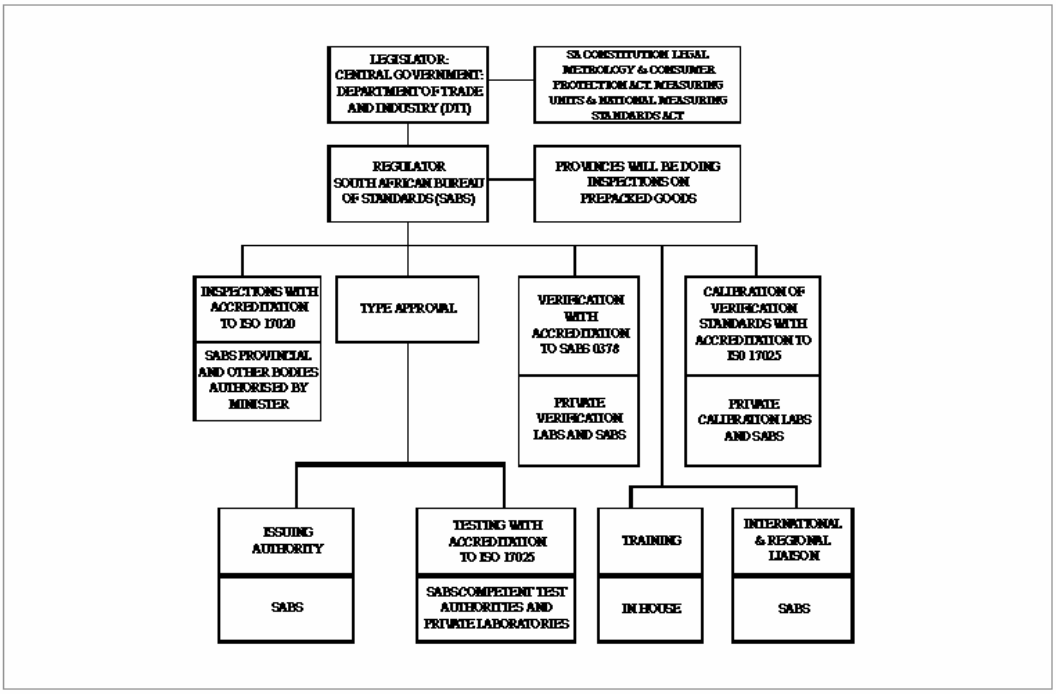


Fig. 3 The future administrative processes in South Africa by 2020

It is envisaged that the developments mentioned above and the legal metrology structures put in place will support the ideals of NEPAD in South Africa and could be applied by all members of the African Union.

SADC will have implemented similar structures to ensure harmonisation of legislation as required by the SADC Trade Protocol.

	SABS REGULATOR	PRIVATE VERIFICATION LABORATORIES ACCREDITED TO ISO 17025	SABS REGIONAL OFFICES ISO 17025 & 17025	SABS CALIBRATION LABORATORIES ISO 17025	PRIVATE CALIBRATION LABORATORIES ISO 17025	PROVINCIAL AUTHORITIES
Type approval	(X) √		√	√	√	
Verification		(X) √	(X) √			
Inspection						√
Calibration of Verification Standards				(X) √	(X) √	√
International/ Regional liaison	(X) √					
Training	(X) √	(X) √	(X) √			

(X) = Present
√ = Future

Matrix 3 The present and future situations

5 Conclusion

South Africa will have an effective trade measurement system underpinned by an internationally acceptable legislative framework. The acceptance of OIML Recommendations as technical regulations and our administrative processes which are managed effectively by the use of ISO management standards will also instil confidence.

It is envisaged that the high ideals of NEPAD which are to ensure that Africa competes as an equal in the global arena will necessitate the African Union member states looking at implementing similar structures.

The advantages to Africa are:

- An international acceptable legal metrology framework.
- Basis for increased export of commodities.
- Confidence in measurements.
- Increased productivity.
- Increased job opportunities.

Discussion

Comment: Confidence in measurements not only deals with the initial performances of an instrument but also with the way it performs during its life. In this connection, what is covered by the word ‘inspection’?

Reaction: In South Africa, inspection covers on the one hand the control of prepacked goods and, on the other hand, a control exercised on measuring instruments in use in order to check their accuracy without entering into the whole process of verification, which is done by private laboratories.

Comment: A workshop on prepacked products was recently held at the level of the Americas, which revealed problems resulting from different languages and different units used in the various countries of the region. Does this kind of problem also exist at the African level?

Reaction: Within SADC, the official language is English although certain member countries may speak French or Portuguese. Concerning units, all countries use SI or metric units although there may be certain differences (e.g. use of millilitres or centilitres). Provisions are being developed in order to ensure the free circulation of goods throughout SADC countries.

8 LEGAL METROLOGY IN 2020 – ROLE OF GOVERNMENTS OF AFRICA'S DEVELOPING COUNTRIES

Jackai Derrick Mosima,
Department of Prices and Metrology, Cameroon

Introduction

In Africa, as in every other society, weights and measures are ranked among the necessities of life. They feature among the earliest tools invented by the people because they needed rudimentary measures for tasks like the construction of dwellings of an appropriate size and shape, fashioning cloth, or bartering food or raw materials.

As contacts with the international community developed during the colonial era, the international exchange of raw materials, goods, and communication made societies to evolve and weights and measures became more complex.. It therefore became necessary for Africans and their trade partners to use measurement systems in which both parties had confidence. This led to the adoption of European and Asian measurement systems which comparatively were more accurate, consistent, and coherent.

Retrospective overview of governments' role

At independence some forty years ago, these systems were inherited by the new national governments for the following reasons:

- the meager resources of the new countries were preferably allocated to areas like the civil service, Building of roads, schools, and health centers,
- there were no viable indigenous private economic or civil sectors,
- legal metrology was not considered as a priority because its importance and role in social and economic development had not been established,
- there were very few or no adequately qualified metrology personnel.

As society evolved, it became necessary for governments to protect consumers from unscrupulous traders. Also, they had to ensure that consistent and dependable measurements were carried out in areas like petroleum, mining and agriculture which were of substantial economic importance to the country. The inherited measurement systems were therefore modified and adapted to the aforementioned needs.

The emergent modified systems, some of which remain unchanged till date have the following major characteristics:

- government is the sole regulatory and conformity assessment authority,
- training of personnel is mainly 'on the job' and is offered only by government services and agencies,

- all funding for metrology activities is provided either directly or indirectly by government.

These systems do not possess adequate qualified personnel and metrology infrastructure. This partially explains the non-existence of:

- traceability,
- the accurate evaluation of the uncertainty of most measurement results.

Traceability and the existence of a hierarchical chain of standards each having its own stated uncertainty makes it possible for measurement results to be compared. Without traceability, comparability is impossible and confidence in the measurement result is absent.

The ultimate result of this lack of confidence being:

- uncompetitive exports,
- diminution of government revenues,
- unsustainable development,
- unemployment,
- and social instability which in most cases leads to unrest.

Impact of globalization

Following the death of communism about fifteen years ago, the process of globalization characterized by the expansion of cross-border flows of ideas and information, goods and services, technology and capital, has advanced rapidly and broadly in Africa.

Most African developing countries have realized that in order to facilitate their progressive integration into the world economy, they have to:

- lower trade barriers,
- pursue joint ventures,
- enforce intellectual property rights,
- protect property rights,
- reduce high import and export taxes,
- eliminate government corruption,
- support entrepreneurship,
- remove restrictions on investment,
- observe the rule of law,

- set up measurement systems with a coherent structure that ensures that measurements can be made in a constant, accurate, transparent, and internationally accepted manner.

So far as metrology is concerned, legal metrology is no longer considered as just 'weights and measures' but as a science indispensable in areas like human health and safety, resource and environmental control, and other domains where good measurements also serve as a basis of important government decisions.

With the advent of globalization, small and medium sized enterprises which help in:

- job creation,
- dissemination of entrepreneurial capacities,
- promotion and diversification of exports,

are faced with:

- difficulties adopting innovative technologies, and
- problems of access to global markets.

Consequently, it has been realized that metrology related technical barriers to trade like differing standards, technical regulations, and conformity assessment requirements must be compatible with international practice in order to facilitate trade which is an important mechanism for the economic development of the African countries in question.

Government's new role

Fifteen years ago, the economies of the developing countries of Africa were state-run, government-controlled, with little or no growth. Today most of these same economies are opened or opening and liberalizing. Governments are privatizing the para-statals and their economies are growing. The governments have thus realized that in the present globalization context, sustainable prosperity ultimately depends upon creating an environment for:

- domestic capital formation
- private sector led growth
- successful integration into global markets.

For this to be achieved, governments have the following policy-making, arbitration, and supervisory role to play:

- put in place mandatory legal requirements for:
    - units of measurement,
    - methods of measurement,
    - measuring instruments and measurement results,

used in the following areas of activity;

- commerce and trade,
- fiscal matters,
- services and utility metering like water, electricity, telecommunications, and taximetering,
- resource control like oil and fishing quotas,
- environmental control and pollution like automobile exhaust gases,
- health care like temperature and blood pressure measurements,
- human safety matters like speed radar control.

- draw up coherent and unfragmented laws and make sure that enforcement is uniform. This can be facilitated by the adoption of internationally recommended metrology requirements.
- ensure that emphasis on societal concerns like trade or health do not dominate fundamental aspects of metrology like precision, uniform conformity assessment, and traceability, whenever national laws and regulations are being drawn up.
- urge metrologists to provide them with analysis and guidance on realistic infrastructural needs necessary for the implementation of legislation.
- take measures to increase the availability of high quality education and training in metrology.

It should be noted that the above-mentioned duties are related to legislating and regulating metrology.

On the other hand, enforcement can no longer be a government monopoly and should be carried out by government services, para-statals and private bodies. The lack of the capacity to invest in the enforcement of laws and regulations in the modern fields of metrology like health, safety, and pollution monitoring by government, makes the use of the private sector indispensable.

However, the existence of many enforcement bodies might lead to the existence of multiple unrelated methods and procedures creating a state of incoherence and non-uniformity of assessment procedures.

For there to be confidence in the measurement system, the government has to monitor and supervise the activities of conformity assessment bodies to ensure uniformity and coherence.

This supervisory role makes it necessary for:

- All mandatory legal and technical metrological requirements to be registered, made public, and available to all.
- All conformity assessment bodies should be registered.

Government should create a forum which will permit cooperation, consultations, coordination, and the development of fruitful relations between all the actors of the metrology sector (legislating and regulating bodies, enforcement bodies, and clients). Such a forum could be called 'National Metrology Council'.

Government should create conditions that will attract investors into the metrology sector because metrology infrastructure is expensive and government alone cannot support the cost.

Legal metrology department

For government to play its role fully, it must have a department which is solely in charge of legal metrology. The form and structure of such a department will definitely depend on the political organization of each country. However, by the year 2020, a Legal Metrology Department placed directly under the authority of a member of government should be in charge of the following:

- the conception, definition, and implementation of a national legal metrology policy,
- the drafting of coherent legal metrology laws and regulations which meet national and international concerns for consistent, credible, and appropriately accurate measurement,
- the authorization, registration, and control of private legal metrology bodies delegated the responsibility to enforce mandatory technical and legal requirements. The aim here is to ensure and guarantee uniformity of enforcement,
- the secretariat of a national metrology council or any national forum set up to promote consensus, debates, discussions, consultations, cooperation, and good relations between all legal metrology bodies in the country,
- the drawing up of guidelines and the implementation of measures aimed at providing appropriate training and education in legal metrology,
- advice the government on the following aspects relevant to the needs of legislation; measurement standards, calibration programs, traceability and accreditation,
- representation of the government in all regional and international cooperation matters and organizations,
- sensitization of national public opinion on the importance of legal metrology in the socio-economic development of the country,
- facilitate the development of partnerships between national and foreign metrology bodies, mobilize national and international capital for metrology development,
- ensure that legal metrology is not over-regulated for as it is often said, too much of everything is a disease.

Conclusion

As the world's last great emerging market, Africa offers tremendous opportunities especially as there are many things to be developed. About fifteen years ago, internal and foreign investors were not welcome in many parts of Africa, but today they are not only welcome, they are sought for. This shows the desire to come out of marginalization and it includes legal metrology. The question is not the will but the way, especially as these countries possess limited financial resources.

The answer to this is regional and international cooperation. Africa is today divided into economic zones like ECOWAS, CEMAC, SADEC, etc. Development of legal metrology along the same lines is cheaper and faster.

Discussion

Comment: Which achievements have been made by UNDP and UNIDO in African countries in the past?

Reaction: Quite a lot has already been done by UNDP, UNIDO, etc. but it is not sufficient.

Comment: Governments have to prioritize their activities in order to be able to focus on most important areas. However, the assistance which is offered by certain international organizations does not always focus on the right priority areas, and often provides systems that are badly focused.

Reaction: This is quite right and assistance coming from the outside should not be offered only to governments, but also to private companies which are already engaged in metrology and which need to be encouraged.

Comment: After giving information concerning existing African sub-regional organizations and their role and membership, the SADCMEL representative pointed out that countries outside the SADC sub-region might participate in SADCMEL activities as associated members.

Comment: Developing countries are currently facing major problems in Africa as well as in other parts of the world, such as (i) training and (ii) increasing the awareness of policy makers (governments and donor organizations) concerning the role of metrology.

Reaction: This is quite true. The OIML has a responsibility in convincing governments and donor organizations about the role of metrology and the need to assist developing countries in the establishment of sound metrology bases. The CIML President and Vice-Presidents and the BIML Director may also play an important role in visiting OIML developing country members and giving them sound advice as to how to develop their activities. It was also pointed out that the OIML should develop its cooperation with the Metre Convention, ILAC, etc. in order

to better coordinate assistance provided by donor organizations. In this respect, information was given by Mr. Magaña about a recently established joint working group comprising representatives of the BIPM, OIML, ILAC, ISO, UNIDO and others, with a view to proposing coordinated actions to donor agencies which assist developing countries in the setting up of metrology, accreditation and standardization structures.

9 Desirable legal metrology framework for the APLMF

Akira Ooiwa, President, Asia-Pacific Legal Metrology Forum

1. Introduction

Considering legal and economical peculiarities in the Asia-Pacific region, I try to focus on some specific and inevitable demands and to prospect a future shape of the international legal metrology framework that should satisfy such demands. One of the main characteristics of APLMF demands is the vast diversity in their sense of values among various economical and cultural different member economies. Will it be possible to satisfy the different needs by an internationally unified regulatory legal system? It is clear that, for APLMF member economies, desirable functions of a future legal system should not be realized by the usual and traditional legal metrology structure and concept. Now I am going to try to draw a future sketch of Legal Metrology that shall be possibly a new complex system that should cover future social demands, and the system should consist of governmental/intergovernmental legal control and reliable metrology in various markets and fields.

Legal Metrology has a very old history that goes upstream to thousands years ago because it has been indispensable for the foundation of national system. Many of APEC member economies have enacted their own metrology law. Originally such law was established for only domestic purposes, therefore each metrology law has different field and scope depending on its economical situation and law system. These days, even domestic legal metrology should adapt to international purposes in order to satisfy the strong demand from APEC/WTO activities. However it is easily expected that many difficulties will come up if we will mix together many different metrology laws of all economies or force them to use only one of them under the name of harmonization. Because the task for legal metrology is new, the system shall be a new one that will be made through international activities.

2. Characteristics among Asia-Pacific area

Since I took over the presidency of APLMF from Mr. Birch at January of this year, I have visited several economies to have frank talks with the responsible persons to the legal metrology. Basing on this survey, I summarize the common problems of our member economies.

We should correspond to trade globalization so as to meet the needs from WTO/APEC activities and to adapt ourselves to a new infrastructure of international trade. Their motivation might be in the competition of trade race or just seek their survival in the coming new framework.

We usually see the bad footwork of Legal Metrology while confronting such global needs, because the legal system was established originally for domestic purposes in order to control least technical necessity.

There are various and different conditions in legal metrology among member economies.

We have difficulties in acquiring enough budgets to restructure our works. In order to get the budgets, it is essential to make a better advertisement to people and politicians.

We have to make good collaboration with sharing common information so as to go to the common direction.

3. Common benefits of APLMF

In order to have good collaboration and cooperation, we have to find common benefits in our activities. Firstly many economies, especially small economies, are eager to have right information about the international activities and technical matters.

APLMF are going to start information delivering service about OIML and other relating articles. In legal metrology, OIML recommendations and documents have been the model standards and now are becoming almost regulatory standards in the international activities as well.

We need coordination of techniques in testing, verification, and calibration in the fields of legal metrology. Trainings those are usually technical supports and aides are strongly asked by almost all economies. In APLMF, there have been several training courses concerning testing/verification of NAWI (Non-Automatic Weighing Instruments), Oil Dispenser, and Rice moisture meters.

For these activities, we have used mainly our APLMF own budget or bilateral aide between members. But the amount is far from that is needed. APLMF will make more cooperation with APEC, more participation in APEC activities, and more application to TILF funding. One of them is a project of “Study and Training of Rice Moisture Meters”, which is specific demanded measurement in Asia-Pacific area. The project started 2001, and 2002 is the second year for this project.

The project is shifting to the next phase. Based on results of survey and training, we are preparing to propose a revision plan of OIML-R for ‘Moisture Meters for Cereal Grains and Oilseeds” so as to introduce an article that covers rice moisture meters.

4. Common subjects

In Asia-Pacific area, we have to think about a possibility of restructuring legislation in Legal Metrology.

We will need new methodology to guarantee for metrological confidence by national or international body.

It is surely predicted that the technical part of Legal Metrology should be placed more dynamic position near private sectors. And this change may be realized by using

Internationally approved Documented Standards and Laboratory Accreditation activities.

5. Diversity among different economies

As for the metrology law has been thought to act domestically, there has been no special rule for international acceptance of verification results made by other economies. Each economy has to judge by itself for such acceptance. But we notice that there are so many differences among member economies in the economical structure and status, the industrial fields, the development stage in each industry, the size of each industry, Natural circumstances such as climate and natural resources and size of land, and Culture, population and political situations. Those differences cause diversity difference in demanded category subjects, and diversity in required quality level of goods. Therefore it is very difficult to determine the only one acceptable standard model for all such different economies. If the coming new solution would be the determination one standard that is selected from existing ones, and force it to all economies to follow, it is clear that many troubles would happen in the process. Harmonizing the differences is essential to establish a new international framework of legal metrology. Now OIML is developing a new Mutual Acceptance Agreement rule, the purpose of which is to accept the testing result data of the type approval of measuring instruments. I think that the MAA is a preliminary reform to lead to future reforms. We look at these several comparable lists to make sure of the differences between traditional/present and new/future purposes of legal metrology.

6. New purposes of legal metrology

6.1. Traditional / Present purpose of legal metrology

The main purposes are related to tax collection, penalty, and to fair trade that means the consumer protection. In some economies, safety, medical and/or environmental metrologies are also included in legal metrology. In general, legal metrology should be performed in order to make a judgment with referring to the only one acceptable threshold level that was determined by the government as the standard. Because the law is acting as a crackdown, usually such reference level is relatively low enough in technical sense so that ordinary people can easily achieve the level.

6.2. New / Future purpose of legal metrology

On the other hand, the main purposes of newly demanded legal metrology will be shifted to focus on the quality of human life, and the transparency of confidence level of its related activities will be more essential because of international accessibility. For example in usual supermarkets, major consumers are interested not only in quantity of food but also in quality and safety of it as well. In many cases such products are imported. This means that each consumer needs more information to estimate a total quality value according to each consumer's interest. Therefore the coming new legal metrology should realize various kinds of measurements, showing the values in dynamic scale with some estimation of confidence levels. New law will act as a governor or a supervisor that grades and adjusts the confidence level of every wanted

measurement rather than act as a player of such measurements. In the future, legal metrology will cover, in addition to the present, such fields like analytical chemistry, safety grading, health estimation, food quality, game fairness, reliability of data, security of information and so on.

7. New technology and instruments for legal metrology

7.1. Traditional / Present instruments and technologies

Major instrumentations of traditional legal metrology are attached to limited technical areas namely weights and measures, which mean trading quantity measurements in principle. The instruments are such as weighing balances or oil dispensers used in the retail shops or gas filling stations, and water meters and gas meters used in houses. Mainly these instruments are used for consumer trade. Beside to trade metrology some economies have introduced safety metrology and recently environmental and medical metrology as well, but covered areas are still limited.

7.2. New / Future instruments and technologies

Future instrumentation shall involve information technology (IT) and reliable network system those are progressing and changing very rapidly. The technical problem of such new instrumentation is that we need to develop reliable interfacing methodology between IT; electrical and non-IT; mechanical, analytical, and chemical measuring instrumentations. There is an example such that some of utility meters have already been connected with information network and automatic data collection has been achieved. In order to show an acceptable confidence of such automatic system, security of network and information will be the new subject.

8. New active player for legal metrology

8.1. Traditional / Present players in legal metrology

In traditional concept of metrology law, government should be responsible for all the measurements those the law covers on behalf of the people, and therefore all technological basis, i.e. instrumentation, should be supplied by the government because only the government could afford these technologies with confidence. Consequently there should have been a certain amount of metrology officers for testing and verifying all utility meters and their standards. But this system has become difficult to operate because the number of such kind meters has increased so rapidly. At present many economies have been introducing a system that enables the government to commission private sectors such as manufactures to verify the instruments on behalf of the government. Farther more in new technological fields such as analytical chemistry for food safety measurements, it is difficult to involve instantly new instruments into governmental full control because the necessary technological information usually does not belong to the government but to industries.

8.2. New / Future players in legal metrology

Considering that so many new instruments will appear and that they will have to be controlled by the government so as to meet the new framework of dynamic trade, it is quite clear that the traditional legal metrology style is not suitable to keep for such new technologies. The main player of legal metrology field will be changed from the government to the private sectors such as manufactures, market traders, or IT companies. The problem of this transition of responsibility is how to realize acceptable confidence levels in private sectors. There should be introduced some new reform concept into metrological law and its structure in order to involve the information technology as a powerful tool for managing confidence of metrology.

9. New role of government for legal metrology

There are supposed four different players concerning legal metrology. The first is a demander of qualified measurement results, the second is a controller of such measurement and estimate its confidence, the third is a supplier of such measurement technology, and the fourth is an object holder of such measurement. The demander is usually the people, traders or consumers. The controller is the government. The supplier has been historically the government, but in the future a main part of the role will be taken by private sectors. There are problems because the objected technical field has been the trade measurement, but other measurements have been involved such as safety, medical, environmental, and food measurements, and these cannot easily be involved into this system. When the purpose of legal metrology is to show to the people a confidence level for every item that should be controlled by the government, the demanded contents and their quality levels will become more diversified in future. The essential changes of legal metrology will be a separation of the role of supplier of the measuring technology from the government to private sectors in order to correspond to lots of possible variable demands, which will enable the on demand supply of metrology. The new role of government will be a supervisor for the harmonization of domestic diversity as well as international wider diversity. The domestic and international problems may be solved by the similar methodology mentioned above using information technology. I would like to emphasize that the biggest role of the government shall be the establishment of information control system for legal metrology with acceptable level of confidence and transparency so that this system can be easily accessible from other economies and to the international legal metrology framework. This system should be flexible technologically and stable in confidence.

Discussion

Comment: It has been suggested to have a common roof for legal metrology activities related not only to trade, but also to health, safety and environmental protection and this proposal should be supported. However there is a problem resulting from the fact that, in most administrations, there are separated responsibilities for all these fields so it is difficult to achieve common views. Has the APLMF any ideas about how to succeed?

Reaction: This is a governmental responsibility. Metrologists have to explain the situation to their governments and convince decision makers that a big change in policy is needed. In particular, the decrease in metrological human and financial resources which may be observed in many countries should stop.

10 PERSPECTIVE FOR CHINA'S LEGAL METROLOGY

Li Dai, Jiangxi Provincial Bureau of Quality and Technical Supervision, People's Republic of China

Legal metrology hereof stands for all the metrology laws, statutes, and technique regulations that have been instituted and enforced by the authorities concerned. With the rapid development of science and technology and the advent of a global economy, the category of metrology is accordingly enlarged and its function becomes increasingly important. This paper is intended to analyze the present situation of China's legal metrology, give an account of the likely challenges, and provide a prospective for its development in the next 20 years.

1 Present Situation of China's Legal Metrology

Since the implementation of reform and open policy, the social and economic systems have undergone remarkable changes in China; a framework of socialist market economy has been constructed. Accordingly, an administrative system for legal metrology has also been developed in China, covering metrology administration, metrological technique institutes, and legal institutions of metrology. These institutions have played an indispensable role in the development of China's metrology enterprises and the socio-economic development. The established state system of primary metrological standards includes 10 categories of primary metrological standards with 191 items, state standards for 2452 types of materials, and more than 43000 metrological standards of various grades for public applications. Of the legal metrology services 28 are responsible for the pattern evaluation of new-produced metrological instruments. Up to now, they have implemented the pattern approval for 475 series of imported measuring instruments, and done prototype testing for 21094 types of new metrological instruments. On average, more than 700,000 sets/pieces of standard measuring instruments and more than 23,000,000 sets/pieces of working measuring instruments have undergone compulsory verification by these institutes per year. In addition, they have worked in cooperation with governmental metrology administration departments to effect product quality supervision sampling examination on more than 700,000 sets/pieces of measuring instruments and supervision sampling examination on more than 500,000 batches of prepackaged commodities with fixed content per year, and undertake more than 800 arbitrational verifications of metrological disputes. However, since the Metrology Law of the People's Republic of China was enacted in 1985 in response to the needs of a planned economy at that time, it is necessary to meet the new requirements of legal metrology called for by a market economy.

a) Management of measuring instruments

Currently, there are a large number and variety of measuring instruments subject to the legal metrology management in China. They fall into three broad catalogues: A) Catalogue of measuring instruments supervised in accordance with the law of the people's Republic of China (400 kinds); B) Catalogue of working measuring instruments subject to compulsory verification of the people's Republic of China (116

kinds); C) Catalogue of imported measuring instruments (18 kinds). Moreover, China has also effected legal management of the primary standard measuring instruments, standard instruments and standard materials. On the one hand, the management is too wide-ranging; on the other hand, there is insufficient management of the measuring instruments used in such fields as resource control, safety, chemical metrology and governmental execution.

b) Transfer of the value of a quantity (Traceability)

According to the recent provisions of China's metrological laws and regulations, the major method for transferring the value of a quantity is verification rather than metrology calibration. The trial calibration work has been carried out in some areas of the country, but no well-defined national management system of calibration has been established yet. There have neither been specified subjects and objects of calibration management, nor norms and market of it.

c) Measurement of the quantity of commodities

There is no specific stipulation for measuring the quantity of commodities in the Metrology Law of the People's Republic of China. What can be applied are only such as The Provisions Regarding the metrological Supervision over Weighing of Retail Goods, The Provisions Regarding the metrological Supervision over Prepackaged Goods With Fixed Content, The Rules for the Punishment of Violations Against The measurement of the Quantity of the Commodities, The Rule of Metrological Inspection for Net Content of Prepackaged Commodities With Fixed Content, which were issued by the former state Bureau of Quality Technical Supervision in the light of the new development of the socialist market economy. Although these regulations are complementary to the Metrology Law of the People's Republic of China, and some international recommendations of OIML have been adopted, there is still much room for improvement in aspects such as their legal rationale and manipulation ability.

Besides, there is still a gap between what has been done and what is required by OIML in the aspects of the management of metrological technical regulations, the conformity assessment and the adoption of international recommendations. All these above-mentioned have shown that there is still much to be done on China's legal metrology in the future; otherwise, the authority and equity of legal metrology will be unfavorably affected. Moreover, the legal metrology will not efficiently stand up for the benefit of customers, ensure the health and safety of the public and protect the environment, etc.

2 Challenge to Legal Metrology

The rapid development of science and technology in such fields as biology-engineering, digital measurement, computer network and nanometer technology will lead to changes not only in the mode of economic activities, but also in people's way of living and thinking. These, in turn, will have an effect on the category of legal metrology. Moreover, the influence of globalization cannot be neglected, for the globalization of economy will lead to the globalization of trade, which will inevitably influence the legal metrology everywhere.

a) The influence of the new fields of legal metrology

Currently, the scope of legal metrology is well beyond the limits of weighting and measuring; it has entered many new fields such as the following:

A. Trade: This includes retail and wholesaling, domestic and foreign trade in substantial amount. These activities primarily entail the measurements of weight, volume of flow and prepackaged commodities with fixed content. According to statistics, the volume of goods to be measured accounts for 60%~80% of GDP, and will undergo repeated measurements by various metrological instruments in the whole process from producer to customer.

B. Service: This field involves a variety of measuring meters, such as the fuel dispensers with tax function, taximeter with revenue function, all kinds of time and price meters and retail appliances for vegetable oil. In addition, it covers the range of measurement from that of running water, natural gas, coal gas to that of electrical energy, heating.

C. Medical metrology: Medical measuring instruments include the medical thermometer, sphygmomanometer, radiant dosimeter, computer tomography, electrocardiography, electroencephalography, the medical ultrasonic diagnostic equipment, etc. In recent decades, the diagnosis and therapy measuring instruments have been rapidly developed. Since medical metrology is concerned with the quality of life and even determines the difference between survive and death, it is vital to ensure the accuracy, congruity and dependability of measurement.

D. Safety and protection: The safety of life, in particular, becomes increasingly dependent on accurate measurement and on-time control over the system. For example, the accuracy of the meters, such as the instruments on the transportable facilities (ship, plane, automobile), radar velocity meters, mileage meters for cars, detectors for alcoholic quantity from breath-out gas, the pressure meters on the pressure vessel and mechanical meter for architecture, is in close connection with life safety.

E. Environmental protection and pollution control: This is a field requiring the management by law and substantially entails legal metrology. For example, the physics, chemistry, biology measurements are always applied to a variety of situation, such as the supervision measurement for nuclear power station, the measurement for the CO, CO_2, SO_2 and suspended particulates in the air, the supervision control for environmental noise, car exhaust fume and the poisonous pollution to water, soil and gas, etc. In the 21st century, as an effective means for the environment protection and pollution control, the metrology will give rise to more concern of the politics, the public, the economics and the law.

F. Resource control: In the management of petroleum, minerals, fishing quantity, and water quota, we can hardly do without the application of legal metrology. Many kinds of resources on earth, especially those unproductive ones, are faced with the danger of exhaustion. Every country in the world, out of either political or economic consideration, becomes increasingly concerned with the utilization and exploitation of their resources, which demands more and sometimes extremely accurate measurements.

G. Lawsuit: In this field, legal metrology has a preventive effect. For example, when lawsuits involve medical service, life safety, or pollution control, the result of measurement sometimes becomes important evidence for the judge to go by. Additionally, there is also demand for legal metrology in measuring contract and financial administration, tax collection and law enforcement.

b) Influence of WTO/TBT

WTO/TBT treaty is in effect the Agreement on Technical Barriers to Trade, which mainly addresses three issues: A. Standards; B. technical regulations; C. Conformity assessment. Nowadays, conformity assessment develops very rapidly in China and other countries. The main cause is a drive for the promotion of commercial intercourse. The conformity assessment is a process whereby a product, a process, a service, or a system is evaluated against a standard. If a government issues some regulations, such as the pattern evaluation of new-produced metrological instruments, to require products or services to conform to certain technical specifications or standards, it can be regarded as a case of conformity assessment. In order to reduce repetitive assessments, lower the cost and enhance the authority, it is necessary to build up the worldwide confidence through bilateral accreditation, that is, the bilateral accreditation of each other's system. The development of the conformity assessment is a motivation to the development of legal metrology because the conformity assessment, particularly the laboratory accreditation and product quality accreditation, is based on metrology and the bilateral accreditation of metrology system is one of the bases of bilateral conformity assessment. The worldwide confidence must call for a global metrology system.

c) Challenge to administration reform

With the rapid development of globalization of economy, administration reform is inevitable, which present a new challenge to legal metrology. Firstly, the public investments and governmental appropriations of many countries tend to be geared to projects with short-term effect and quick return resulted from market economy. As the trend of globalization develops rapidly and the competitions between countries become stiff, every country has to stimulate its own economic growth and strengthen the competitiveness of its domestic enterprises. Consequently, it is natural of them to invest in projects that have a quick return and attach importance to market economy. Secondly, the general trend for the reformation of government agencies is to streamline the size of government, reduce the cost and reposition the institutions serving for politics and economy. This is a universal trend. In order to accelerate the economic growth and the development of trade, government agencies are bound to reform themselves step by step and gradually make distinction between its supervision function, public administration function and service function. Thirdly, it is a global trend to loosen the regulation and even cancel some ones. As a matter of fact, the reforms in China are mainly intended to make preparations for entering WTO and tend to loosen or cancel regulations, approval procedures and supervision. The main reason is to promote economic and commercial evolution.

d) Effect of technology and management on metrology

Technological and managerial progress may have some negative effect on metrology or make it face new challenges.

A. Automatic measurements, especially digital ones, may pose challenge to the traditional metrological consciousness. This problem is by no means a new one in the international community of legal metrology. Before the use of digital measurement, weighing was a technology, no matter it involved the use of scale or balance. The concept of uncertainty could be conveniently demonstrated; the measured value of quantity may vary with person who makes the measurement. With the use of automatic measurement, especially digital one, the result of measurement is always accurate and consistent once the object is put on weighing. Since no professional is needed in the process, the concept of uncertainty is difficult to detect. Therefore, it is even more necessary now to develop and popularize the consciousness of metrology among the public.

B. As more new fields of legal metrology emerge, it becomes difficult for the regular governmental agencies of legal metrology to effect an all-encompassing administration in this field. Consequently, the management of legal metrology becomes the concern of many instead of one department. This is actually the case everywhere in the world. This trend in legal metrology administration is quite disadvantageous for attaining the goal of a concerted management by the metrological departments and thus is often mentioned by OIML as a common problem. Presently, it seems feasible that the metrological departments, in cooperation with other departments concerned, implement the management of such new fields in legal metrology as medical care, environmental protection, resources monitoring and traffic safety.

C. In the agreements of WTO/TBT, there is little mentioning of metrology. This means the problems arising from metrology are not taken into consideration for settling problems arising from technical barriers to trade. Moreover, there is the problem of product verification. In China, systematic verification develops fast, which also includes requirement for metrology. Unfortunately, such requirement is often neglected. Since product verification involves testing, it is closely related to metrology. However, the requirement for product verification is often covered up by that of systematic verification, which makes it easy for the customers to think that the certificate of systematic verification is effective for all situations. Actually, it is not feasible that the issue of quality is tackled only by means of quality management system .As a developing country, China must attach importance to product verification; otherwise, it will pay the price.

3 Prospect of China's Legal Metrology in the Following 20 years

According to the world developing tendency, the present situation and the challenge of China's legal metrology, there is much legal metrological work to do in the following twenty years that is faced consequential reformation.

a) The Adjustment and fulfillment of Metrology Law and Regulation

The modification to the Metrology Law of the People's Republic of China is a prime assignment of following China's legal metrology. The rationale of legal metrology is metrology law and regulation, therefore the modification to the Metrology Law is necessary and important to the following China's twenty-year legal metrology, which will have a far-reaching effect on the social, economic, technical and metrological work.

Under the premise of abiding the WTO treaty and the OIML relevant recommendation, the Metrology Law completion should take into full account of China's present situation and apply effective protection for the country's estate and market according on the request of market economy. So the metrological legislation should be carried out in three aspects, which is the unification of metrology unit, the accuracy of the value of quantity and the regulation of market metrological action. Specially, it should be adjusted and fulfilled in the following directions:

Build up the national metrology system fitted in with the global metrology system; lessen the range of management to emphasize the legal metrology; expand the field but reduce the sort of compulsory verification; strengthen the metrological supervision for the commodity quantities to regulate the market metrological action; reinforce the admonishment of law and aggrandize the penalty.

b) The Fulfillment of National Metrology System

My country's present metrology system was integrally came into being and stipulated in accordance with the requirements of that planned economy, though partly adjusted, there is an insufficient estimation of market economy and it can't fit in with the WTO rules in some parts. Therefore, with the fulfillment of metrology laws and regulations, in the following twenty years, a fulfilled national metrology system is a fundamental condition to do the legal metrology well.

- Stipulate the relevant technical law and regulation when we abide by and accept the WTO rules. Therefore, we ought to refer to the relevant files and regulations of the BIPM, the OIML, the ILAL and the WTO and combine them with China's situation to set up a sort of metrology system fitted in with the WTO rules and inner character.
- Future metrology system should be a communicative, competitive and harmonious system. We should take part in the international and regional metrological activities and calibration, measuring activities, which include participate the important international comparisons and the accreditation of the measuring and calibration competence of the metrology institute, the discussion of quality management system and the uncertainty of measurement. Through these methods, we can acquaint the knowledge, describe the review, stand up for the benefit and try for the advantage. On fixing up, adjusting and fulfilling the national metrology system, on the one hand we should abide by and accept the rules of the international metrology organization and the WTO, on the other hand we must make the full use of the items to stand up for the benefit of China in the course of participating the competition.
- The development of the field of legal metrology makes it difficult to carry out the trace of the value and management. The increasing trend is that a department

exerts the universal supervision management and several departments put into force the trace to the primary standard and international comparisons.

- Future services of legal metrology will have the impact on not only measurement but also measuring technology and will become the measuring technical research center . It is not only a part of the trace of the value of quantity but also a very important research institute in the metrology system.
- Make best use of social resource. It is obvious that the legal metrology is a government action, however, it doesn't mean only the government controls the assignment of legal metrology. On making perspectives for China's legal metrology, we find that a lager amount of assignment, particularly the task of the verification, calibration and measurement of metrological instruments, can be undertaken by non-governmental organizations, which involve private laboratory and even the factory itself. It can make the control efficiency of the legal metrology effective and flexible. Of course, the stipulation and ultimate determination must under the control of the government.

c) Go on in the Way of Global Metrology System

Make perspectives for future legal metrology, the world will build up a global metrology system for the reason that the demand of the globalization of trade requests the consistency, dependability of the measuring result in the world and the business enterprise field request a measurement and a certificate will go through all over the world. To make the result of inspection or measurement interchangeable, the most important base is the global metrology system or else the result of inspection or measurement can't be interchanged. Third there are some technical and economic matters touched on the metrology that ought to be accurately described and effectively resolved on the base of the global metrology system. For instance, the question of the global warm, without a global metrology system it will hardly assured that the result of measurement would be accepted by each part. The establishment of global metrology system can apply the bilateral accreditation mode of the primary standard of every country's metrology institution. The establishment isn't a unique global metrology system but an intercourse and compatibility among the countries. Therefore, the metrology system of every country should use the International System of Units, apply the reproducibility of materials, set up the national primary standard and a set of integrated trace system which has an unique standard of conformity assessment.

The establishment of global metrology is a main tendency of the development of present international metrology and a metrological challenge faced in future several ten years. It should be seen that the region metrology is a primary scheme of legal metrology. Lots of activities will be executed much more easily among the regions than all over the world, for example the comparisons, cooperated training and technical help. The next ten-year developing trend is to strengthen the regional cooperation in the field of legal metrology and participate the development of world economy. The OIML has the responsibility to ensure necessary cooperation between different regions. It should be acquainted that the globalization of economy makes it hard for the single organization to get the satisfactory result. Hence, the OIML should keep in close touch with other international organizations such as the Agreement of Meter, the IMEKO and the unit ILAC, the LAF relevant to calibration, the ISO, the IEC and The WTO, etc.

We think that the legal metrology is faced rigorous challenge in the tendency of globalization. Although the legal metrology has drawn up the regulations, the stipulation of metrology law and regulation is within the sovereignty of every country. The adoption of the OIML international recommendation is a moral responsibility of each nation but not a legal responsibility. The participation of the OIML doesn't absolutely request the adoption of the international recommendation such that at present then international recommendation is hard to expand. In order to achieve the freedom of trade, the WTO/TBT treaty demands to reduce or abolish the barriers to trade. But for a certain proper reasons, the technical barriers can be set up as usual. It includes the requirement in the directions of life safety, the health of human beings and animals, environmental protection and the national safety. Even though the technical barriers were existed in these aspects, the TBT treaty doesn't cut off them. At the same time the legal metrology covers up the fields. As a result, there must have some international restrains more tough than the TBT treaty so as to carry out the international cooperation in the metrological field, or else it is no use to regulate among the countries.

All in all, the 21 century is beginning, we can see three substantial tendency of following some ten-year legal metrology: first, with the establishment of the widespread applicable system of metrology unit based on the physical constant, each nation's metrology system will become a global metrology system step by step. Though it is not a unique metrology system, it could at least enhance the confidence among the countries. Second, the field of legal metrology will become much more important with the wide of the globalization of trade and the development of science and technology. Third, the authority of the OIML can be strengthened and the legal metrology of each country is bound to be harmony and interchange.

11 LEGAL METROLOGY TENDENCIES IN THE RUSSIAN FEDERATION

Alexander Astachenkov, Director General, VNIIMS, Russian Federation (presented by Vasily Mardin, VNIIMS)

The beginning of a new stage of the development of legal metrology in the Russian Federation may be considered as from 1993 when the Federal Law "On assurance of measurement uniformity" was adopted. This Law has established for the first time and at the highest level the basic norms and rules of the administration of metrological activities in our country. When developing this Law we took into account the most of international and national experience to protect the society and the State from non-trustworthy measurement results. Of course, we relied upon the OIML D 1 "Law on metrology", which at the moment is reconsidered by a special Joint WG. We are preparing to follow the new version of this document, because it's the time for changing of our Federal Law of 1993.

There is no need to explain the different elements of legal metrology in Russia established by the law because all details have been published in the OIML Bulletins No.1, 1994, and No. 3, 1998.

The globalization of the world's trade, the international integration and trends to the establishment of a global measurement system, the intention of Russia to join the WTO – there is not even a complete list of prerequisites to the reformation of legal metrology in the Russian Federation. In view of these reasons we are developing the conception of the national policy in the field of metrology for the coming decades and the middle-term program of its realization. The aim, the tasks, the strategy of the conception are formulated for the new approach of metrology as a science and as specific activities related to measurements. All new challenges are divided in 3 main directions – legislative, including the legal metrology documents, executive, including the metrological service, fundamental and applied metrology, and supervising, including the state metrological control and supervision.

Concerning the legislative field, it is necessary to take into account the future federal law on principles on principles of technical regulations. In consequences of that, there is some tendencies for legal metrology: more concentration on removal of barriers to trade, restriction of the sphere of control and supervision, harmonization of the organization of the principles of metrological activities with the international level, paying more attention to consumer protection in the field of safety. Now we are in process of establishing the new technical regulations for the uniformity of measuring requirements, the assessment of conformity in legal metrology of domestic products and services for the competitiveness of Russian products, appropriate adaptation of accreditation and certification processes based on international principles developed by ILAC, ISO and EA to the procedures of verification and type approval.

We are also preparing the adoption of the future European Directive as a national technical regulation.

Last year, the Gosstandart of Russia has adopted as national standards the ISO standard 17025 and others dealing with accuracy in measurements. They represent the master standards for the development of legal metrology.

Legal metrology as a part of national measurement system is a model for global measurement system in generally. Besides the procedures of conformity assessment and effective quality assurance systems for type approval testing and verifications it's necessary to elaborate procedures for mutual recognition of tests and verifications results. This problem depends on the competence of laboratories and on true traceability of measurement results to the corresponding key comparisons of the national measurement standards. So, for the future it's necessary to harmonize all the arrangements of the international organizations concerned.

12 ISSUES AND TRENDS IN LEGAL METROLOGY FROM A U. S. PERSPECTIVE

Charles Ehrlich,
CIML Member, Weights and Measures Division, NIST, USA

and

Henry Oppermann,
Chief of the Weights and Measures Division, NIST

Introduction

In forming our views, we have consulted with various parties in the United States, including both regulatory officials and instrument manufacturers. From the title of this presentation, it is probably clear that we are not going to make many bold predictions concerning the future of legal metrology, but will rather discuss only issues and trends that we feel are likely to lead us in new directions.

Legal metrology historically covers a large range of topics and activities. The challenge posed by this Seminar is certainly daunting as we try only to correctly identify areas in which significant changes are likely to occur over the next 20 years, and not specifically what those changes might be.

If we begin by asking whether the overall functions of legal metrology will be different in 20 years the answer to us seems to be "no". Documentary standards and regulations will still need to be developed and harmonized globally. There will still be the need for type evaluation and approval and verification of measuring instruments, as well as net quantity and labeling requirements for prepackaged products. Responsibility for enforcing compliance with standards will remain the province of the legal metrology official. What will change is how these processes are carried out, and possibly how requirements are established. The following discussion addresses issues and trends that we see in each of these areas.

Standardization and harmonization

Beginning with the standards development process itself, there is little question that the global marketplace is demanding that legal metrology standards become more harmonized internationally to reduce the number of different requirements that must be met around the world. Mergers and acquisitions have consolidated business into a smaller number of multinational companies that desire a single worldwide standard for a particular type or category of measuring instrument or prepackaged product. In the United States, the National Conference on Weights and Measures (NCWM) was created in 1905 to bring about harmonization of standards among the States. Now that such harmonization is somewhat routinely achieved, the situation has evolved to where there is growing interest on the part of the NCWM to better align the U.S. national standards with international standards, and to play a greater role in international standards development. It should be recognized, however, that there will always be cultural, developmental and market differences among countries making it unrealistic to expect complete worldwide agreement on individual standards.

In the United States in areas of legal metrology other than weights and measures, such as health, safety and protection of the environment, there has generally not been an equivalent unified approach to harmonizing standards used in government regulation with those that have been developed on a voluntary consensus basis in the private sector. This has led to market inefficiencies in some sectors, where manufacturers have had to develop products to meet non-uniform requirements for different federal, state and local government agencies. As most of you are aware, part of the problem is that responsibilities pertaining to legal metrology in the United States exist across different levels of government depending on the subject area, so that central coordination is difficult. What can be said with some certainty is that this decentralized system of authority will not change, since it has strengths that frequently outweigh the weaknesses. However, to address the problem of various requirements in assorted federal regulations, the National Technology Transfer and Advancement Act was enacted by the U.S. Congress in 1996 to require federal regulatory agencies to incorporate private sector standards, if they are available and appropriate, into their regulations. The Act also encourages state and local agencies to do the same, so that there is now at least a motivation and growing trend towards harmonization of regulatory and other requirements in the United States.

The speed with which standards are developed and harmonized, both domestically and internationally, is also recognized as an important issue. Here we see technology playing an increasingly important role.

As electronic means of communication become more routinely available in all regions of the world, the time required to develop a standard should be reduced.

E-mail, the internet, and telephone/video-conferencing are currently being used for this purpose, as documents can be distributed much more quickly than through conventional mail, and virtual meetings can be held where the participants may be at different locations around the globe. We see this trend increasing.

Another current trend concerning standardization that will likely shape the face of legal metrology in the relatively near future is the establishment of formal international and regional agreements and arrangements among nations to recognize each other's capabilities in calibration, testing and certification. This is seen in the United States, as elsewhere, as creating the potential for tremendous market efficiencies and for better facilitation of trade. As an example, the Mutual Recognition Agreement (MRA) of the International Bureau of Weights and Measures (BIPM) has facilitated the creation of the key comparison database that will, one hopes, be used by regulators as a strong basis for recognizing traceability of measurement results across international boundaries. This recognition should allow manufacturers and testing laboratories to successfully achieve and claim traceability of their measurement results directly to National Metrology Institutes (NMIs) in the countries in which they wish to do business, eliminating the requirement for duplicative calibrations. Similarly, the OIML Mutual Acceptance Arrangement on OIML Type Evaluation (MAA) should serve to facilitate marketplace efficiency through reducing the need for duplicative type evaluations and approvals for measuring instruments under legal metrological control. The MRA among the members of the International Laboratory Accreditation Cooperation (ILAC) could likewise help reduce duplicative accreditation audits of the competence of legal metrology testing laboratories. These agreements have the added benefit of making the regulatory bodies

in the various countries think more routinely on an international basis. This is surely happening in the United States with the NCWM. All such agreements should serve to increase competence, confidence and efficiency at reduced costs for both industry and regulators worldwide.

Two important international documents are used in some countries as standards for both metrology and legal metrology purposes; these are the *Guide to the Expression of Uncertainty in Measurement* (GUM) and the *International Vocabulary of Basic and General Terms in Metrology* (VIM). These documents were developed under the auspices of the Joint Committee for Guides on Metrology (JCGM), led by the BIPM and comprised of seven other sponsoring organizations, including the OIML. Current work related to developing supplements to the GUM is likely to lead to a universal methodology for incorporating measurement uncertainty into conformity assessment decisions, such as those concerning maximum permissible error (MPE) requirements in legal metrology. The future will likely see the increased development and greater application of software packages that aid not only in the calculation of measurement uncertainties, but also aid regulators in establishing MPEs that best suit the need based on estimated likely levels of uncertainty and acceptable risk. Better means of testing individual instruments on a statistical basis covering simultaneous changes in several influence quantities is also likely to be developed. The work related to both the VIM and the GUM should lead to more comprehensive terminology, resulting in a better understanding of the measurement process at all levels, from the national metrology institute to the testing laboratory to the field verification site. There is certainly a global trend towards more organizations using and relying on these documents, and we expect that to continue.

Type evaluation

There is a clear global desire for market efficiency in type evaluation. From the manufacturer's perspective, this means only a single type evaluation test per type of measuring instrument, preferably performed locally according to a universally agreed upon standard, the results of which would be accepted in all countries. The *OIML Certificate System* was certainly established with this objective in mind. However, experience shows that the *Certificate System* does not always achieve this goal. Reasons may be because there is a lack of confidence in the data obtained by the pertinent testing laboratories, or because some countries have requirements not interpreted to be compatible with the applicable OIML Recommendations. The OIML MAA will address these issues, and we anticipate that it will make great progress in establishing confidence among the participants. However, the establishment of bilateral and multilateral agreements between and among countries to address these same issues is also expected to continue, at least until the MAA matures. We may always need both of these different approaches, however, since it has become clear in the development of the MAA that there are different views concerning the level of cost and effort necessary to establish and maintain confidence in the competence among participants. We certainly hope that a single type approval will eventually result in worldwide acceptance.

There is also the question of whether it is practical from a global perspective to have type evaluation capability in every country for a given type of instrument. We expect that expertise for performing type evaluation and issuing certificates of conformance will be concentrated in the future among a relatively small number of countries that may

have to ascertain compliance to a broader range of requirements. This trend may reduce the differences in national requirements; however, the differences are not likely to disappear by 2020.

Ensuring production compliance

Another key issue that is receiving considerable attention in the United States is how to ensure that production-meets-type: that is, how can the regulator efficiently establish that the instrument in service has the same metrological characteristics and performance as the instrument for which a type approval certificate has been issued? Similarly, have any performance problems developed over the life of the instrument? Confidence is currently obtained primarily through the initial and subsequent verification processes during field inspection, but it is anticipated that future databases will contain such information collected on a national - or possibly an international - level to detect widespread problems. The nature of the local legal metrology infrastructure and service structure will be expected to play an important role in how such information will be collected.

Increasing efficiency in regulatory activities applies to prepackaged consumer products as well. Since the marketplace is increasingly global, it is desirable that importers and the regulatory authorities in the destination countries are assured that imported products comply with local product and quantity standards, rather than requiring testing when the product arrives in a country or after it has entered the market. The most logical solution to these problems is to accept products based upon the quality system of the manufacturer, or based on sampling and testing by a third-party product certification body. The acceptance or rejection of prepackages then would be based on the credibility of the manufacturer's quality control system, sampling plans, and frequency of testing. Distribution factors, such as local environment or length of time in storage, can also affect the net contents of prepackages. This issue remains to be resolved, but with reduced resources, the pressure to increase efficiency, and the interest on the part of importers to be assured that their imported products will comply with the applicable requirements, we can expect this to become a global priority.

Enforcement activities

We expect that effective and efficient enforcement programs will remain essential for ensuring compliance with legal metrology regulations. However, the testing that is carried out for enforcement can be very time consuming, so new methods must be developed. Transportation time alone in getting to field sites can be costly. We see technology and automation playing an important role here. We are likely to see more use of electronics to perform verification and surveillance activities, especially remotely, similar to the digital photography and video examinations that are currently being used in the medical field. A scale industry representative [1] reports that remote reading of instruments and components, such as load cells, already permits efficient monitoring of performance to determine if a device remains within tolerance, without the regulator having to be on site. Railroad companies use the internet to obtain information from scales that are weighing railroad cars. This trend is expected to extend to virtually all electronic measuring instruments in the future.

Diminishing resources in the United States continue to pressure regulators to find better and more efficient methods to test instruments and devices for compliance to

requirements. The efficiency of testing retail motor fuel dispensers has increased greatly as a result of mounting volume standards on trucks with storage tanks to reduce the time needed to return the product to the storage tanks. Perhaps in the future the retail motor fuel dispenser will have a built-in calibration capability, or a new type of field standard will be developed to allow the dispenser to be tested while product is delivered into the motor vehicle.

Increased competition forces companies to control the variables that affect the quantity and quality of the products that they produce. Manufacturers are incorporating accurate weighing and measuring devices into manufacturing processes to reduce waste and promote desirable characteristics in the raw materials that they purchase. For example, grain moisture and protein measurements allow grain processors to pay a premium for grain that has the desired moisture and protein levels most beneficial for use in the final product and pay less for grains that do not have the desired characteristics. Similarly, the meat processing industry is using high technology instruments to measure the percentage of fat on animal carcasses, then paying a premium or reduced price based on these measurements. The trend to pay prices for raw materials based upon their quality is expected to increase. The consequences for regulatory officials are that performance standards, test methods, and reference standards will be needed to test these instruments. The field of legal metrology will continue to expand into quality measurements, even though regulatory resources decrease.

From a regulatory perspective, the use of surveys or questionnaires to assess the levels of compliance of commodities and measuring instruments across a marketplace will be an essential tool for legal metrology officials to exercise a high level of supervision over a marketplace that is expanding in size, diversity and operation every day. Targeted national surveys, such as the models jointly conducted in the United States by State and Federal agencies on retail prices of products and the net quantity of dairy products, conducted in the 1990s, proved the capabilities these surveys had in allowing their participants to achieve maximum leverage of their resources. The State of California is an experienced leader in conducting marketplace surveys similar to those just mentioned and their efforts and results will likely serve as a model for other States considering developing survey programs in the future.

These coordinated surveys were especially useful in: 1) collecting a large amount of data from a broad range of packagers of similar products, using uniform test procedures for testing the prepackages; 2) facilitating data analysis that both identified problem areas and allowed officials to define what constitutes “current good manufacturing practice”; 3) integrating training with practical application which prompted industry to implement proactive changes in its packaging and pricing practices; and 4) bringing national and stakeholder attention to the importance of legal metrology activities and reconfirming the need to have this type of metrological supervision to provide consumer protection and ensure value comparison and fair competition in the marketplace.

In the future, surveys of specific types of products, marketing practices, and weighing and measuring instruments will allow officials to measure compliance levels across a broad segment of an industry so that regional variations in practices and environmental effects that impact test results can be identified. These survey results can then be used as a baseline to measure the effectiveness of future information gathering, educational activities, and enforcement efforts that may be implemented in response to the survey

results. But the primary goal of surveys should be for developing and implementing information gathering and educational efforts, enforcement procedures and frequency-of-inspection policies so that resources can be focused on reducing noncompliance rather than repeatedly confirming high levels of compliance. One of the absolute truths of law enforcement is that a visible presence of regulatory officials in the marketplace on a routine basis ensures the highest levels of voluntary compliance. Testing and retesting products that have high compliance levels will likely, in this new era of declining resources and increased availability of data collection and analysis tools, be considered wasteful and counterproductive. In the future, as it is today, administrators will be evaluated on their effectiveness of resource utilization and on how high a return in equity and value they can deliver on their investment of tax dollars. Regulators will have to share test results and information so that inspection efforts can be focused on testing devices or products with a history of problems, rather than on testing devices that have traditionally demonstrated good performance. Testing only a sample of devices rather than all of them may be a more efficient use of resources. Another approach may be to educate the management of companies on the importance of the proper use and maintenance of measuring and testing equipment instead of the companies expecting regulatory inspection to fulfill such "service" needs. More effective targeting of inspection resources on problem areas may result in higher rejection rates for equipment tested for enforcement purposes, which will actually reflect more effective and efficient approaches to enforcement.

Resource availability

As suggested several times, the need to do more with less in all areas of operation is probably the biggest issue facing weights and measures officials today in the United States. The legal metrology infrastructure is typically being taken increasingly for granted, as reflected in dwindling funding to maintain programs. As products and measuring instruments become more sophisticated, it is necessary to have more highly trained staff for testing and inspection, yet budget cuts in most States are moving things in the opposite direction. Thus it is becoming increasingly necessary to develop strategies to perform as many tasks as possible more efficiently or in an automated fashion, and this is seen in the United States as an inevitable direction for legal metrology.

Since the weights and measures regulatory responsibility in the United States is at the State level, it is difficult to initiate a national campaign to bring attention to the dire financial situation being experienced by most States. However, a coordinated effort is needed to educate consumers, industry stakeholders and especially elected officials about the need for and benefits of legal metrology. An alternative to doing more with less is, of course, just doing less. However, this would be a viable alternative only if the consequences were still acceptable. Of course, effectively demonstrating that the consequences would be unacceptable, such as by showing adverse economic impact or an increase in unfair trade practices, may be the way to obtain additional resources. The use of national surveys is again seen as an important tool for collecting such information, and efforts are currently under way.

Conclusion

In conclusion, we have provided our perspective on those issues and trends in legal metrology that are considered most likely to lead to significant changes in the future. We have noted that the rapid growth of electronics and computerization will have the largest, and hardest to predict, influence on the state of legal metrology over the next twenty years, as it has during the last thirty years. Means for developing and harmonizing standards more quickly will result. International agreements for calibration and testing are also anticipated to improve worldwide efficiency for type approval and surveillance. New means of ensuring that production meets type will be developed. From a regulatory perspective the use of marketplace surveys to assess the compliance of commodities and measuring instruments will be useful in developing sound enforcement procedures and policies, and hopefully in providing information that can be used to persuade elected officials to reverse the current trend of declining operating resources in the United States.

Reference

[1] Mr. David W. Quinn, President, Weighing Consultants, Inc.

13 THE EXPANDING SCOPE OF LEGAL METROLOGY AND THE CHANGING ROLE OF THE STATE IN A GLOBALIZATION WORLD

John Birch, CIML Honorary Member, Australia

I will be talking primarily about the relationship between the State and metrology and I will be using the State in a generic sense of a theocratic state, an empire or a democratic government and I will be using metrology in a very broad sense of both legal metrology and trade metrology, but making a distinction between metrology and people making measurements.

Metrology developed when civilization developed and it developed in response to the need of the State for information which was provided by metrology. That information was needed by the State to assist it to organize, plan, defend and tax. The role of metrology was to make this information consistent.

State means bureaucracy and it was bureaucrats in China or in Mesopotamia who wanted the information in order to be able to carry out their tasks. Another aspect of that was that the State involvement to require measurements to be make consistently was that the measurements had to be derived from standards, royal standards, theocratic standards and this concept of traceability is the continuing thread through the history of metrology.

Another aspect was that State involvement provided a trust in measurements and this is why they could then be used in transactions in the community, this involvement constituting an element which could reduce disputations and facilitate market and commerce. In addition, the great virtue of measurements, because of their objective nature, is their mobility. They can be moved and accepted. They only move as far as they are trusted and that trust is determined by the reach of the State.

Another important aspect of the relationship between the State and metrology is that strong states have strong metrology systems, weak states have weak metrology systems. An typical example is given by the French Revolution and the establishment of the metric system: it took one thousand years, from 789 (Charlemagne) through 1789, to reform the French measurement system. This reflects the difficulties that measurement is very much determined by the political and that has some relevance to what is happening to the State in our today society.

Eric Hobsbawn noted that '*the most lasting and universal benefit of the French Revolution was the metric system…. For it is well known that such small changes usually require socio-political earthquakes to bring them about*'.

Another point to be noted was at the establishment of the United States, when George Washington, in his first address to the Congress, identified what he thought to be the six priority areas, one of them being the establishment of a national weights and measures system, which became effective in 1797 at the time of John Adam, through a national weights and measures law which was a survey act about the collection of excises on goods imported in the United States, which highlights that important factor that, for most states, the main source of income was in fact taxes on imports and trade, not

income tax. With the establishment of income tax in the 19th century, excises on imports and trade reduced in importance, which partly explains the reduction of metrology to governments compared with the first 5000 years.

We also need to look at some changes that occurred in the late 19th century.

Such changes occurred because of globalization. If you measure globalization in terms of percentage of international trade compared with total growth national product of the world, you will realize that globalization was greater in 1930 than it is in 2000. The Treaty of the Meter was a reflection of the need to support that globalization which was occurring, driven by the industrial revolution and increased transportation. This Treaty was between the legal metrology authorities but one of its outcome was that, when at the turn of the century, the modern states began establishing national measurement institutes, these institutes were in many cases separated from the legal metrology authorities. We had therefore a bipolar structure of metrology which we are still trying to come to terms in our particular societies.

The expanding scope of metrology was driven by changes in agriculture, industry, demography, transportation and technology. There were also changes from direct sale of products to consumer to a multiplicity of transactions through production, wholesaling, processing and retail trade. Quality measurements were also introduced and became more and more important, as shown by the commerce of grain, initially sold by volume, then by mass, and for which now humidity and protein contents are taken into consideration. The establishment of water, gas, electricity and telephone utilities further expanded the scope of trade measurement, as did the provision of a wide range of services charged on the basis of measurements such as taximeters, parking meters, postal services, etc.

But the biggest structure problem we are facing is the use by governments of measurement for an increasingly wide range of regulatory measurements, in environmental and resource control, health and safety which have never been properly incorporated into our measurement system.

In 1980, when the OIML held its Conference in Washington D.C., Dr. Mc Coubrey from NBS noted that the institutionalized metrology services did not extended in these new areas to a sufficient degree. I think that the same comment could have been made up at that time about any other national measurement system. The reason of this situation is that trade metrology systems are not adapted to regulatory metrology. In trade metrology, the government acts as a referee between two people involved in a transaction. In regulatory metrology, the government is one of the people. This situation is not covered by weights and measures regulations. However, in many cases, the national systems have relied upon weights and measures regulations to define the legal basis for measurements in the society.

Another major structural difficulty is that very basic and ancient requirements stipulate that all measurements shall be derived from the national standards. This is traceability. But to what extend to we have a traceability definition in our legislative system which meets the requirements of modern society. In many cases the weights and measures systems do have a traceability requirement but it does not extend to cover this wider range of regulatory measurements. In fact we have not got a legislative basis which is appropriate for this expanded scope of legal metrology in the present days.

I would like now to refer to two other aspects of the challenges we are facing. One relates to economics, and the second one to globalization.

Lot of things could be said concerning the changes in economics over the last thirty years. But one thing you can say is that if you deregulate the market, you increase the need for metrology. An example may be found in the deregulation of electricity industry. If you change from a vertical integrated structure to one with separate components for generation, transmission, and retail sale, then the measurements needs of the second system will be far greater.

In terms of globalization, I believe that our ability to globalize will partly be determined upon how long we have nationalized, how will we sort out our national problems so that we can essentially integrate them into a global measurement system. The traceability requirement is still a major problem. But the other fundamental problem in terms of globalization for metrology is that if you have a system of trust based upon traceability and government requirements at a national level, to what extent can that system be transferred internationally where you don't have a international governmental structure that can provide the same degree of trust for the measurement system.

The CIPM is currently developing their MRA and the OIML is developing its own MAA. I believe that they will go some way to meeting the technical and scientific needs of the metrology system but it is the judicial or legislative needs which I think are the major problems. I do not think we are going to get world government and so we have to find the smart ways to do with difficult problems. I believe that we may need to look at providing stronger treaty provisions even in the Convention of legal metrology which will allow the acceptance of calibration results and measurements which are derived from standards outside national systems. The difficulty in doing so is to accept a great deal legal liability. And so I think that there are some major challenges which to me are primarily relating to the fundamentals of legal metrology which is the legislation. So the question is how do we find a legislative basis for metrology which will encompass the expanded scope into a coherent system and how do we provide a legislative basis for metrology which will also meet the demands of a globalized system.

Discussion

Comment: An interesting distinction was made between trade metrology and legal and regulatory metrology. In certain new areas where measurements occur, the word 'metrology' is even unknown and there is no standards, no traceability. Owing to the limited means of NMIs, how is it possible to expand the necessary measurement system? This question is not limited to legal metrology; it applies to metrology as a whole.

Reaction: The trust is primarily setting the rules and this is a governmental responsibility. In a sense, all metrology is legal metrology because all

measurements should be derived from a national standard and this provision should appear in the today legislations. Concerning the general problem of traceability, it may be noted that we have, with the SI, an excellent system of units of measurement, but a very poor system of quantities of measurement. And not all physical quantities are traceable.

14 TOWARDS TOTAL APPROACH IN LEGAL METROLOGY

Bruno Vaucher, CIML Member,
Deputy Director, METAS, Switzerland

In Switzerland we have decided to totally renew our legal metrology system and I think that other decision makers, metrologists and experts should may be consider our reflections and solutions we are about to implement.

The first step when thinking about the future is to know exactly what our objectives will be. In broad terms, they may be expressed so: protect the people and their interest against false measurement and eliminate technical barriers to trade. I feel sure that these present objectives will be still valid in the year 2020. What is going to change are the ways and means to reach them.

The means are an adequate legislation and an effective enforcement by an efficient infrastructure. What protection measures and which level of protection will be decided remain a political question. If we study the present situation, we cannot escape the conclusion that the existing system has many strong points but also several weak features, some of them I shall briefly mention.

Legal metrology today suffers of old regulations in the field of trade with much too details and rigid requirements focused on measuring instruments alone. On the other hand in other fields like health, safety, environmental protection, the metrological legislation is either non-existing or has many large loopholes.

Since legal metrology has expanded or is in process of expanding in many new fields other than trade, it is of paramount importance that the difference state authorities responsible for these areas coordinate their actions. This coordination is largely missing today.

Another failure in the present situation is the missing security of data. Rough data are being even more transmitted and evaluated through complex and extended networks. This is fine and good as far as nobody can tamper with them. Since this is the subject of another paper of the seminar, I will not expand on it.

About the means, with one exception, we have still today only the procedure to ensure the continuing measurement reliability of measuring instruments: this procedure is pattern approval coupled with verification. Quite adequate for measurements in trade, it is hopelessly inadequate for in other areas where the people performing the measurements and the procedures are much more important than the instrument itself. Take for example non-ionizing radiations emitted by antennas of mobile phone nets. The measured quantity is vectorial, depends on reflections, on mobile reflecting objects, number of channels used at the time of measurement, etc. The procedures and experience of the staff is much more relevant to correct measurements than the instruments themselves.

From that starting point, the question is: what are the ways and the means to overcome these failures?

We have decided to use all existing competence of state authorities and private bodies as soon as their competence could be proved; not to restrict legal metrology to the classical field; to set up a national coordination committee in which every state authority having metrological responsibilities is represented; to introduce performance-oriented requirements for measuring instruments and methods, fully harmonized with those of our main trade partners, which includes legislation on prepackages; to take all necessary measures in order to have all our metrological certificates recognized worldwide and to recognize certificates of other countries.

We have also decided to add to the traditional scheme, type examination and product verification, the new features of the European Union as laid down in the new and global approach, and to complement this system which covers only the production and putting on the market, by the necessary ways and means to maintain the measurement reliability at all steps of measurement activities.

Unlike the classical system in which only one possibility of conformity assessment is offered, namely pattern approval and verification, the new system offers a modular solution at two steps of the life of measuring instruments.

Firstly, the manufacturer has the choice of different modules in order to establish the conformity of his instruments before the long-term placing on the market; these modules are described in the EU Directive on global approach. He has also the choice of competent bodies, state or private, which will do for him the necessary tests and evaluations to prove conformity. In this system, the manufacturer is responsible for conformity and this shift from the current preventive system to a more or less repressive system makes necessary that we have a surveillance of the market in order to ensure the protection of people and the environment.

Secondly, there is a choice of different ways to maintain the measurement reliability depending on the features of the measuring instrument. It starts from periodical verification and includes also remote calibration and verification, and combination of them. The competent authorities will prescribe which modules are valid for which type of instrument used in its area of responsibility.

At all steps of this scheme, the severity of the activity required will depend on the risks linked to erroneous results of measurement. If the risk is small, the conformity assessment procedure and the surveillance will be simple. If the risk is high, as for instance for medical dosimetry or radiation protection in nuclear power plants, the procedure will be much more demanding. For that reason, not every module will be available for every type of instrument. The specific ordinances will prescribe what modules or conformity assessment and which level of measurement reliability assurance will apply to a given type of instrument. The scheme is also applicable to measurement methods and procedures such as for measurement of non-ionizing radiations. In this case the measurement procedure must be examined and approved and compulsory comparisons must be performed. Moreover, the testing laboratories have to be assessed and/or accredited.

A new surveillance concept will be introduced to control that the new system is correctly enforced at all steps of measurement activities. The surveillance has several elements. We have first the surveillance of conformity assessment bodies. The state authority shall not only assess and notify them, but also control that they maintain their

competence and correctly perform the tasks they have been mandated to carry out. For that it can rely on accreditation. The surveillance authority shall check by random controls that the instruments declared conform are really complying with the legal requirements at the time they are put on the market. For that a centralized information system is required to avoid multiple controls. We have also surveillance on the enforcement where we shall survey that the procedures prescribed for maintaining the measurement reliability are really and completely performed in the prescribed time spans. Responsible for that is the user.

As last element, the authority shall control whether the instruments and the measurement procedures are adequate for the use and whether they are used and perform correctly.

A very important feature for the surveillance is measurement, which is for me much more important than fastidious checks of documents and certificates. The main points will be to actively check that the instruments measure within their maximum permissible errors and that the measurements are reliable. I call this scheme measuring surveillance.

As now the state authority will be responsible for this surveillance. According to the level of risks linked to erroneous results, the authority may delegate the whole or parts of the surveillance to competent third parties.

Instead of summarizing, I would like to make some final remarks.

I have tried to show you steps towards total approach. We shall start with the introduction of new means not only for control of measuring instruments including software of course, but also measurement methods and, if necessary, the measurement actors in order to ensure measurement reliability, and this not only for trade but also in the new fields. For that coordination between the states authorities is a must. We will try to achieve it by setting up the coordination committee already mentioned.

I think it is clear for everyone involved that our tasks and activities will become even much more complex and demanding in the future considering the on-going technical developments and the new field of legal metrology. Therefore, it is a must that all involved parties maintain and develop their competence and collaborate closely together to reach a transparent, universal and global measurement system and conformity assessment system. Only this will allow us to attain the main objectives of legal metrology presented at the beginning of my presentation and I do hope to see one day, and this before 2020, the merger of the international organizations involved. This will also solve the dispute about names we had just a few minutes before, if it’s legal metrology or if it’s metrology, or trade metrology.

A final remark: total approach does not mean total surveillance or over regulation. It means appropriate, effective and efficient measures to protect the people and the environment where and as much as it is needed. And here I agree with a statement made yesterday by Mr. Mosima, or with Montesquieu who was also quoted yesterday by Mr. Gaudin: when it is not necessary to regulate something, then it is forbidden to do it. For that we need to monitor the outcome of our activity in the public and according to the feedback of this controlling system, we shall increase, maintain or reduce our efforts.

Discussion

Comment: Lot of countries and NMIs can learn and take profit from the way things are handle in Switzerland. Concerning this approach, is it something coming from METAS or is an initiative from your government. In the first case, how have you been able to convince your government and minister of the validity of your proposals? Second question: you said that you have decided to use the existing infrastructure. Is it a decision based on an analysis showing that the infrastructure was adequate, or simply because it was pragmatic to do so?

Reaction: To the first question: the best way was to involve, from the very beginning, all concerned parties, including decision makers. They were consulted, hearings were carried out and it is now a proposal to the government of Switzerland. To the second question: an infrastructure is necessary to implement the new scheme. The existing infrastructure is not 100 % adequate, there are failures and limitations, but they will be eliminated and what is missing will be built up.

There were also questions from Mr. Schultz and Mr. Lagauterie, however unfortunately, these were not recorded.

15 NEW METHODS OF INTERVENTION OF THE STATE AND NEW TASKS FOR LEGAL METROLOGY OFFICERS

Gérard Lagauterie, CIML Member,
Sous-Direction de la Métrologie, France

Note concerning the English translation of this presentation

The original presentation was given in French. The English translation is a slightly shortened version and hence contains less detail. The French original is available from the Author or from the BIML.

Introduction

Traditionally and until these last years, the control of measuring instruments has been performed by State officers in France. Since 1988 some delegations of controls to private bodies were possible. A new decree published in 2001 has clearly established that :

- each time applicable, the conformity assessment of measuring instruments is performed in the framework of the quality assurance system (QAS) of the manufacturer, the repairer or the installer, approved by a designated body,
- if not applicable or in the case of no approved QAS, verifications are performed, according to the case, by bodies designated by the minister of industry or by bodies agreed by the prefect (local authority representing the State) where the body is located,
- the control is performed by State officers only when above mentioned modalities are not possible.

This policy is implemented on the one hand in order to provide flexibility to manufacturer, repairers and installers capable to demonstrate their competence by implementing a QAS, and on the other hand, both because of the increasing of the number of activities for State officers and the policy of the government to decrease the number of civil servants and to delegate some activities.

The 2001 decree defines four levels of metrological control :

- type examination (approval),
- initial verification (for new or repaired instruments),
- verification of installation (for instruments for which this operation is critical),
- control of in service instruments (periodic verification in particular).

In addition to the national control, procedures in application of European directives apply.

When the process of delegation of all these activities (called “first level activities”) is achieved, the essential activities of State officers will be :

- surveillance of operators,
- surveillance of instruments in service,
- market surveillance.

These activities are called “second level activities” because State officers are not involved directly in the conformity assessment process.

This document describes the new modalities of the State officers’ action in this context. Those are called the “new jobs in legal metrology”. Synergies between these activities, factors for success and difficulties will be pointed out.

Definitions

The following definitions apply.

Surveillance of operators

Set of activities implemented in order to check that operators respect their obligations and, in the case of operators having implemented a QAS, their commitments.

These operators are of two main types : firstly designated bodies, agreed bodies, or French notified bodies, and secondly manufacturers, repairers or installers.

Designated body means a body designated by the minister of industry for some activities of conformity assessment of measuring instruments. These bodies have to demonstrate their competence, impartiality and independence from manufacturing and repairing activities in particular.

Agreed body means a body agreed by a prefect for some activities of conformity assessment of measuring instruments. These bodies have to demonstrate their competence and impartiality.

French notified body means a body notified by France for conformity assessment in application of a new approach directive. Requirements made to designated bodies are similar to requirements made to notified bodies.

Surveillance of instruments in service

Set of activities implemented in order to check on the one hand that instruments in service are correctly maintained and verified and on the other hand, they are suitable for use and correctly and legally used.

Market surveillance

For instruments intended to regulated uses, set of activities implemented in order to :

- check that instruments placed on the market and put into service have been subjected to appropriate conformity assessment procedures, are conforming to statutory requirements and are correctly marked,
- undertake statutory corrective actions.

For instruments not intended for regulated uses, set of activities implemented in order to check that instruments put on the market are correctly marked.

Audit (definition according to ISO 9000 : 2000)

Systematic independent and documented process for obtaining audit evidence (1) and evaluating it objectively to determining the extend to which audit criteria (2) are fulfilled.

Facts, recordings…

Requirements

In depth visit (of surveillance)

Visit, in general expected, made at the head office or in an agency of an operator, intended to investigate whether the operator fulfils some of its obligations or some of its commitments, or that these commitments are appropriate.

In depth visits may be considered as small intermediate audits.

Unexpected visit of surveillance

Unexpected visit of an operator mainly intended to check the competence of its staff in real situation, and to check that the staff fulfils the obligations and commitments of the operator in the presence or in the absence of the State officers as well.

Global description of the situation

The 2001 decree foresee 3 categories of operators :

- private bodies in charge of certification (designated or agreed),
- manufacturers, repairers or installers having a QAS approved by a designated body (Laboratoire national d'essais-LNE in particular),
- manufacturers, repairers or installers having no QAS approved but having to request verification to a third party body.

Each type of operator necessitates an appropriate level of surveillance.

See French version for more details

Surveillance of agreed bodies in charge of verifications

In addition to the initial audit, the surveillance includes :

- periodic audits,
- in depth visits,
- unexpected visits of surveillance,

- instruction of the demand and general follow-up of the activity of the body.

The 2001 decree foresee that the agreement of a body is issued by the prefect of the department were the body is located and that the agreement is valid for all France. So it was necessary to develop rules for co-ordination between the DRIREs (local authorities in charge of legal metrology), as far as the instruction of the demand and the follow-up of the activity is concerned.

The pilot-DRIRE (of the region where the prefect issues the agreement) is responsible of this co-ordination, particularly for the organisation of audits and the transfer of information concerning the bodies for which they are responsible.

Each DRIRE performs its minimum programme of surveillance that is defined at national level. This programme takes into consideration the size of the body. The DRIREs reinforce the surveillance of a body according to their own observations or on request of the pilot-DRIRE.

Audits

The initial agreement is issued after the conclusion of an audit has been positive. Periodic audits are performed each two years and the agreement is renewed every 4 years (complete re-instruction). If necessary intermediate audits may be performed.

The audit team shall have competence in quality assurance aspects, legal metrology and the specific instrumental technology. In some cases, the team may include only one person provided he/she has all these competencies.

Audits are organised taking into consideration the entire national organisation of the body. For this it has to declare all its operators, all facilities and all procedures.

The qualification and the management of competencies of operators are of the responsibility of the body, but in the process of the audit the checking of the competence and suitability of procedures may involve any operator whatever is the location where it is intended to operate.

In depth visits

The head office of the body is subject to an in depth visit each year where no audit is to be performed. Each local agency of the body is subject to such visits each two years.

The duration of these visits depends on the size of the body and on whether it is the head office or a local agency.

During an in depth visit it may be checked that the body respects all its obligations and commitments but in particular those directly connected to statutory aspects and quality aspects having a direct connection with statutory aspects.

See French version for more details

The conclusions of each visit are recorded on a specific report.

Unexpected visits of surveillance

The knowledge about regulation, the competence of individual operators of bodies are checked in particular during unexpected visits of surveillance. It is also the occasion to

check they respect the obligations and commitments of the body. The unexpected aspect allows appreciating the quality of operations in the presence or in the absence of the State officers as well.

During this surveillance the operator is invited to repeat measurements he has already performed in the absence of the State officer. The results obtained in the presence and in the absence, and the quality of judgements on the conformity of the instruments are analysed. It is also checked he has all the necessary elements and that the standards are calibrated according to the rules.

Each body working in a region is subject to such visits whose number depends on the size of the body.

In order to allow this surveillance, the body has to notify to the DRIRE its programme of verifications. As soon as possible a software will be made available to them in order to notify automatically this programme when establishing it for there own purpose.

The conclusions of each visit are recorded on a specific report.

Instruction and follow-up

Instruction means initial or renewed agreement (every 4 years). At initial agreement the acceptability of the request has to be considered. In any case the instruction includes the organisation of the audit and the decision of agreement (or not).

The follow-up consists in particular to organise periodic alternate audits (alternate to renewal) and to manage available information (reports of visits in particular), in order to judge the quality of the work of the body (reinforcement of surveillance, corrective actions, suspension or withdrawal of agreement). As already said it necessitates organising the transfer of information between the pilot-DRIRE and other involved DRIREs.

Surveillance of designated bodies in charge of certification (or French notified bodies)

The surveillance of bodies designated by the minister of industry is similar to the surveillance of agreed bodies with the principal difference that the Sous-direction de la métrologie (SDM), representing the central administration, plays the role of the pilot-DRIRE.

The surveillance of LNE is adapted taking into consideration the quasi-permanent relationship between LNE and SDM.

Surveillance of manufacturers, repairers and installers

The surveillance of manufacturers corresponds to market surveillance (see afterwards). The surveillance of repairers and installers is of the same nature, but in order to avoid ambiguity the expression “market surveillance” has been kept dedicated to placing on the market and putting into service of new (or considered as new) instruments, according to the meaning given to this concept by the Commission of the European Union. On the other hand, for questions of homogeneity and similitude, manufacturers are kept at the level of the same chapter than repairers and installers.

Moreover, the surveillance of manufacturers, repairers or installers may provide information on the behaviour of these operators, but also on the one of the bodies they charge of the certification of instruments.

Whenever they act in the framework of their approved QAS or have to request verification to a third party body, the manufacturers, repairers or installers have to respects a number of obligations that the certification bodies cannot check by themselves : in particular these bodies may not enforce the operators to subject the instruments manufactured, repaired or installed to the statutory certification procedures. This is the role of the State.

The rules implemented for this surveillance involve systematic preventive actions and a posteriori actions as well. The number and the type of visits are depending on the status of the operator.

Manufacturers

A manufacturer has to fulfil 2 essential obligations.

1- Subject manufactured instruments to the appropriate operation of metrological control.

Ensure conformity to type. This is a key point of the metrological control.

See French version for more details

Only in depth visits are foreseen, according to the type of necessary investigations. These visits may be unexpected or not.

The conclusions of each visit are recorded on a specific report. If appropriate the information is passed to the designated body that is concerned.

Manufacturers having an approved QAS are subject to specific attention in order to determine if the designated body in charge of the approval has taken all appropriate provisions in order to ensure the manufacturer respects its obligations, in particular concerning conformity to type.

Repairers and installers

Repairers and installers are also subject to an appropriate surveillance in order to check they respect their obligations.

See French version for more details

Surveillance of instruments in service

The surveillance of instruments in service consists essentially in verifying :

- instruments in service are correctly maintained and controlled,
- instruments are suitable for use and are correctly and legally used.

So it includes the surveillance of the users.

Indeed this activity is not really a new one for legal metrology, and very few will be said about it.

Instruments in use are correctly maintained and subjected to the applicable control

According to the category of measuring instruments, this surveillance is made in a systematic or in an occasional way.

Systematic means each years continuously or punctually as well.

Occasional means punctually a year for a category, with or without particular reason or for a particular instrument after complaint of a customer for instance.

The choice of the system (systematic or occasional) for a category depends on the importance or public concerned by measuring results.

Instruments are suitable for use and correctly and legally used

This surveillance is performed :

- at the same time than other activities,
- after complaints.

Modalities

The surveillance of instruments in service consists in checking that :

- instruments have been subjected to the applicable metrological control,
- sealing are presents,
- instruments are in an apparent statutory state,
- in a general way, users fulfil their obligations.

It may involve metrological tests or may be purely administrative.

Market surveillance

The market surveillance is a concept developed by the Commission of the European Union for application of “new approach” directives. It consists in obligations made to the States. In addition to requirements in the directives, the whole concept is developed in a guide on the new approach.

The aim is to guaranty that provisions in the directives are respected in the whole European Union, and so to ensure consumers protection, but also a fair competition between manufacturers. The State is responsible for this.

For instruments put on the market and put into service for statutory purposes it consists in ensuring they are properly marked, have been subjected to the appropriate procedures and fulfil requirements.

Practically it consists in checking the manufacturer or its representative has respected all its obligations concerning the measuring instrument put on the market (proposed for sale) and put into service. This may be done at the manufacturer’s factory, on the location of saling or of delivery, but also using information provided by performing other activities of legal metrology. Preventive actions made with professionals can contribute to the market surveillance.

By principal it stops at putting into service. However when it is possible to demonstrate the responsibility regarding the product in service, the resulting information may be taken into account for market surveillance. For example actions may be undertaken against the manufacturer if it can be demonstrated that an instrument in service has never received the appropriate making or in a general way, that a flaw did exist before putting into service.

A new instrument put recently into service and not respecting metrological requirements can provide indication that an action of market surveillance would be appropriate. Repressive actions of market surveillance may only be undertaken when the systematic aspect of a flaw is established, the instrument being placed and used in normal operating conditions.

One of the essential obligations of the manufacturer is to ensure the conformity to the type.

The notion of market surveillance corresponds also to obligations made at national level.

Systematic action

The systematic action consists in verifying that manufacturers respect their obligations, performing scheduled in depth visits. This systematic action involves mainly preventive actions, information and discussion with manufacturers or importers acting as manufacturers in France.

The DRIREs dedicate a given percentage of their metrological activity to the systematic action of market surveillance.

Punctual activities

In addition to systematic aspects, the market surveillance involves punctual activities.

Punctual activities are often the only possible way to perform market surveillance for an instrument subjected to CE control (or C.E.E.) abroad. It consists in visiting locations were instruments are imported and performing visual examination and tests that are easy to perform on site.

Punctual activities necessitate specific credits in order to buy instruments sent to laboratories for fundamental tests to be performed.

Reinforced surveillance

The reinforced surveillance completes any form of systematic surveillance of :

- operators,
- instruments in service,
- the market.

It is implemented :

- when a DRIRE has noticed a need concerning an operator,
- on declaration of an anomaly declared by a certification body,

- after complaints,
- in a punctual way for non systematic activities,
- on request of the pilot-DRIRE,
- by any DRIRE on its own initiative, with or without particular reason.

Synergies

As already mentioned, each form of surveillance allows highlighting facts relating to other forms. That is in particular.

Synergies between forms of surveillance

The surveillance of a certification body could allow detecting problems on new instruments installed or in use, or on their use. According to the case the responsibility may be the one of the operator (see definition) or of the custodian or user.

2 The surveillance of instruments in service could provide information for market surveillance, particularly : are new instruments correctly marked ? However it is recalled that if the surveillance of instruments in service may provide information for the market surveillance, it is contrary to its basic principle, the latter stopping at putting into service, except if the responsibility of the manufacturer may be established.

The surveillance of instruments in service could provide indication on certification bodies, for instance have they correctly checked sealings, proceeded correctly to stamping, filled the metrological logbook.

3 The market surveillance at the manufacturer's factory could demonstrate the designated body having approved a QAS did not take appropriate provisions in order to ensure conformity to the type in particular.

In the case of a third party certification, it could show that the body did not perform correctly or made the verification on the basis of a non-valid certificate in particular.

Synergies linked to operators

Some operators have several metrological activities, for instance :

- verificators for initial or subsequent activities,
- verificator and repairer,
- operator intervening on several categories of instruments.

Information got from the surveillance of an activity could provide information for other ones.

Factors for success and difficulties to overcome

New jobs and competencies

By no longer performing controls themselves, State officers will necessarily loose globally some competence. However it is not a fundamental handicap if appropriate provisions are taken for maintaining a level of competence sufficient for the new forms of surveillance.

To that aim, in a first step, the new jobs must be defined and may be classified so :

- Control of bodies *
- officer in charge of instruction and follow-up of files, and corresponding judgements,
- quality assessor,
- technical assessor,
- officer in charge of in depth visits,
- officer in charge of unexpected visit of surveillance.

* Classification partly applicable to surveillance of manufacturers, repairers or installers.

2 Surveillance of instruments in service

officer in charge of checking the presence of statutory marking and other similar aspects,

officer in charge of more metrological investigation (tests, suitability for use, legal use of instruments…).

3 Market surveillance

officer in charge of checking the presence of statutory marking and other similar aspects,

officer in charge of more metrological investigation (conformity to type…).

In a second step the competencies for each job must be analysed as far as is concerned :

- general metrology and legal metrology,
- instrumental techniques and regulation in the particular fields,
- quality assurance and audits,
- administrative law (European relations in particular) and juridical right (reports about offences).

This leads to define basic competencies that everyone must have and competencies for specialists, which results in appropriate training programmes.

Reflections on rules of qualification of State officers are under process.

In addition, it is also suggested that one way for maintaining competencies is to have State officers trained for periods by certification bodies, LNE in particular.

Sanctions

The confidence in the new metrological control system implemented in France will necessitate that the State implements an appropriate surveillance, will apply rigorously intended sanctions versus contraveners, and will demonstrate it and let it know.

The DRIREs have received instructions in order to perform correctly the new forms of surveillance above referred, to apply administrative and penal appropriate sanctions and to inform of their action.

For certification bodies, according to the fault, administrative sanctions are :

- recall or observation,
- advertisement,
- suspension of agreement (designation…),
- withdrawal of agreement (designation…).

For repairers or installers the withdrawal of their mark replaces the suspension or withdrawal of agreement (designation…).

Users that possess non-legal instruments, in particular that do not submit their instruments to the statutory control, are exposed to the refusing of their instruments or placing under sealings.

Penal sanctions are foreseen either specifically in the metrological regulation or generally in the penal Code.

Conclusion

The DRIREs have been instructed on how performing correctly above operations. However general instruction may not avoid State officers having to face situations that can not be foreseen.

In order to apply correctly the new implemented system and to face unpredicted situations, the State officers must have an appropriate background of competencies. So it is necessary to take appropriate provisions in order to get and maintain this competence by organising suitable initial and continuous training.

The delegation of certification activities to agreed or designated bodies must be done keeping the same level of metrological quality for measuring instruments. In the same way the flexibility provided to operators intervening in the framework of their approved QAS shall be seriously controlled, first by bodies designated for this activity, but also by a surveillance action of the State. This necessitates maintaining an appropriate level of supervision of the system, even if this system relies on confidence in a first approach, and to have a set of efficient administrative and penal sanctions at disposition. Sanctions must be applied rigorously each time necessary.

Discussion

Comment: Mr. Magaña added that in order to implement these changes successfully, it will be necessary to develop the training of staff members who will no longer act as legal metrology inspectors but who will

become responsible for assessment teams. In addition, it will be necessary to establish information and coordination networks.

Comment: Privatizing the tasks of market surveillance is an interesting idea. But who will pay for these services? The government, users or manufacturers?

Reaction: Certification activities will be paid for by those who apply for such certification (manufacturers or users of instruments). Periodic verification activities will be paid by the owners of the instruments. Concerning surveillance, which is organized by the state, it should remain free - with the exception of audits.

Comment: How will the control be organized in fields other than trade, i.e. health, safety and environmental protection? The concept of market surveillance is not perfectly clear with its preventive aspects: it is rather a repressive activity. Also, the principle of purchasing an instrument and checking it is not a market surveillance activity but rather a surveillance of the conformity assessment bodies.

Reaction: What has been said will apply to all categories of instruments subjected to regulations, and not only to trade instruments. Concerning market surveillance, it should be noted that measuring instruments are rarely offered for sale in manufacturers sale points. The action described in the presentation has therefore preventive aspects. As for the last comment, purchasing an instrument is, according to the EU Commission, the only solution to test it.

Comment: According to which criteria are the bodies responsible for metrological control designated by the Ministry of Industry or by Regional Authorities?

Reaction: If a limited number of highly competent bodies are to be designated, this will be done by the Ministry at central level. If a low competence level is sufficient, local administrations will be responsible for their designation. The matter of cost will also have to be considered since these bodies will not be allowed to combine control activities and repair activities. There are therefore several parameters which will guide the choice between the two possibilities.

Comment: Is it intended to have one single body for regulatory and accreditation activities or will the accreditation be left to the French Accreditation Committee? And will market surveillance over a two year period have a 100 % surveillance or a sampling surveillance?

Reaction: Accreditation will be carried out by the French COFRAC but technical experts will be provided by the metrology body. Concerning market surveillance, it has only been decided that each manufacturer will be visited yearly but no decision has been made concerning the percentage of instruments to be checked.

Comment: Is it intended that the surveillance of designated bodies will be in addition to the surveillance of their quality systems?

Reaction: Yes, this will be an additional action to certification and to accreditation which will be required for bodies carrying out type examinations and quality system approvals.

16 METROLOGY IN A GLOBAL MARKET

Pieter van Breugel, NMi-Certin, The Netherlands

When talking about 2020, we must imagine how long twenty years is. I have looked at the Dutch situation (and maybe the European situation but I don't think it is a worldwide situation because many countries have a completely different background) in the 1920's. It was the so-called 'class-society'. Everybody lived in small villages and everything was available there: doctor, church, etc. There were other villages across the river but nobody went there.

In the 1950's at the peak of the 'comportmentalization' period, meaning that society was organized along political and social lines, when you were part of one group, you were living in that group and even your sports club or your church was in this group, and the group remained separate from other groups.

Then in the 1960's, we encountered a new world called the 'flower-power period' and idealism was the real force behind it and the structures disappeared.

In the 1980's, we had in The Netherlands a 'no-nonsense' period based on business, everything had to have a sense, and that was the start of globalization.

And now in the 2000's, I think that the economy rules the world; it is already a global economy, but it is not finished yet, and shareholders are very important. Our world is more and more money driven and also the individual is central.

We have now to make the next step and try to know what it will be. I think that the world will become a village again, but the whole world will be this village. Networks and network economies will be very important and will be global. And also because of technological developments, communication will become easier and easier and we will be getting closer. Countries and borders will reduce in value; global ideas and global values will be developed. So why should we not develop a global idea about measuring instruments?

Mobility will become huge and I think that there will be some global culture, besides or above the national cultures which will stay there as well.

Manufacturers will produce more or less universal products. Of course, requirements for conditions of temperature, etc. will differ but in principle it will be universal products, produced at low cost.

Manufacturers will be centralizing their R&D activities as they are already doing. Product life-cycles will become shorter and shorter and IT and internet will be dominant but above that we will have a new revolution which will be sensor technology which is just starting: the equipment will "look around", will see what is happening, and will inform us accordingly. We will have to deal with these technical developments.

What will be the manufacturers' demands? An efficient certification process because it is time and money consuming. They want global acceptance of type approvals (or something like type approval) and global acceptance of self-verification.

So we will change our focus more to the process than to the end control as self-verification involves looking at the process. Manufacturers' responsibilities will increase.

Certification bodies will reduce in number, perhaps one or two on each continent depending on where the industry is located and these laboratories will form a network, even a kind of virtual institute. They will connect their operations more intensively and they will operate as consultants providing market access. What they will deliver will be quality, proven confidence and proven improved quality. Efficiency and service levels will have to be high too. Certification bodies will get closer to manufacturers, almost working together. That means that there is something else to do in metrology: there will be a focus on inspection and enforcement, and market surveillance by others than the certification bodies. Also the involvement in regulations, i.e. the harmonization of technical requirements, will be a job that is performed by somebody other than the certification bodies. It will be the same for drawing up criteria to recognize certification bodies. So what are the rules of the game?

Some and even most of these tasks will be part of governmental activities, or at least paid by government.

At the product development level, there will be a training and consultancy instruction relation with test laboratories in the form of a network; then directly after or even during the development there will be an approval process with the aim to reach global acceptance; then when the production is started, everything is running on the quality system of the manufacturer; then the distribution to the sales agents of the manufacturer or agents on other continents takes place and when the product is sold on the target market the approval network has already performed its work so the approvals are there, contrary to what exists now where most approvals are still business between the local agents of manufacturers and local governments.

So you have to start with a definition of the target markets, then you do an investigation about requirements, thirdly you make an integrated test and type plan for the manufacturer and give this to the manufacturer; fourth you have to make a test report; fifth you do the application for all countries and sixth you have to collect the tools. And that is the job you have to do for the manufacturer.

So what are the things we have to do now?

We are able to decide more or less what the future will be and how to envisage where we will be in twenty years because we are all metrologists. If we agree on this then the world becomes an easier place for us. Global acceptance is very important and so will continue with all kinds of mutual and bilateral agreements I think. But we have to shift it more to the test laboratories themselves. We have to invest in global knowledge so there must be a way to be made aware of how complex all the requirements are. Then we have to work on approval competence so I think the way of accreditation is the most logical way - though there may be others. We should work on the harmonization of regulations and the universal approach on self-verification is fairly important - it is strange that we do not talk about that so much. We have to harmonize the use of quality manuals and systems for delegating responsibilities to manufacturers and we have to focus on market surveillance (though that is the job of governments or other bodies).

So my conclusion is that if you make the right decisions now, you have to choose what you want to be in 2020. Do you want to hold a government regulator function, an inspection body for market surveillance or other kinds of enforcement, or do you want to be a part of the network as a certification body.

Maybe we can talk together and start setting up this network in the near future.

Discussion

Comment: Is it not possible to extend the argument even further and to say that in 2020 we will no longer need any certification of products for type approval but just rely on the manufacturer's self-declaration on type compliance?

Reaction: It is possible that the classical type approval system will no longer exist but I think that there will be something else, software analysis, or paper examination… anyway there will be a need for a third party who can use its network to make information available to all regulators to issue approval.

Comment: The scheme concerning product certification leaves things unclear concerning the respective responsibilities of the authorities and those of the manufacturers. It would be preferable to use the ISO guide for product certification which answers those problems.

Reaction: This is may be a good alternative possibility which has to be considered.

Comment: You have shown a very interesting scenario for market access of products. Measuring instruments are not just simple products. They change in time, they drift, so we need permanent control. What is your scheme there?

Reaction: When the instrument is operating in place, it is the responsibility of local governments to establish surveillance or re-verification programs and there are several methods for this.

17 THE PATTERN APPROVAL PROCESS: THE PAST, THE PRESENT, THE FUTURE, AS SEEN BY U.S. INSTRUMENT MANUFACTURERS

Darrell Flocken,
Mettler-Toledo and U.S. Scale Manufacturer Association

and

Daryl Tonini, SMA

What will the pattern approval process look like next year or in the year 2020?

Will it be different than it is today?

No one person can answer both these questions with 100 % accuracy but each of us here will agree that it will be different than it is today. In this room sit the leaders of the international metrology community. No one individual organization should be able to set the future of the pattern evaluation process, but all of us as a group can and must define what the future process should look like. To do this we need to begin now. We need to look at all the hard work that was applied to develop the current systems. We need to look at the current efforts of many of the OIML Technical Committees and their Sub-committees who are focusing their work in this direction.

I am here today representing the U.S. Scale Manufacturers Association membership as members of this metrology community. Our goal, as manufacturers, is not to undermine the approval process, but to streamline it; not to ask for easier standards but to work toward developing strong global standards. Our goal is no different than manufacturers of any other product: bring high quality, cost effective products, using new technology to the marketplace faster with no violation of the legal requirements and with a minimum consumption of natural resources!

Those of us here must work together to define what legal metrology will look like in the year 2020, to define the efforts needed to reach these goals, and begin working on them today. The most effective way to accomplish this is to look at where we have been compared to where we are today. We need to identify our successes and our failures and learn from both. We need to look at the needs of our customers and work together to meet them.

Beginning in the 1960s and continuing into the 1980s, individual United States weights and measures jurisdictions began to require that manufacturers pre-qualify their weighing instruments before allowing them to enter their commercial marketplaces. While these early evaluations were relatively informal and rudimentary, they met the needs of the day. In the mid-1980s, with some 15 or 16 individual state jurisdictions requiring certification, the National Conference on Weights and Measures in conjunction with the National Institute of Standards and Technology (NIST) developed the National Type Evaluation Program (NTEP). The program was a national system managed by the National Type Evaluation Committee that relied upon a small network of approved state and federal laboratories. These laboratories conducted instrument evaluations and issued national Certificates of Conformance. Under the leadership of

the National Conference on Weights and Measures, this program continues to grow today with a goal of developing common technical requirements designed to meet global product needs.

From this, I would now like to share with you an example of how two different members of the metrology community worked together to achieve a common goal. A goal that did not compromise any existing technical or legal requirements associated with the either country's metrology requirements. I am sure many of you in attendance can think of other working examples. This is only one.

By the early 1990s, the U.S. had a well-established evaluation program. U.S. manufacturers then looked to expand this program outside the U.S. borders. With the U.S. National Institute of Standards and Technology taking the lead role, this effort resulted in discussions that led to a bilateral mutual acceptance agreement with Measurement Canada to recognize each other's test data. The program's unique feature was that the U.S. and Canada did not attempt to harmonize their technical requirements; they "simply" reviewed and compared the two sets of technical requirements and agreed to evaluate the instrument to the more stringent requirement. As a part of this process, the laboratories on both sides of the border along with industry experts worked out standardized test procedures to assure uniformity in the end product, the test report. The testing laboratory then shared the results of this evaluation as evidence of compliance. Thus a single test system was developed which provided a single evaluation as the basis for issuing both a U.S. and a Canadian approval certificate.

Looking back, one can certainly feel a sense of accomplishment; a goal realized. Can we stop here? No! We need to look into the future. We need to set new goals and realize new accomplishments. Everyone has heard the statements "the world is getting smaller" and "the marketplace is more global." It's true; obstacles such as time and distance are a fraction of the inconvenience they were in the past. The obstacles of today are consumption of natural resources, global standards, time to market for new technology, and limited market potential. Products that were once designed and manufactured for a single national market are being replaced with ones that meet the requirements of a global market. As members of the metrology community we need to think along these same lines.

Some of this is already occurring. The previous example of the Canadian and US agreement is an indication of global thinking without compromise to national requirements. Other efforts in this area is the agreement between Australia and New Zealand to accept each others' test data, and the current effort of the OIML on the Mutual Acceptance Arrangement designed to permit acceptance of test data on a global level and open to anyone willing to participate.

Mutual acceptance of test data is a great first step, but it is only the first step. It clearly brings the metrology community and product evaluations to a higher level but it still has many shortfalls. One laboratory is reluctant to except the test data from a second laboratory because of confidence in the other laboratory's abilities. While this is an understandable concern, it causes delays in reaching an acceptance agreement. In an extreme example, the cost necessary to show an acceptable level of confidence may prevent the agreement from ever being realized and the first step never being reached.

Mutual acceptance of test data is a good idea but we must ask ourselves if this approach will ever be the normal mode of operation. Or, will the few examples that currently exist be the exception?

We must also ask ourselves if the evaluation of a single unit conveys satisfactory confidence in the manufacturer's ability to produce additional units to the same performance level as the one unit evaluated. If we have that confidence, then why have initial verification? Type or pattern approval should be enough! If we do not have this confidence then why express so many concerns regarding the confidence in the ability of other laboratories. Focus on the big picture, initial verification! This is where you will find the problems.

We should also look to the manufacturer to help in this area. Conformity assurance programs like the one defined in the NAWI Directive of the European Union and the Conformity Assessment (Production Meets Type) program of the U.S. Scale Manufacturers Association go a long way in providing confidence in the produced product. More confidence than the evaluation of a single unit built for the reason of type or pattern evaluation.

What are the issues we should be looking at today? How do we adjust today's approval process to overcome today's obstacles while preparing ourselves to address new ones in an effective and timely manner? Here are some of our thoughts:

We need to move technical standards to a global level! Some of us may think this is a large task. I assure you, from a technical position it is not. As manufacturers we are already aware of the many different technical standards that exist today. We need to understand the written word and how it applies to our products. We need to understand why the requirements exist so that we can communicate this within our companies. Our experience has shown us that these technical standards have many more similarities than differences. We need to be conscious of our individual and national concerns, but should not use them as a roadblock to a global standard; we should list them along with similar concerns from others and find a common solution. We must also look at the benefits that a global standard will bring.

Common technical requirements will result in fewer interpretation issues. Fewer interpretation issues will result in better educational opportunities.

More education results in a higher level of product compliance during the evaluation process and initial verification.

Develop a seamless approval system! A single manufacturer spends a lot of time, money, and natural resources to obtain all the approvals necessary to place his product on major markets. If we add together all the manufacturers' approval efforts we soon see that large amounts of each are spent. For example, if a manufacturer's goal is to place a product onto the global market he can be assured that at least two, and maybe as many as five, different approval organizations will be testing his product. To get his product to the marketplace in a timely manner means that at least two to five samples will be sent to various evaluation agencies. Each one of these samples will undergo evaluation to very similar requirements. This adds cost to the product, delays introduction to local markets and wastes resources. We must ask ourselves why?

As I mentioned before, we need to be aware of our individual and national concerns, but should not use them as a roadblock to a seamless approval system. We must also look at the benefits that a seamless system will bring.

Eliminate repeated testing of the same product to reduce cost, time to market, and wasted natural resources.

Allow national laboratories to apply knowledge to the initial verification procedures and market surveillance resulting in increased confidence in production instruments.

New technology can be placed in the marketplace faster by assisting and supporting local industries in maximizing efficiency while minimizing cost resulting in benefits to the local economy.

Develop An International Conformity Assurance Program! As mentioned earlier in this presentation, several members of the legal metrology community have developed conformity assurance programs. These programs contain a common theme, and ensure that continued production represents that of the sample evaluated. These efforts should continue but on a global basis. We should take care not to end up with 2, 3 or 5 different programs each having similar yet slightly different requirements. This is where we are with type or pattern approval today and this is one of the reasons we are here today. We need to learn from our experiences, we need to develop a single program that provides benefit to the consumer not to individual businesses. Benefits of a well-developed conformity assurance program are:

- Increase confidence that manufacturers move away for the 'golden unit' used for evaluation.
- Provides performance results to requirements that cannot be obtained during initial verification testing.
- Improves initial verification compliance.

The world is truly becoming a smaller place; national laws and requirements are being adjusted to fit a more global world. Most of this work is being lead by upper levels of our governments. We, as members of the legal metrology community can sit back and wait to be told what our future will look like or we can begin working on it today and feel confident that our efforts are directed to a common and global goal.

Discussion

Comment: What exactly is meant by 'global technical standards'? In the field of NAWI, for example, there is an OIML Recommendation also adopted as a European Standard which is widely used in Europe and many other parts of the world. So what is missing in such a Recommendation to become a 'global technical standard'?

Reaction: R 76 is an excellent standard which is accepted in many countries in the world, but not in the USA and that is a problem. I think that there are countries that accept R 76 on paper but when it comes to practice, they do not follow it either.

Comment: Within the USA, is there a single standard or are there different standards from state to state?

Reaction: There is one standard, Publication 40, which is accepted by all states. It is a basis for the national type approval process. When this process is followed, then all states accept certificates. This standard, which is more or less the equivalent of R 76-2, is under the responsibility of the National Conference on Weights and Measures.

Comment: At the end of the presentation was mentioned a 'common goal', understood as common to industry and government people. A good relation between both is necessary and seems to be the reality on occasions such as this Seminar. But when speaking privately with government people, they very often speak about industry as people who try to make money, are ready to violate the law, and need a lot of inspection and surveillance to see that everything is going in the right way. On the contrary, when speaking privately with industry, they worry about the bureaucracy which makes industry's life very difficult, they wish for deregulation, etc. For a good common future, we need a considerable change in the direction of speaking in terms of partnerships between industry and government instead a kind of two party system. It is very easy to say that, but how can it be accomplished?

Reaction: These views are quite correct. Industry shall make money, produce, and maintain employment. The situation described results from human nature. The cultures are different from one group of countries to another. Efforts have to be made to increase contacts and discussions between industry and administrations. This is done in the USA at SMA level and the OIML should constitute such a forum for mutual contacts.

Comment: In general, manufacturers agree with mutual acceptance and with one specification for the whole world, but they also need assistance to avoid the bad practices of certain manufacturers.

Reaction: It is true that there exist manufacturers with bad practices against which national and international bodies should try to struggle.

Comment: The OIML has very close contacts with the European Commission, and with ISO, but does the OIML have such good contacts with the US NCWM?

Reaction: The CIML President, the BIML Director and certain CIML Members have been invited on several occasions to attend and address the NCWM. In addition, the US CIML Member systematically attends the NCWM and participates in a better mutual understanding. The NCWM is well aware of OIML activities. The former US CIML Member, Dr. Chappell, gave more details about the NCWM and its role in the US decision to join the OIML. He also described the way consensus is reached within the NCWM.

18 CHANGES OF THE CONSUMER PROTECTION IN LEGAL METROLOGY AS A RESULT OF NEW TECHNOLOGIES

Wilfried Schulz, Physikalisch-Technische Bundesanstalt, Germany

My presentation describes the technical development of measuring instruments as far as they have an influence on consumer protection. In this connection also the maximum permissible errors for verification and in service will be discussed. New technologies require new conformity assessment procedures. Here the limits of existing verification procedures and future modifications are pointed out. With the initial verification carried out in many countries by the manufacturers, market surveillance becomes more and more important, which is however only part of the metrological surveillance. Finally my proposals will be summarized with an outlook in the future.

In legal metrology it is assumed that the measuring instrument is a complete unit from the sensor up to the display of the measuring result. There is a tendency, for example in utility companies, that peripheral equipment is integrated which is not verified. Therefore the consumer obtains measurement results relevant for the price to pay from devices not subject to mandatory control. In the future, the internet will be used for the transmission of measurement results from the measuring instrument to the remote display.

The function of measuring instruments will increasingly be influenced by software. Often this software is not testable because there is no clear separation of the software which is subject to legal control and the other part of the software which is modifiable and changeable by the user. Furthermore there is a trend that the users would like to modify the software by download so it has to be granted that the modification concerns only the permitted part of the software. Only restricted tests with classic instruments such as type approval, initial verification, re-verification and inspection can be carried out with these electronic modern instruments. Furthermore, in utility companies, the measurement results are connected with prices or tariffs so that the customer is not always in the position to check whether the measurement result, which forms the basis for the price to pay, arises *de facto* from a verified instrument.

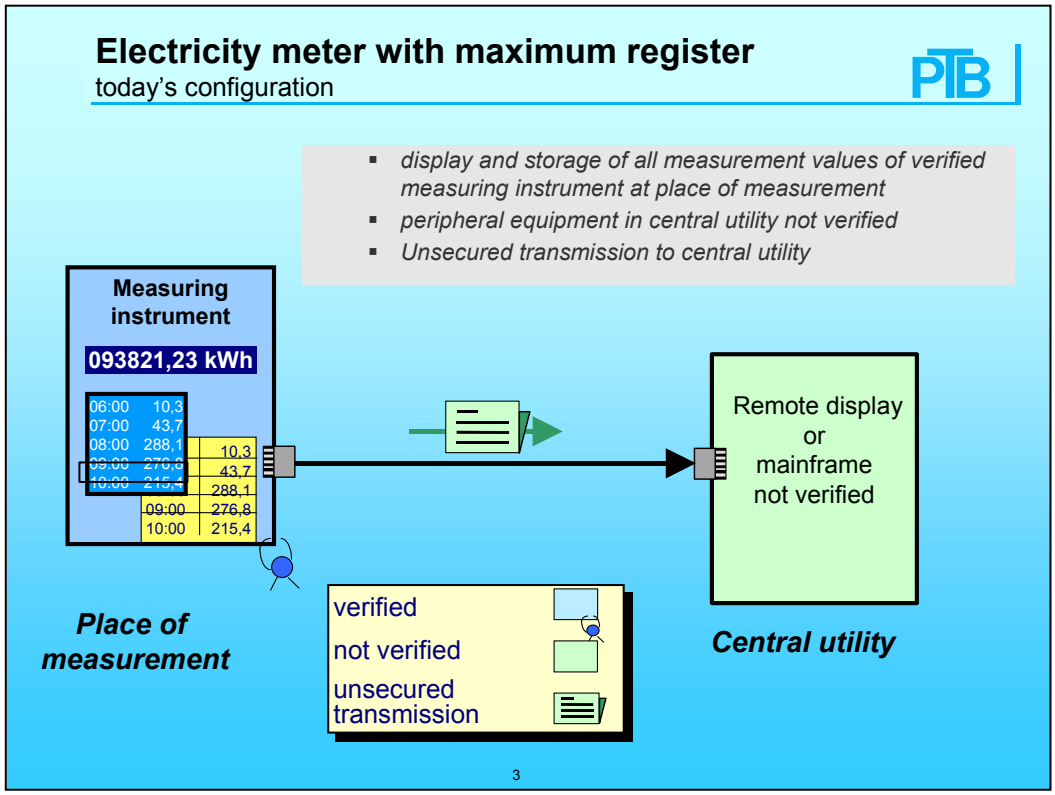


Figure 1

Figure 1 shows a today's configuration of an electricity meter with additional measurement of the load (maximum register). All measurement values are saved and displayed in the measuring instrument at the place of measurement. The transmission to peripheral equipment or central mainframes is carried out unsecured. In case of doubt the customer can check the results at the measuring instrument and this is our understanding of legal metrology today.

However, it is in the interest of industry to simplify the measuring instruments and not to store all the measurement results in the register for a long time. In the future this can lead to a configuration demonstrated in the next figure.

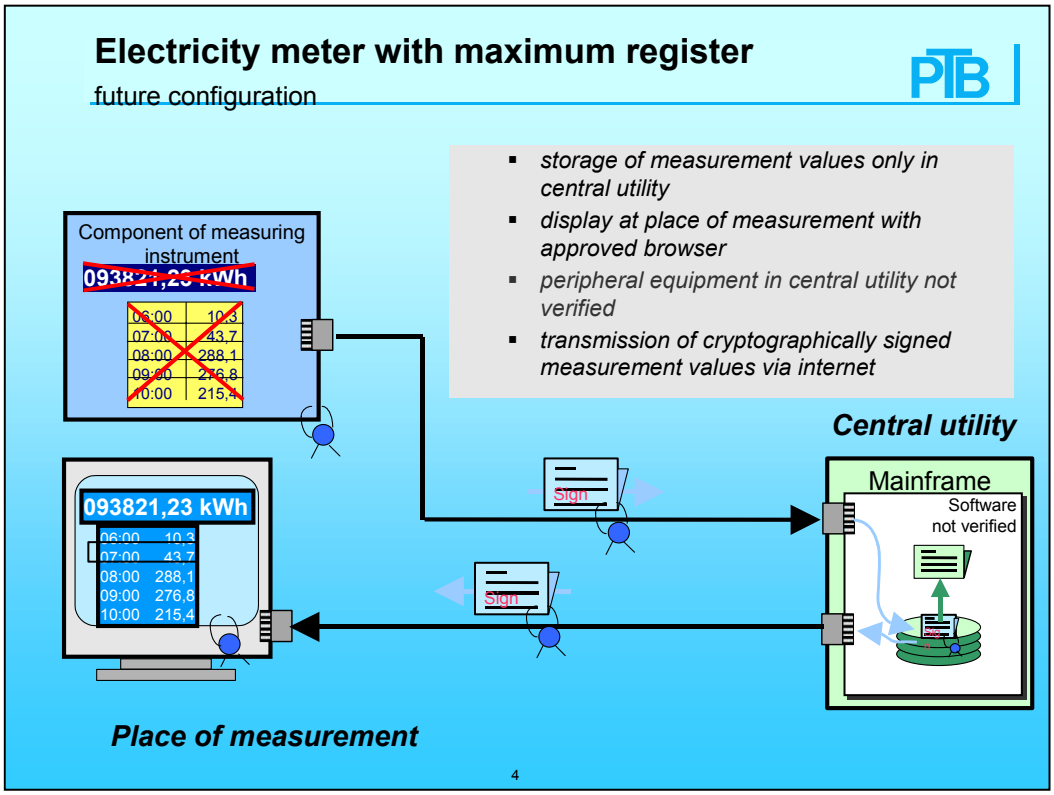


Figure 2

Figure 2 shows that at the place of the measurement, the customer has not a complete electricity meter but just a component without storage and display. The measurement results are signed cryptographically via opened networks, for example internet, and transmitted to the central utility company. The mainframe and all the software are not subject to legal control.

At the place of the measurement, the customer may use a computer and an approved software and has the possibility in this way to access all signed measurement results via internet at the place of measurement or even at other places. In this way he can check the invoice of the utility company.

The development of cryptographic codification technologies will lead to the fact that, in the future, distributed measuring systems will be developed with parts which are not subject to legal control but nevertheless with a safe data transfer for the purpose of consumer protection.

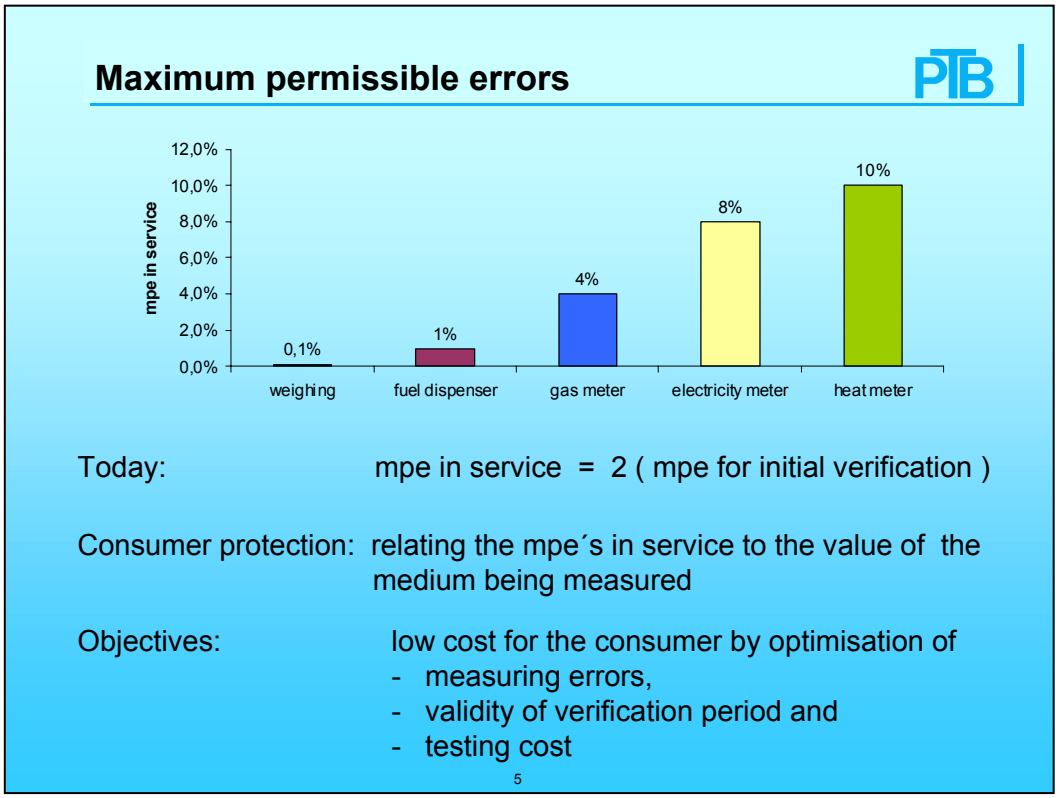


Figure 3

To a great extend the maximum permissible errors of measuring instruments depend on the measurand but also on the used technology. As Figure 3 above shows, the mpes in service may varies from 0.1 % for weighing instruments to 10 % for heat meters but in all cases we speak of consumer protection at the same level. Today we differentiate between mpe for initial verification and mpe in service, which as a rule is twice the mpe for initial verification, so that measuring instruments can be used for a longer period without exceeding the tolerance limited by the mpes in service.

With the introduction of new technologies, the mpes decrease for some kinds of measuring instruments. But better accuracy does not always mean better consumer protection. We must realize that the price to be paid by the consumer also depends on the cost of the measurement. These costs can be very high for instruments of the utility companies because these instruments have to be re-assembled for re-verification. Since today electronic devices very often have a shorter lifetime with shorter validity of verification, it may be reasonable to define higher mpes in service for such devices which are very accurate when they are new. An optimization of the cost for the consumer might make it more reasonable to apply a factor higher than 2 between mpes for initial verification and mpes in service. In particular this applies to measuring instruments with a small economic impact to the consumer.

In the future the assessment procedure will change.

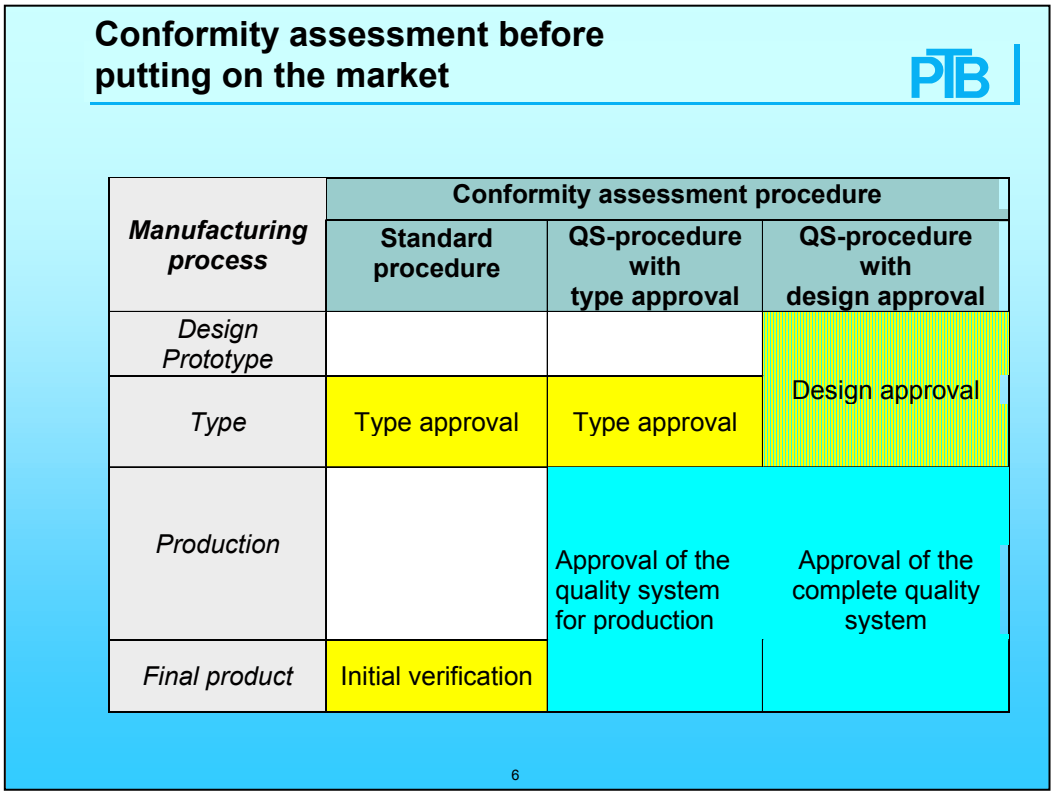


Figure 4

With series-produced instruments, it is reasonable to carry out a type examination and a simplified examination of the final products, called initial verification. However, the type approval procedure does not look at design, prototype and production stages and, in addition, only a limited number of produced instruments may be checked through initial verification. Therefore it may be reasonable to put the responsibility for this examination on the manufacturer on the basis of his quality system. This means that we do not apply the standard procedure but a quality system procedure with type approval. This quality system should be approved and under surveillance by an independent body. Sometimes this kind of examination is called manufacturer-verification or self-verification. However there is still a limitation concerning design and prototype stages.

It is advisable that software-controlled instruments are not only tested when they have become a complete type or black box, but already at the design stage so that it is easier for the manufacturer to carry out modifications in time so that the instrument meets legal requirements. The quality system of the manufacturer should not cover only the manufacturing and the final product testing, but also the design stage. So you can see that QS-procedure with design approval covers all relevant stages. Due to the experience with type examination, the same bodies should carry out the design examination. The same bodies should also be in charge with the approval and surveillance of the complete quality system of the manufacturer, because there is a very close interchange of this kind of quality system and the design requirements. In the

future in Europe, the manufacturers will have the possibility to choose between these three different conformity assessment procedures.

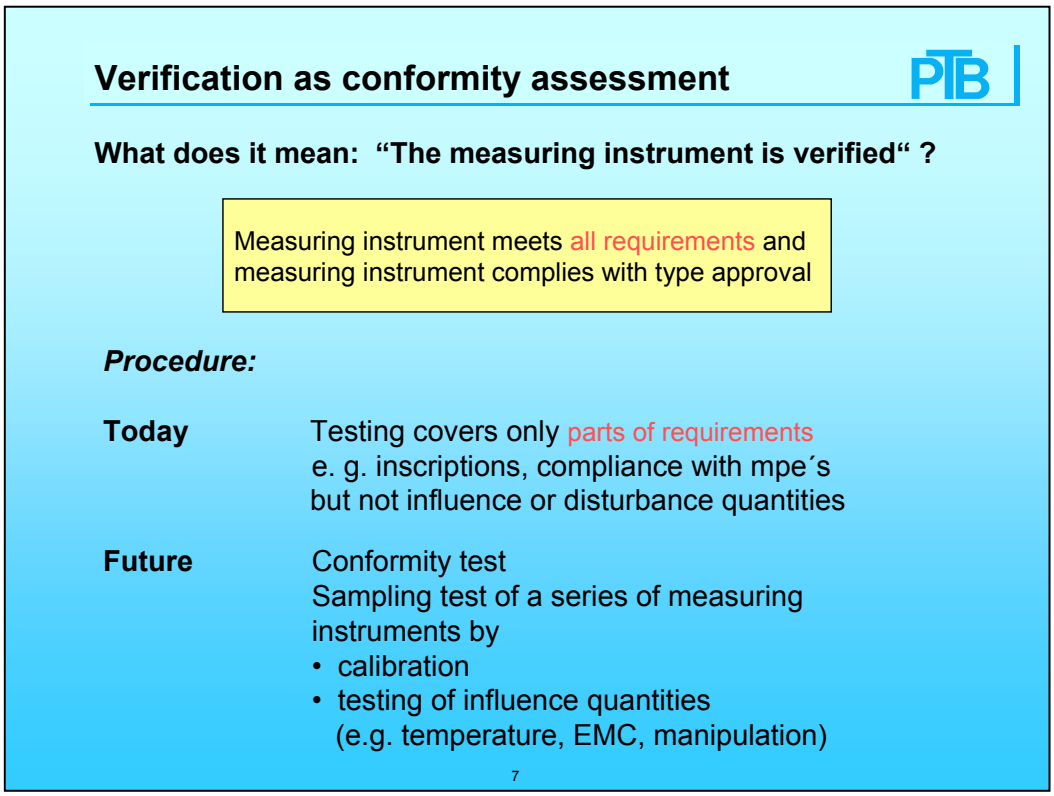


Figure 5

The verification should grant that that the measuring instrument meets all legal requirements but, in practice, the verification on site covers only parts of the instrument, for example inscriptions, installation and the compliance with maximum permissible errors, but not the influence of disturbances such as EMCs. Verification means testing of each measuring instrument so there is an economic limitation for an extension of the verification procedure with the aim of a conformity test.

In order to achieve a testing and certification procedure with measuring instruments meeting all requirements for type approval, series-produced measuring instruments should be tested only by sampling. With a limited number of specimen it is possible to extend the procedure of verification to the significant influence quantities. It would even be possible to apply a simplified EMC-test by using a mobile telephone near the measuring instrument under defined conditions written down in the type examination documents. The result of such simplified examinations at the level of verification cannot be compared with a pattern approval but provides more information than no examination at all, as it is the case today.

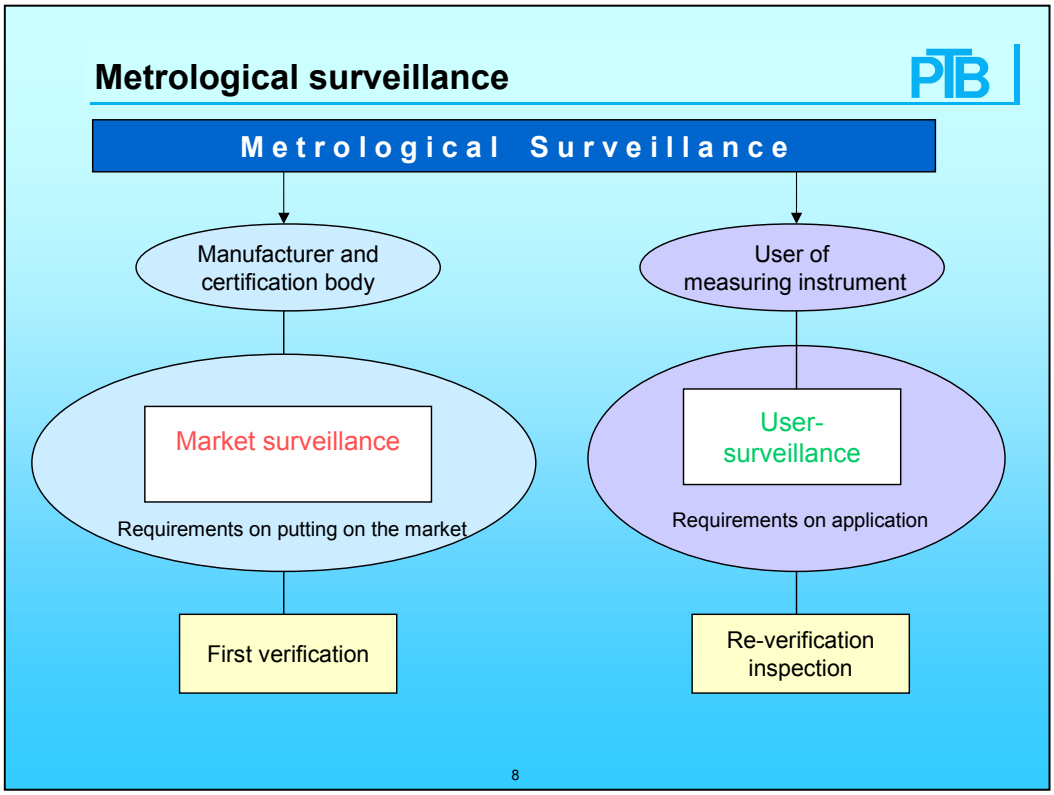


Figure 6

By introducing 'self-verification' performed by the manufacturer or verification by another private certification body, there is the necessity of metrological surveillance by the government. We should distinguish between the surveillance of the manufacturer and the surveillance of the user of the measuring instrument.

The ability of the manufacturer to put approved measuring instruments on the market has to be checked by market surveillance. The problem is that the market surveillance can only apply when the instruments are already on the market. A modified verification is a possible tool for this task. With this 'first verification', the instruments can be checked on the basis of requirements which are valid at the time of the putting on the market. This procedure should guarantee that the manufacturer has met the requirements for all of his instruments.

The surveillance of the user concerns the correct use of the measuring instrument and can be carried out by 're-verification' or 'inspection'. The requirements referring to this aim are not the same as at the time of putting on the market but on using the instrument. This procedure should mainly aim at the responsibility of the user.

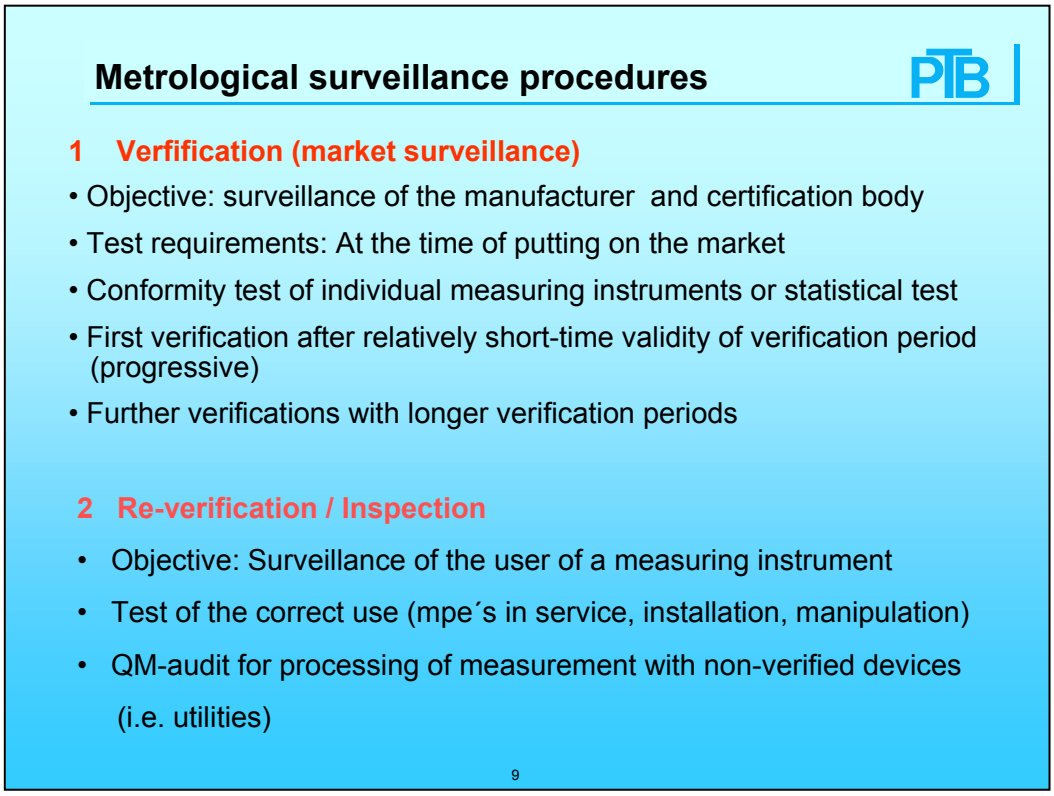


Figure 7

The figure above shows two surveillance methods.

The verification suitable for market surveillance concerns the surveillance of the manufacturer or that of the certification body. The requirements for this verification are those valid at the time of putting on the market. Should this verification be a conformity assessment of the measuring instrument, a modification must be made compared with the today's initial verification which has been already explained. Of particular significance is the statistical test for a series of measuring instruments. This verification could be carried out after a relatively short-time validity of verification period, for instance one year after putting into use. Later re-verifications would be possible after longer time intervals so that the cost for the first short-time validity of verification period would be compensated.

The re-verification or inspection serves the user-surveillance. Therefore the requirements have to be met on using. This concerns the maximum permissible errors in service, the installation and the possibilities of misuse. Furthermore it is reasonable to test the processing of the measurement results relevant to the charging of the customer.

This is important when the measurement results might be influenced by peripheral equipment which is not subject to legal control. Concerning utility companies or petrol stations, this test could be realized if a convenient quality system for this data procession would be required and if checks would be carried out in form of an audit of the relevant part of the quality systems.

Conclusion

In summary, it may be noted that a preferably quantitative definition of consumer protection is necessary and that the maximum permissible errors in service should be reconsidered in this connection. Furthermore the definition of a measuring result relevant to the price to pay is necessary so that the customer can check his bill on the basis of correct measurement result. Legal metrology not only means trade with instruments; it also means trade with measuring results.

The manufacturer has to develop the software in such a way that it may be tested. In addition, concerning modern measuring instruments, new conformity assessment procedures are required which make use of the manufacturer's quality system.

The introduction of progressive intervals of validity of verification period, starting with a short interval which is later extended, might contribute to an improved market surveillance of the manufacturer.

Concerning the surveillance of networked measuring systems, the internet should be used by the verification authorities in order to check these measuring systems e.g. for download activities.

As the quality of the measuring instruments is assessed by the manufacturer and/or by the certification body, also these bodies have to be monitored. In the future, the increasing privatization of the testing and certification bodies will become more and more a challenge for the legal metrology authorities.

Discussion

Comment: The figure on mpes shows a large difference between the values, this difference being even worse when considering that these mpes are in plus or minus. This may have no real consequence for e.g. petrol pumps since the mpe is rather small and that, when going to different petrol stations, you may hope to have plus and minus errors. The situation is critical for e.g. electricity meters where the mpe is not small, and when you have at home a meter which is 8 % wrong to you disadvantage, it will be for many years. On the other hand, which are the 'simple verification tests' you have mentioned? Do they alleviate the manufacturer's responsibilities?

Reaction: Simple tests are statistical test based on ISO standards which may give a good probability concerning the quality of a batch.

Comment: You spoke of 'trust in measurements', and it has been pointed out that measurements are more and more sophisticated. Don't you think that there is or will be a big gap between the knowledge of people carrying out market surveillance and new technologies? What about the possibility for local authorities to work in close cooperation with

specialized people who take care of the maintenance of measuring systems, of software, etc.?

Reaction: This gap already exists and people are aware of the technology, i.e. type approval people, must work in close cooperation with verification officers and develop training facilities especially on software.

Comment: The figure showing an electricity meter without any display directly accessible for the consumer is symptomatic of the current trends. Such a problem should not be discussed only between legal metrology authorities and manufacturers, but consumer associations and other bodies responsible for consumer protection should be involved. In the case of these electricity meters without display, provisions should exist so that the consumer may have access to the measurement results used for the transaction.

Reaction: This question is currently being discussed in Germany with manufacturers, so that the consumer may have access to this information through the internet. Of course, matters such as securing the information, or facilitating the use of internet by consumers, have to be solved. During discussions with manufacturers, PTB represents consumers' interests.

Comments from Mrs. Gaucher and Mr. Kildal, and the replies from Mr. Schulz, were unfortunately not recorded.

19 MEASURING INSTRUMENTS INVISIBLY CONNECTED

Wim Volmer, NMI, Netherlands

The purpose of this presentation is to outline the possible future and based on examples, open discussions on some of the possible future problems metrological authorities may come across.

What I have sketched here is a conventional measurement system which may be found in large refineries and chemical plants. There are lot of sensors which are mounted for example in pipelines, and yellow blocks which are flow computers or indicating devices and are connected to sensors for volume measurement which is the primary measurement, and to temperature, pressure, density, etc. sensors to calculate the volume under base conditions or the mass. All the flow computers are connected to printers where tickets are produced to document the transactions. Generally all these plants have automated systems and data-collecting systems and at this moment legal metrology has nothing to do with them.

A few typical characteristics of such a conventional system are the fact that there are dedicated components: volume sensors, flow computers, printers, etc. which have very well described tasks within certain order and which are well known. Because of that it is possible to have a very clear distinction between legal and non legal parts. Also such installation has mechanical seals for inspection officers who are required to be on site to perform their inspection. Proof of the transaction is usually in the form of a printed ticket. Measurement operations require human intervention. All dedicated components are connected to one another using cabling. Cabling may be as expensive as the instrument itself!

Let us now look at a few characteristics which may form the bases for measurement systems in the future.

Power will be locally generated by solar or wind power. This will decrease the need for power supply cabling. Cables for communication will no longer be needed because wireless networks will be installed everywhere.

The devices will be less dedicated that in our conventional systems. PCs or PC systems which can perform many tasks will be used for legal and non-legal activities and it will be difficult to make a distinction between legal and non-legal software.

Proof of the transaction will be available only electronically, via e-mail or SMS-message on a mobile phone.

In the future, the measurement system will comprise a PC network, with a lot of different tasks in it, including Weights and Measures control software, Weights and Measures control settings, Weights and Measures control log-files, to show human intervention or alteration of software settings. Both Weights and Measures Office and the customer are not physically connected to the PC system nor are the various sensors. Communication with both the customer and Weights and Measures authorities is wireless and electronic. This opens the way for Weights and Measures inspectors to perform inspection from a distance: they can call in to the PC system, check if some

settings haven't been altered, if electronic seals are still intact. With on-line reference equipment it will even be possible to perform a calibration-like test from a distance.

Is this science fiction or not? In 1966, the television series Star Trek started with gadgets and technologies invented for that series which were intended to date from around 2100-2200. many of the possibilities of computers thought of then are already now a reality. The communicators from Star Trek strongly resemble nowadays mobile phones.

I think that the future I sketch is not science fiction because here are some developments that are taking place at this moment.

Batteries are getting better and better. Wireless communication is also improving and for new office buildings it is cheaper nowadays to install a wireless network than a cable network. Also most electronic devices are now decreasing in their power consumption, with the possibility to combine data cables and power cables. The performance of solar cells is getting far better.

What could be the problem for us as legal metrology people?

When transmitted through wireless networks which operate on digital communication, measurement signals are, by definition, delayed. The instrument receives it signal, made some calculation to determine how many liters there were and then sends it at a later stage in a sort of a cycle towards the central PC system.

Software sealing is not yet fully harmonized.

There is no clear distinction between legal and non-legal software.

Because of the development of multi-functional devices, huge amount of software may be contained and it would be helpful to know which small part performs the legal operation.

How will we handle the electronic proof of the transaction, via email or SMS message on mobile phone?

Apart from the first analogue to digital conversion inside the instrument, all the measurement characteristics will be determined by software. The performance of the measuring instrument, if you can still define it, will be far less dependant of hardware than it uses to be and you will have a sort of approval document with requirements such as:

- such software,
- running on a PC equipped with Windows 95 Operating System or higher,
- at least 128 MB of internal memory,

and you may guarantee that it will operate.

That is the way to go with the increasing effect of software rather than hardware.

Why would it be a problem for us?

All what we wish as approval authorities or certification people is to offer some form of guaranty about the accuracy of the measurements and the data processing after the approval of the transaction. We need some confidence in the measurement itself and in the registration of the transaction.

We do have some technological features which will help us.

The instruments can be identified using electronic addresses so you know which kind of. device you are looking for.

Software modules can still be identified individually and each module may have a check-sum protection so that you can check that it is still intact and that it is the same module that you checked one month ago.

Log- and intervention-files where measurement data are stored or where is stored a proof that somebody has altered some settings are also already there.

By their nature, digital communications may always be checked.

So we have some technological possibilities to help us.

Weights and Measures problems can be solved by technological means but we will need to invest in knowledge of these new technologies and we need international harmonization on, for example, software sealing, to come to a solution for these problems.

Discussion

Comment: In fact the instruments mentioned by Mr. Volmer already exist: there are in certain countries taximeters of which the tariff may change at a distance by radio emission; there are also instruments of which the software may be reloaded at a distance. In addition to the questions evoked in the presentation, it should be noted that, in addition to invisible connections, hidden connections may also exist and may facilitate frauds: legal metrology should be able to detect them.

Reaction: Yes, this is a crucial problem. However, log-files and protections of software should make it possible to check the integrity of software.

Comment: Can you clarify your vision of multifunction non-dedicated systems?

Reaction: This already exists for example in self-service petrol stations where the transaction is finalized in a terminal with a sort of PC which delivers the ticket concerning the purchase of fuel but at the same time delivers the invoice for what has been purchased in the supermarket associated with the petrol station. So where is the distinction between legal and non legal parts of the software operating the PC?

Comment: The transfer of measurement data should create no major problem provided that legal metrology authorities take account of the consumers'

needs concerning the securing of these data. However, it should not be forgotten that, if these data include addresses, invoices, etc. there are rules aimed at consumer protection concerning the confidentiality of such information. These rules go beyond the responsibility of legal metrology and therefore the matter of data securing should not be dealt only by legal metrology authorities and manufacturers.

Reaction: Of course matters of confidentiality will have to be seriously considered by relevant authorities.

20 MEASURING INSTRUMENT TECHNOLOGY AND CUSTOMER AND CONTRACTOR OF LEGAL METROLOGY IN MID 21ST CENTURY

Mitsuru Tanaka, CIML Member, Deputy Director, NMI, Japan

My talk relates to what should be new business for us in 2020.

At first, let us have a brief look at the relationship between metrology and activity of players in a society. Player of economy, such as individual, industry, association, will have its own strategy. Metrology plays an important role since the result of measurements enables evaluation. Then the player predicts and plays according to the prediction. The results of action will be applied again to the measurement for optimization and this sequence will continue for ever as far as the player of economy plays.

It will be true that metrology is one of the most important techno-infrastructure for the intellectual activity of economy and enlarge individual activity of the player.

The increase in the benefit for economy, actually GNP for example, will be limited when the player plays independently. But once they are geared with the techno-infrastructure, their plays will be correlated according to dependability and the productivity of economy must be much increased.

As the economy grows, the cost and speed of supply of the techno-infrastructure become more and more important and its dependability, reliability or uncertainty for example, should be dependant to the cost and speed which the player can afford.

It will be true for metrology too.

It will be also efficient to study the techno-infrastructure a bit deeper.

It must be systematized for easy access, for flexibility to change in economy, for development and for maintenance, and systematization must be coordinated by the legislation or rigid regulations.

Metrology keeps a special seat among many other techno-infrastructures and consists of measurement standards and legal metrology. Besides metrology, we have another techno-infrastructure related to database and evaluation methods. The object of database and evaluation methods may be subject to the policy of economy. In our case, geological, biological and chemical objects and quality of life are regarded of importance because of the recent disasters which we suffered from.

What does the economy in the 21st century look like?

Globalization: I would say global dependability.

Non-profitable organizations will contribute the benefit of economy. New measure, such like quality of life, for the benefit of economy should be applied.

Let me take the example of the Japanese economy.

A player, actually an industry, needed its own cooperating industries supplying the raw material and the services. The cooperating industry needed another cooperating industries and eventually, many industries were involved in the activity of the first industry. It worked well until the bank started assembling on the industries. In order to pursue the productivity, each group constructed its own independent techno-infrastructure. Then we had more than 100 groups in our economy and automatically 100 independent techno-infrastructures. And then the economy corrupted and simultaneously many national securities were violated. Then, the Government devised a structure for the techno-infrastructure and reformed the institutes. The division is installed with office of weights and measures for legal metrology and the institutions were reorganized. The idea is to provide the player with well coordinated techno-infrastructures, like this. It should be noticed that the new division is in charge to join to the coordination of all national R&D program from the view point of developing the techno-infrastructure. With it, all the players of the economy contribute coherently to the benefit of the economy. The national metrology system will play the basic and main role on the program, and then the player must enjoy a free choice on the dependability, cost and time for delivery.

Now let me start with the main subject on the relationship between new technologies and legal metrology in 2020.

The basic idea is the following:

We have present economy and R&D for the advanced technology fed by the economy. They will yield products, like new tools and instruments both for accelerate the evolution and new social system. The economy will evolve and give change to its needs to metrology. Certainly, new metrology will benefit from the product of new technology. The new social system and new metrology will be contractors of legal metrology.

As for the new technology, I can point out three examples among many other fields which will be familiar to you already: they are information technologies, environmental technology and biotechnology.

Information technology provides every technologies with great scale merit and fast processing speed. Typical products will be telecommunication media, downsized devices, wide display, wearable computing elements, robotics with integrated sensors. It will be useful to pay attention to the fact that current information technology looks to be focused onto the human interface. besides the hardware technology, information processing technology enable us such intelligent activities like electronic autograph and electronic security.

As for the environmental technology, new technology takes care of such objects like weather, ocean, pollution waste and the special feature of the technology will be to deal with complicated and multi-component system in the global environmental technology and simulation technology for the material from nano-scopic scale to giga-scopic scale.

The products so far will be to enable global trading of CO_2, suspended particulate transfer of incombustible waste and recycling substances, risk assessment of environmental pollutions to biological effects. Fuel cell for ecological transportation,

application of hydrogen fuel, conversion of refrigerant for the preservation of the ozone layer are also other object of R&D for environmental technology.

In the biotechnology field, many innovative R&D are going on yielding such technologies as gene technology, directly influencing the quality of life, including DNA appraisal for human and whales. Particularly in this field, special metrological issues are present. They are systematization on metrology, establishment of traceability of measurement, certification of measuring instruments. Here I show a part of DNA chip device, which is the tiniest manifold with the size of sub micron to allow the processing of DNA.

Let me show you also the typical example of products of new technology, which will probably claim the metrology new change:

intelligent mobile phone with sensor system, wearable computer, robots, micro chip, DNA chip.

Among them I picked up the example of micro chip for micro totalized analytical system. It consists of the tiny manifold system and multisensor system and the fluid specimen with least amount is analyzed chemically. The results of analysis is fed to the computer and you will have general check up immediately, once you put a drop of your blood on the inlet of the device. You can see the dimension of the manifold in the glass here and all these assembly has the size of normal flash memory.

Before discussing on what these new products of R&D demand to metrology, let me briefly describe the demand from the normal evolution of the economy itself.

Conventional metrology was supported by metrology for its features like mass production, uniform directions of use for the products and the measurement was mostly intended to achieve the quality control for the uniformity and stability of the productions.

Since new economy will be based on such feature as high value added product, market research, short life cycle of technology, wide product range, new metrology must meet the requirements from them in terms of cost, time and dependability. Global production and market system, deregulation, flexible certification for personal activity must be paid attention too.

Now we can discuss on the metrological needs originated from new technology.

Conventional metrology was composed of application of objects to measuring instruments, measuring instrument itself, operation of measuring instruments and display and transmission of the data of measurement.

But the new technology asks the metrology to proceed to other processes in activity of players, such like evaluation, prediction and action:

- calibration for new sensing system (micro TAS); verification of software; immediate certification on the measurement and the evaluation; certification of a number of measurements; quick modification of measurement functions; systematic certification of modular measuring instruments, family of measuring instruments, and system measuring instruments.

We have to discuss also on the provisions given by the new technologies.

Chip sensor on measuring instruments allows us the self diagnostics on the measuring instruments and recording of its personal history and submits the evidence fro the enforcement of verification, calibration and maintenance.

Database technology will enables possible registration of measuring instruments.

The measuring instrument embedded with chip sensor allows the diagnostic on the performance of the instrument and will report the status of the measuring instruments.

The software verification will use the technical requirement for the reference and there are many gaps between natural language and software artificial languages and the process is irreversible. This feature makes it difficult to verify the software. If the development and the verification are cooperated, the process will become much easier.

Artificial intelligence may give us the following improvements on metrology:

- systematic software verification; technical requirements described not by the character but by visual and audio media, which will enable quick and remote certification and surveillance; systematic semantic analysis on natural language and software language descriptions on technical requirements will be very useful; artificial intelligence appraisal will contribute to the impartial coexistence of certification and the production of measuring instruments or measurement itself; simulation technology will improve the precise and quick pattern evaluation; robotics and e-measure will be useful to avoid human errors in verification and testing.

The activities dealt by metrology are shown in this way.

If we have two players involved in the transaction, they wish to evaluate the products that its opponent offers. However, it will be hard for it to evaluate by itself and ask some consultant to evaluate on behalf of it. Then, there should be the nest transaction between a player and the consultant. This will continue until the dependability is guaranteed by the authority.

These new recursive structure of certification will open the new certification business.

Mass media: public reference needs the certification of measurement results.

In non-profitable organizations, its activity must be based on impartial evaluation.

Rigid application and high dependability should be taken care by legal metrology, while flexible and cost-oriented dependability should be taken care by voluntary certification.

As for the contractor of the new metrology, global metrology system should be the ultimate contractor. However, private organization should be counted among them, if impartiality is guaranteed by new R&D.

The role of government as coordinator of players of legal metrology is very important.

As a conclusion, let me describe a little on the tasks of global legal metrology.

So far harmonization on technical requirements for measuring instruments has been installed to the global legal metrology. But, in the future, harmonization on control and certification for measuring instruments must be discussed.

The cost estimation and fee policy for metrological control and accreditation and certification modeling on calibration, testing and supervision must be discussed too.

21 PROGRESS AND OUR GENIUS FOR COMPROMISE

Martin Birdseye, Director, International,
NWML, United Kingdom

Metrological regulation is done largely by the control of measuring instruments and so it is concerned with the precise disciplines of metrology and engineering. In the development work of the OIML we also find a quite different discipline that depends on judgement and a long-term view of progress rather than a precise solution. In the global harmonisation of legal metrology there are compromises to be made. The acceptable solution is not always the best solution, but it is necessary to find the approach that will meet people's needs and aspirations. It is then possible to move forward, to make some progress.

The scope and power of this method is a major asset that we should be aware of. It is embedded in the Convention and procedures of the OIML.

The theme of this paper is to be the talent we have for reconciling many different national and regional perspectives in our work and the importance of understanding certain issues which could impede our progress. In this case our talents include not only personal abilities and good-will but also our collective, constitutional and procedural assets, and practical engineering logic that can sometimes make the right solution fairly obvious.

We must not ignore the scientific foundations of our work, and the need for technical investigations and development; but it is fair to say that progress in the OIML depends on agreement; that is agreement between Member States. One can see that there is already a high level of agreement on general objectives, but it is not easy to agree on how to attain the objectives. The steps on the way are quite complex. To reach agreement on a complex proposition there has to be a good understanding of the issues, usually involving technical, procedural and also "consequential" factors. Under the heading of consequences we should include, for example, the effects on manufacturers, traders and consumers - everyone involved needs time to resolve their national economic and commercial priorities, and, we hope, the needs of their citizens.

So let us examine the means we have for making agreements and see what we might do to improve them. Agreement depends on consensus, together with confidence in the process, and a genuine commitment to implement decisions.

Firstly, agreements cannot be made by votes; there has to be a genuine meeting of minds - a consensus.

There is also a process. We have the means (the machinery) to take what may be no more than an idea from one person's mind and develop it through the structures and procedures of the organisation until we have a global agreement, established in writing. This is quite a remarkable process, and its ongoing success is a major achievement, especially for the facilitating role of the Bureau; but it cannot work well unless all participants are confident in it. We should not be content with structures and procedures until they engender confidence.

Then there must be commitment to the outcome. We are not involved in an academic exercise. Legal metrology is above all practical. Decisions that we make can affect the lives of ordinary people, everywhere. But agreements that do not lead to action may be worse than useless. Without a general commitment to implementation there is not only a denial of benefits to the citizen but also the possibility of establishing unfair advantage. These factors can lead to a justifiable reluctance to reach agreement.

So we need consensus, confidence and commitment.

We should have the courage to examine some of the problems or deficiencies that may inhibit confidence in the process. Then we should examine how things work out in practice, given time, established procedures and good will. What we find is encouraging, so much so that it should give us more confidence in the outcome and thus more commitment to the work.

In a seminar concerned with the future of legal metrology, we should keep in mind that there are two different dimensions or directions to the development work in the OIML, which can broadly be described as technical and procedural. On the one hand we develop Recommendations for control of particular measuring instruments or measurement processes, and on the other hand we develop the tools and machinery to reach agreements, and procedures for implementing them. Sometimes we find that agreement on procedural developments is more difficult, possibly because at this stage in the development of legal metrology, it is more important to us.

Deficiencies in the process may arise not of course from human failings but from the realities of culture, politics, history and geography, and often from our eagerness for progress. Occasionally we see:

- Inadequate consultation;
- Cabalistic working groups;
- Apparently “unequal” votes;
- Asynchronous progress;
- Failures in implementation.

Adequate consultation is necessary, at both national and international level, but it is not easy, even in the days of e-mail. However, it is a vital part of reaching a real consensus which carries the confidence of all parties. We must accept that the time involved is considerable, even when there are no unnecessary delays. In general, all parties should have an opportunity for consideration and comment and then to examine the comments and suggestions of all the others. We already have rules to this effect in the Directives for OIML Technical Work. Whatever we do to streamline procedures, we should not forget that confidence depends on open debate.

However, complex technical solutions do not generally come from open debate but from hard work in small teams. That is why we have working groups, where individuals can forget national priorities and concentrate on the creation of practical proposals. How far they should go before presenting proposals to their international committees is a matter for judgement, but it seems essential that all participating Member States should be kept informed of progress and be able to contribute as they wish. Unofficial networks

can seem to be very effective, but they may be driven by national rather than technical priorities and they will be ineffective in the long-term if all parties are not confident in the outcome.

The term “asynchronous progress” refers to the fact that national and regional legislation must often be developed in a timescale appropriate to local priorities and therefore this is done independently of the OIML work upon which it should ideally be based. This is not always a bad thing. The world of technology and business moves on, and independent economies must react to it in accordance with the best available information, which may or may not be available in the form of the latest OIML Recommendation. Thus the OIML Recommendations must have an ongoing relationship to national and regional legislation. A prime example of the process may be found in the necessarily parallel but asynchronous development of the EU Measuring Instruments Directive (MID).

I have chosen what is possibly a contentious issue, to be the subject of a more detailed discussion. For convenience I call it the problem of “unequal votes”.

Unequal votes may appear to be impossible. We have almost an excess of democracy - one country one vote and usually several stages of voting and approval. However, votes appear to be “unequal” if we suspect, for example, that one country, one policy one vote, is effected as: one region, one policy, 14 votes. Our North American friends will recognise this phenomenon, and Europeans colleagues should recognise it. As an intergovernmental organisation, the OIML necessarily works at the level of sovereign states. The notion of equality among Member States is very important to us. For various reasons it is acceptable, some would say essential, to have equality in this forum, even when there are manifestly huge differences in the economic, demographic and geographical size of the Member States. Where there could be a problem however, is the situation where some of the sovereign Member States find themselves constitutionally linked, so that while retaining their separate votes they might be effectively bound to one policy by common legislative measures. You will of course know that I am talking of the natural concern that other industrialised economies have about the development of the MID in Europe. There may in fact be no real problem here, but it is an issue of fairness and common sense that could threaten our common cause if it is not explained or resolved.

I feel bold enough to raise this issue because, firstly I think that there is some obligation on the Europeans to consider an issue about Europe that concerns their international colleagues, and secondly I see that in practice there are many remedial factors in the situation and we find that the outcome is not as we may have perceived it to be. Thirdly it raises so many other points about how we work that it serves as an agenda for a discussion of the constitutional and procedural strengths of the OIML and a long-term approach to progress.

I am not advocating or contemplating any constitutional change. We can see plenty of examples in the world as a whole where, in spite of there being much greater need and real urgency, the lawyers and political scientists have failed to solve constitutional problems. In Europe we have many ingenious constitutional developments, including QMV - qualified majority voting, but these things are hugely complicated and still

evolving after fifty years. Constitutional amendments are not for us here, certainly not in this forum.

That leaves us broadly with three other angles to consider: legal, logical and practical. Having in mind that the answers should all be consistent, and that we have very limited time here, I shall leave aside the legal enquiry for now, consider briefly the logical approach (to see if there may be a real problem) and concentrate on the practical approach. We will be encouraged to find that there are so many practical courses of action, designed to facilitate progress.

Logically, the "unequal votes" problem should only be a real problem if there are practical circumstances where Member States of the EU would be legally constrained by a European Directive to a point of view that is against their own national priorities. If this is not the case then they can make their own policy along with any other Member State. So the question is: could a Member State support a Recommendation that is inconsistent with an existing Directive?

Logically the answer is Yes; because we are talking of a Recommendation, to which there is, according to Article 8 of the Convention, a moral obligation for implementation where possible. That gives exactly the flexibility we need. Note that in practice it is a flexibility over time; it turns the problem of asynchronous development into an advantage. If national and regional legislation must logically follow the OIML Recommendations then, by the nature of development, there will be differences and scope for improvement at each stage.

In the case of the MID, the relevant OIML Recommendations were, quite rightly, the starting point for the specific instrument requirements, but the regulatory procedures have been developed and the performance requirements refined to some extent. This was necessary, where for example, performance requirements were not yet adequately defined by OIML Recommendations. Europeans will not be inhibited from contributing to further improvements developed in the forum of the OIML, which, in turn could eventually be incorporated into European legislation. (Incidentally, in some cases this can be done by a committee procedure and Commission Directives, avoiding the need for negotiating amendments to the main Directive.)

So, by simple logic in application of the most basic principles of the OIML Convention, we can see that "unequal votes" are probably not a real threat to anyone; and, moreover, we have other, more powerful and practical ways of dealing with this kind of problem:

- Common sense;
- Mutual respect;
- Individual responsibility;
- Good faith;
- Engineering solutions;
- Scientific facts;
- A long-term view; and
- Common objectives.

We should look at the ways we work to see how some of these factors are applied, and this will, incidentally, lead us to a view of where we are going - where will legal metrology be in 2020.

First there is a matter of common sense and good faith. A rather unusual, perhaps unique feature of the OIML Convention is that Member States "shall be morally obliged to implement [Conference] decisions as far as possible." What is the legal status of a moral obligation? I think that a moral obligation is less binding but more useful than a legal obligation. Without a legal requirement or a rigid timetable for implementation, Recommendations can more easily be developed to the point where they are universally acceptable and yet still achieve the necessary level of harmonisation in the long-term. In effect they specify the performance requirements and define the direction of development. Generally speaking, if we decide where we are going, then we are more likely to make progress!

The work of the OIML is intrinsically linked to progress. Long-term development goes on regardless of local progress or national priorities. Technical Committees work to develop and revise Recommendations in a well-defined framework that is, in principle, quite independent of legislative projects in individual Member States and regions. As we have seen it is an asynchronous process which may seem inefficient to an impatient or legalistic mind. We can see it as natural that there should be supportive developments at various levels and regions, that are not exactly in phase. Regional development is now fully supported by the OIML - it is a part of the process.

Thirdly we have respect for and confidence in each other. Individuals can always have in their mind a right or logical solution, and this can lead them to the right way of applying national policy; indeed it enables them to contribute to the development of national policy. The normal everyday development procedure of the OIML provides a framework in which these things can happen. A well-structured logical document has a power of its own - national and regional priorities have relatively little influence when the long-term answer is fairly obvious and when the constitutional commitment is one of principle rather than legal observation. In this way individuals and Member States can function as independent voices.

There is also scope for creative compromise at a more technical level. A classic example is the concept of optional classes for specifying limits of error for measuring instruments. In general, where there is a range of requirements or where it is possible that performance will be enhanced by technological development, then the role of an OIML Recommendation is to provide the framework for specification and control of instruments, rather than a rigid prescription. The task then is to define a practical series of accuracy classes upon which Member States can base their legislation and into which manufacturers can aim their products. In effect we aim for harmonisation of development as a means towards harmonisation of regulation.

Technology is increasingly helpful when we seek scope for practical compromise. Software is powerful and memory is so cheap, that flexibility can be built in at very low cost. Thus it can be acceptable to require that a measuring instrument type shall have a range of functionality, enough to satisfy diverse national requirements, without placing a significant burden on the manufacturers. In time we may find that the national requirements are reconciled. One approach may become the norm, but in the meantime

the OIML Recommendation will have been serving both or several parties, providing the means to move forward in the most logical direction.

In general our task is always to have a long-term view, to look further ahead to what is really the most efficient solution. Jean Monet, who inspired the creation of the European Union, said that "major changes can be achieved if men's minds can be directed to the point where their interests converge. That point always exists, but it takes trouble to find it." If we look far enough ahead we can find it. In nearly all of the points I have made in this paper, time is an important factor. We need a long-term view.

The OIML itself could be viewed as a long-term project. "Long-term" because of the factors discussed above, and indeed a "project" because it has well-defined objectives which may ultimately be more or less achieved. To see where we are going in terms of international legal metrology, one might look at the position in some of the Member States where there is already an established structure of consistent metrological regulation. However, one might also find that, as Mr. Birkeland said of many of the Member States, there will still be inadequate co-ordination between the technical disciplines and administrative groupings.

Ultimately, the OIML will need to go on working in three areas:

- To maintain the established operational structures and documentation;
- To develop new machinery in response to the needs of continued technical, economic and social progress; and
- To respond to the continued evolution and rationalisation of government.

Perhaps in this era of globalisation we are at the peak of activity and by 2020 the workload will be declining or almost done. It seems likely that on a scale related to achievement of objectives, we can predict a natural growth curve which will be something like the curve shown in Fig. 1 and the corresponding workload could then be represented by the differential of the curve in Fig. 2.

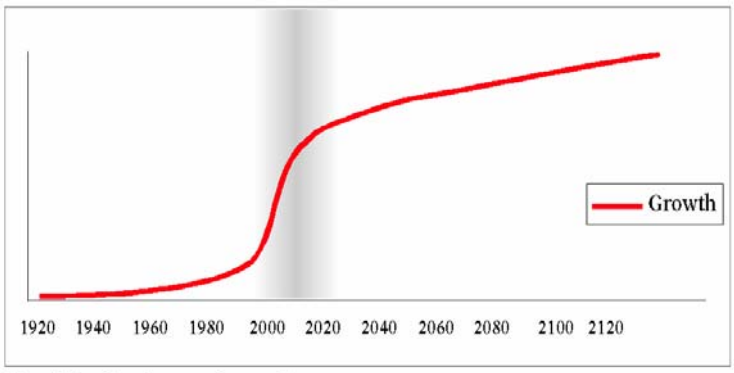


Fig. 1 Predicted natural growth curve

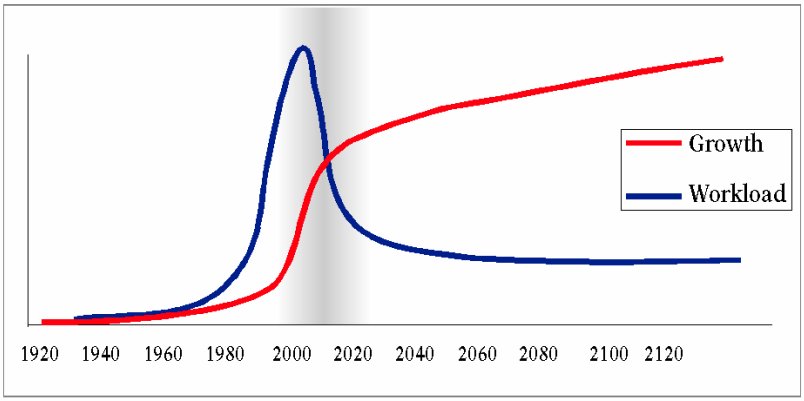


Fig. 2 Predicted natural growth curve and corresponding workload

So there is a broad peak of activity while all the main global objectives are achieved and this is followed by a lower workrate corresponding to ongoing maintenance and responding to changes. This is the simplest curve and even so it is not easy to quantify, but it is nevertheless useful in understanding what is likely to happen. We should think hard about the overall timescale and where we are now, on this curve.

I think there is still a long way to go, but in the meantime we should have:

- Confidence in our talent for reconciling national interests;
- Courage to address deficiencies; and
- Commitment to long-term progress.

Discussion

Comment: Mr. Magaña pointed out that the question of voting and of the weight of each vote was a real problem, for which a satisfactory answer had not yet been found. The only solution was perhaps to reach, at the relevant levels, such a broad consensus that this problem of the weight of votes would no longer play any role. In addition, it appears (e.g. in the revision of OIML D 1 *Law on Metrology*) that difficulties result from problems of reciprocal understanding. More in-depth discussions and better listening to others in order to understand what they mean would facilitate reaching a broader consensus.

Reaction: Quite probably this is a good approach; in addition, it appears that legal metrology officers are often more interested in technical work than in administrative or legislative papers and that they should pay more attention to OIML work, such as the revision of D 1.

22 OPPORTUNITIES AND FUTURE TRENDS IN LEGAL METROLOGY CONTROL OF MEASURING INSTRUMENTS

Sam Chappell, CIML Honorary Member, USA

Introduction

Currently, legal metrology control generally includes type evaluation and approval and initial and subsequent verification. In the future, one can envision legal metrology control to also include:

- quality management systems for the production of instruments and the manufacturer's declaration of conformance of the individual instruments to the requirements of initial verification,
- subsequent verification of measuring instruments carried out in a manner to provide 'market surveillance', and
- exchange of field test information among nations that have established mutual acceptance arrangements with regard to 'type evaluation'.

This future will require oversight by 'national responsible officials' – legal metrology services – to ensure the competence of instrument manufacturers as well as that of participants and partners in the mutual acceptance arrangements. For maximum effectiveness, these processes should be implemented on a global basis. Thus, the OIML is expected to lead and play an important, essential role.

Legal metrological control procedures

For measuring instruments, the following procedures apply:

- Type evaluation and approval:
  - testing laboratories
  - certification bodies (issuing authorities)
- Initial verification:
  - field officials
  - manufacturer's declaration
- Subsequent verification:
  - field officials
  - readjustment (calibration)
  - maintenance and repair
- Market surveillance:

- individual instrument failures identified, recorded and notified
- recalls of instrument types displaying a record of failures
- requires manufacturers to implement adjustments in the field or in production

Current and past practices

A view of the future reflects what is happening currently and has happened in the recent past. The principles of determining the competence of calibration and testing bodies were beginning to be discussed about two decades ago and have been implemented at least during the last decade along with determining the competence of certifying bodies. These principles are being applied broadly. Out of these developments, the *OIML Certificate System for Measuring Instruments* was developed.

The *OIML Certificate System* has been a huge success since it was initiated in 1991. The challenge will now be to complete and initiate the MAA and to revise D 19 on type evaluation and approval and OIML D 20 on initial and subsequent verification, along with developing an OIML program for certifying individual instruments. The basic tools necessary for accomplishing these tasks are in place.

An OIML Technical Subcommittee TC 3/SC 5 on 'Conformity assessment' was established in 1999 under TC 3 'Metrological control' that has responsibility for the project for developing the framework for a mutual acceptance arrangement on OIML type evaluation (MAA).

The output from the various OIML Technical Committees on specific Recommendations and the guidance documents on metrological control are expected to provide a firm basis for global implementation and harmonization of national regulations.

Recommendations pertain mainly to type evaluation* and incorporate the following principles providing a means for type approval and certification:

a) Metrological requirements:

- Accuracy class
- Maximum permissible errors
  - rated operating conditions, reference conditions
  - rated operating conditions, with influence factors

* BIML Note: Most OIML Recommendations pertain also to verification, since initial and/or subsequent verifications belong to legal metrology activity and are thus subject to national or regional regulations.

- Influence factors
    - climatic (temperature, humidity, etc.)
    - mechanical
    - electromagnetic
- Repeatability and reproducibility
- Discrimination and sensitivity
- Reliability over time
- Mutual recognition and acceptance arrangements

b) Technical requirements

- Indication of the results
- Software
- Markings
- Operating instructions
- Suitability for use

c) Test program and procedures

d) Format of the test report

e) Certification or declaration of conformity

Mutual recognition and acceptance arrangements

Another significant development in the past decade has been the mutual acceptance arrangement being carried out under the Treaty of the Meter which focuses on physical standards and calibrations. The successful implementation of this MRA that addresses the 'equivalence' of national physical standards could provide the necessary confidence in the 'traceability' of calibrations and measurement results. It would support OIML activities related to unifying and harmonizing the metrological control of measuring instruments globally.

The basis of these mutual arrangements and oversight functions will be the principles of determining competence that have been developed in international standardization bodies such as ISO and the IEC and member organizations. Such principles are contained in ISO/IEC Standard 17025 for calibration and testing laboratories and in ISO/IEC Guide 65 for certifying bodies. Competence of such bodies can be carried out by assessments by accreditation bodies or by peer assessment. That is:

- Bodies involved:
    - Issuing authorities
    - Testing laboratories

- Methods of assessment:
  - Accreditation
  - Peer assessment
- Considerations:
  - Availability of complete testing facilities
  - Qualified personnel
  - Training
  - Cost
  - Financial and human resources

It will be necessary for the OIML to incorporate such principles in those Documents directed towards national, regional, and an international harmonization of legal metrological control of measuring instruments.

Experience has shown that such principles will need to be updated and revised on a periodic basis. Thus, it will also be necessary to revise accordingly those Documents for which such principles have been adopted in Documents for international application such as fields of legal metrology.

The principles that should be observed by international standards bodies in the development of their projects are as follows:

Transparency – all essential information available to interested parties

Openness – participation open on a non-discriminatory basis

Impartiality and consensus – consider all views and attempt to resolve differences

Effectiveness and relevance – respond to needs and performance rather than design based to promote development

Coherence – avoid duplication and establish cooperation with relevant work of others

Development dimension – consider the needs of developing countries

Future trends

The principles of a 'Framework for mutual acceptance arrangement on OIML type evaluation' (MAA) are in the process of being finalized. Much has yet to be learned after the approval and implementation of the MAA. Based on the experience gained in its implementation, the MAA will require continued development and maintenance.

In the harmonization of metrological requirements in mutual arrangements for type evaluation, agreement will need to be established on metrological and technical performance requirements, examination and testing procedures, and the format of the test report. For metrological requirements, agreement should be achieved on accuracy classes, maximum permissible errors under rated operating conditions at reference conditions and under applicable influence quantities. For technical requirements, agreement should be on features necessary for the instrument to perform correctly and

display accurately and including labeling, except for some specialized national and regional requirements.

Trends in the field of verification are expected to include the use of remote monitoring of measuring instruments in service. The use of Internet services should facilitate much of this monitoring. However, local radio-wave devices may also be employed. Software specific to operating such services should also be available.

Future opportunities

A future challenge based on the experience gained in the implementation of the MAA will be the development of an 'OIML certification program for individual measuring instruments'. Such a program will have as the basis the existing principles provided in OIML D 27 on initial verification based on the manufacturer's quality management system.

The benefits of these efforts will be to facilitate the marketing of 'type approved' measuring instruments for carrying out measurements under legal metrological control globally. The areas affected will be equity in trade of the quantity of products, the protection of public health and worker safety, and the monitoring and protection of the environment. These efforts will provide protection of the consumer and establish broad confidence in the quantity and quality of goods and services.

The areas of legal metrology control of instruments may be summarized as follows:

- Equity in the quantity or quality of products marketed:
  - buyer and seller
  - consumers of products
  - labeling of quantities of products in packages
- Public and worker health and safety:
  - medical diagnostic instruments
  - clinical instruments used in analysis
  - monitoring of workers' exposure to potential harmful conditions
  - monitoring of the workplace environment
- Environment:
  - monitoring pollutants in the air, water, and soil
  - determining the level of pollutants (contaminates) in food products
  - verifying and maintaining analytical instruments used for analysis

Conclusions

Future developments in legal metrology control of measuring instruments will depend on the application of the principles laid down in significant publications.

Some of those publications that include vocabularies, requirements for competence for testing and calibration laboratories, requirements for bodies operating certification systems, quality management systems, type approval, initial and subsequent verification, and the framework for a mutual acceptance arrangement for type evaluation are as follows:

OIML VIML: 2000 *International vocabulary of terms in legal metrology*

BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML VIM:1993 *International vocabulary of basic and general terms in metrology*

ISO/IEC Guide 2:1996 *Standardization and related activities – General vocabulary*

ISO/IEC Guide 17025: 1999 *general requirements for the competence of testing and calibration laboratories*

ISO/IEC Guide 65: 1996 *General requirements for bodies operating product certification systems*

ISO/IEC CD 17040: 2001 *General requirements for per assessment of conformity assessment bodies*

ILAC-G10: 1996 *Harmonized procedures for surveillance and reassessment of accredited laboratories*

ISO 9000 Series: *Quality management systems*

OIML D 19:1988 *Pattern evaluation and pattern approval*

OIML D 20: 1988 *Initial and subsequent verification of measuring instruments and processes*

OIML D 27: 2001 *Initial verification of measuring instruments utilizing the manufacturer's quality system*

OIML P 1: 2003 *OIML Certificate System for Measuring Instruments*

OIML Draft Document *Framework for a mutual acceptance arrangement for OIML type evaluation (MAA)*

OIML Draft Document *Checklists used by issuing authorities and testing laboratories involved in type evaluation*

Discussion

Comment: In one of the illustrations shown during the lecture, only two ways for establishing confidence are mentioned, accreditation and peer assessment. However, knowing each other, long lasting experience and facts may establish confidence as well.

Reaction: This is quite true. However, accreditation or peer evaluation of a given laboratory have benefits not only for other partners, but for the laboratory itself by giving good advice on how to improve the management, the staff, etc.

CONCLUSIONS OF THE SEMINAR

i) Discussion immediately after the Seminar

The floor was first opened up for general declarations or comments.

Comment: It has been said that metrology is a basis for other sciences and technical activities but a basis is like a root: it is invisible and this is perhaps the reason why it is so difficult to make policy makers sensitive to the importance of metrology and to the need to allocate it appropriate financial and human resources. A solution would perhaps be to associate metrology with other disciplines, in particular quality, accreditation and standardization in order to form a large entity which would be more visible. Communication should not follow metrological actions, but rather anticipate them in order that these actions may be influenced by groups of persons (e.g. consumers) who would then understand these actions and participate in their promotion. The transversal character of metrology should be more marked by associating really non-metrologists with metrological activities. Last but not least, assistance to developing countries should be carried out by experts having wise views and not willing to impose costly solutions just because they have been implemented in developed countries.

Mr. Magaña reacted to these comments by explaining that, in each OIML Member State, it is the difficult responsibility of the CIML Member to explain the role of the OIML to decision makers who have an economic culture but, in general, no technical culture. Cooperation between metrology (including legal metrology) and other connected activities exists, as shown by e.g. the work of the Joint Committee for Guides in Metrology within which the OIML and the BIPM work in close cooperation with ISO, IEC, ILAC, IFCC, IUPAC and IUPAP, and also a recently established BIPM/OIML/ISO/IEC/ILAC/UNIDO working group aimed at reflecting on the coordination of their activities related to problems of development. However, it is obvious that metrology is a discipline by itself which should not be merged with other activities. In particular, experts working in the field of metrology should be good metrologists, and not general technical advisors. Concerning the experts in legal metrology, a list is maintained by the OIML.

Comment: It is pity that the participation in this seminar has been limited to legal metrology specialists, including manufacturers of measuring instruments subject to legal metrology controls. It would have been appropriate to have a broader participation, e.g. the World Bank, which could not attend. However, a current theme of work for the World Bank is ‘building institutions for market’ which is closely connected with trade metrology. However, there is no mention of legal metrology and even of measurements in the two hundred page development report.

Mr. Magaña agreed with the concerns expressed. He also said that it would perhaps be interesting to ask sociologists or journalists to attend this seminar and give their 'external' views concerning metrology.

Comment: Contributions from African metrologists were excellent and showed that lot still had to be done by the OIML in its program aimed at improving legal metrology resources in developing countries.

Comment: It was suggested to extend the analysis made during this seminar by considerations and discussions on costs-benefits of legal metrology and the introduction of the concept of risk analysis in determining the requirements on the instruments and the surveillance of the instruments.

Comment: It would be appropriate to reflect about the role of the State in new conditions and the risk that the interconnection between legal metrology and the State might disappear.

Before closing the meeting, the Chairperson noted that the Seminar "*What will legal metrology be in the Year 2020*", held in Saint Jean de Luz, France, on 26-27 September 2002, was attended by nearly 150 participants coming from 45 countries. Practically all Regional Legal Metrology Organizations were represented as well a number of industrial associations.

A total of 22 lectures were given, dealing with a number of matters of interest for future developments of legal metrology at the national, regional and international levels. It was decided to make them available by appropriate means including the OIML web site and Bulletin (on a selective basis) and through complete proceedings to be sent to all participants and to OIML Members and Liaison Organizations.

The CIML President and the BIML Director were requested to inform the International Committee of Legal Metrology about the output of the Seminar so that the CIML may use the views expressed by lecturers and participants in the definition of the long-term policy and strategy of the OIML.

The floor was then given over to Mr. Gerard Faber, CIML President, for the closure of the meeting.

Mr. Faber expressed, on behalf of all participants, his satisfaction and thanks to the BIML for the way in which this Seminar had been organized, and to all the lecturers for their very interesting and fruitful contributions and for the many hours they had spent in preparing their presentations. He also noted the active participation of all those attending the meeting and their pertinent questions and comments. He also expressed the hope that the output of the Seminar would be largely disseminated through e.g. information to be published in national technical journals in addition to the information directly made available by the BIML through the OIML web site, Proceedings and Bulletin.

Mr. Faber said that when reporting back to the CIML, he would suggest that this Seminar should not be considered as an isolated event, but should constitute the first of

a series of meetings aimed at looking at the various trends and parameters which will contribute to a successful development of legal metrology activities and of the OIML.

To conclude, Mr. Faber affirmed that the complete proceedings of this Seminar, including the conclusions, will constitute the material he will use when working on new strategies.

ii) Report by the BIML, published in November 2002

Note from the BIML: ***This report contains certain proposals for action on the part of the OIML that are derived from the lectures delivered in Saint-Jean-de-Luz. These will be considered by the Presidential Council and by the International Committee of Legal Metrology.***

1 Background

The idea of organizing a Seminar on *Legal Metrology in 2020* was put forward in 2001 by Jean-François Magaña, BIML Director. The main objectives were:

- To consolidate and broaden views concerning the foreseeable developments in metrology and legal metrology and to analyze their social and economic role, as already evoked in particular during the International Symposium held in Braunschweig in 1998 *The Role of Metrology in Economic and Social Development* and in the Birkeland Report *Legal Metrology at the Dawn of the 21st Century*; and
- To open the floor to OIML Member States and Corresponding Members, to Regional Legal Metrology Organizations and to manufacturers and users of measuring instruments with a view to sharing experience about the most predictable developments in legal metrology during the next two decades.

The Seminar, held in Saint-Jean-de-Luz (France) on 26–27 September 2002, reviewed the evolutions that legal metrology is facing, and the long term perspectives in the context of which the goals of legal metrology will have to be attained.

The most clear-cut developments that can be observed relate to the fundamental economical, political and technical background of metrology and legal metrology.

2 Globalization of economies

The first point that appears clear to all observers is the tendency towards the globalization of economies. The shift from local to national economies started centuries ago, but the worldwide development of this trend has shown such an acceleration over the last twenty years that no activity in any country can be isolated from the influence and competition of the rest of the world.

The development of international trade has allowed commodities and industrial products to circulate throughout the world and although tariff and technical barriers to

trade still remain, worldwide competition has become a reality. No industry in any part of the world can ignore what competitors from other countries, even far away, are developing and providing. Barriers to trade are a false protection for industry, because they are a burden for clients who demand the best possible products and services.

The globalization of financial markets and their interconnection using new information technologies results in the development of multinational industrial groups that are able to better develop new products and new technologies, and hence allocate their production resources worldwide in the most strategic way. The trend is now that manufacturers of measuring instruments are merging (or have already merged) into large multinational companies. Small manufacturers may still exist when small segments of markets remain, but they mainly adapt components or modules developed and produced by these multinational manufacturers.

In the not too distant future, it is likely that all technical progress and all new technologies in measuring instruments will emanate from a limited number of multinational manufacturers and be used worldwide, and very often at a lower cost than traditional technologies. National manufacturers will probably limit their activity to adapting these international products to specific local needs.

3 International geopolitical background

It became increasingly apparent that individual countries could not handle the problems raised by this globalization on a stand-alone basis. International organizations were set up to consider issues that states could not manage independently and as a result economic and social issues have been addressed (UNDP, UNICEF, UNESCO, FAO, WHO, etc.). This is now being extended to environmental issues.

International trade has been facilitated, organized and developed by setting up the GATT then the WTO, and the OIML was formed in 1955 to facilitate international trade in measuring instruments and to help developing countries to set up national legal metrology systems.

In the second half of the twentieth century, two trends were observed:

- The founding of small independent states, brought about by people's increasing right to determine their own future; and
- The constitution of regional structures grouping countries together to better deal with globalization issues, aid development and form politically organized zones.

The international landscape is made up of a larger number of small countries and also of regional groups of countries which may have no formal political existence, but which do have a growing economical influence.

The gap between industrialized countries and developing countries still remains, although some former developing countries have significantly expanded their development. This question of development has increasingly been taken into consideration, and support offered to developing countries is now quite an important issue in each international summit and within all international organizations.

4 Political evolutions

Most developed countries have adopted a liberal economic approach whereby the state avoids any unnecessary constraints on the economy and withdraws as few resources as possible from it. The state is then limited to fundamental tasks.

This results in progressively reducing the resources allocated by the state to activities which are deemed to be transferable to the private sector or ones that could conceivably be financed by industry.

Metrology is often considered as a necessity for industry that should be financed by the private sector, and legal metrology is too often considered as an old fashioned regulatory task that could be replaced by standardization and the promotion of quality, both voluntary. In nearly all industrialized countries, the resources allocated by the state to metrology and to legal metrology are constantly diminishing. Most political decision-makers are primarily economists or lawyers and they have a relatively low level of metrological awareness.

The schemes generally recommended by international funding agencies are the following: develop education, facilitate private activity and free trade, limit the role of the public administration to fundamental tasks, and develop basic infrastructures.

Metrology has to date rarely been considered as a major issue for developing countries. However, some international organizations (essentially the WTO and UNIDO) have understood that an adequate metrological infrastructure is necessary for development. At the July 2001 G8 summit in Genoa, the development of metrological infrastructures was identified as a key issue for the development of African countries.

The situation in 2020 will doubtless be that efforts made by the state in the field of metrology in each industrialized country will be significantly less than today, while some potential in metrology will probably exist in what are today developing countries, so long as the development programs are efficient enough.

5 Technologies

New technologies have transformed all aspects of the economy and day-to-day life in a major way, and of course they have deeply affected measuring instruments and legal metrology. Industrial products are no longer limited to material artifacts but their value is now largely composed of “intelligence”, thus allowing them to analyze their environment and their interfaces, and to adapt their behavior to these interactions.

People’s consumption of information has considerably increased, and will continue to do so. We are entering a post-industrial civilization in which most human production and economic value will come from information management and delivery. Metrology is a fundamental tool for societies in this new context.

As far as legal metrology is concerned, the context in 2020 will be quite different from the context we have witnessed over recent years:

- “Stand-alone” instruments will give way to systems that are integrated in networks, perform complex functions, associate different kinds of measurements and manage numerous measurement results. The elements of these systems will

not be complete instruments but sensors, modules of instruments and data processing systems, all of which will interact with each other;

- Instruments and systems will be able to carry out tasks that are presently reserved only for metrology or other specialized bodies: self-verification, self-calibration, maintenance assistance and adaptation of their behavior to environmental conditions or to measuring conditions. Future instruments and systems may even be able to develop relatively intelligent fraudulent behavior and to prevent such behavior from being detected by legal metrology officials;
- The scope of these measuring systems will be considerably enlarged. They will cover a wide variety of measurements and quantities in nearly all fields of human activity. The integration of measuring devices in global networks, often using the internet, will require legal metrology to address the entirety of these networks.

6 Consequences for legal metrology

All these changes will have major consequences for legal metrology at both national and international levels.

At national level, legal metrology authorities will have to face up to the new, considerably higher stakes of metrology. They will have to carry out their tasks with limited or partial resources, and still address a wider scope of measurements and advanced technologies. They will need new skills to deal with these new fields and technologies, probably with fewer staff. They will have to demonstrate the utility of legal metrology to political decision makers whose awareness of technical issues will be very low.

Legal metrology authorities will have to develop new ways of ensuring confidence in measuring systems and in measurements, and to replace the traditional conformity assessment procedures by new ones. Type approval and initial verification will often be obsolete concepts. Confidence in measuring systems and in measurements will have to result from a global approach to the whole life cycle of instruments and measurements, from design to maintenance and use. Establishing this confidence will also need a global approach on the part of all the bodies and users involved.

The reduction in national public resources for legal metrology in industrialized countries and the limitation of public resources available in developing countries will require that some technical activities be delegated to private bodies. This approach has already been adopted by some countries. In others, this will result in a major transformation of the tasks and necessary skills of the public bodies in charge of legal metrology implementation.

Legal metrology authorities will not be able to fulfill their mission using only their own national resources: sharing facilities and resources with neighboring countries will be necessary. Cooperation and coordination at regional and international levels will be the only way for national legal metrology bodies to fulfill their mission. National legal metrology bodies will have to specialize in specific and complementary technical fields and rely on other countries' bodies for the other fields. Conformity of instruments to type, and more generally market surveillance, will have to be organized in cooperation with other countries.

International harmonization, mutual confidence and mutual recognition among legal metrology bodies and authorities are not only a necessity for trade facilitation, but also for fulfilling the missions of legal metrology at national level. Legal metrology work will have to be globalized, or it will be ineffective.

Sharing resources will be generalized in regional legal metrology organizations:

- This will be developed in industrialized regions in order to respond to the demand to decrease the cost of legal metrology infrastructures while addressing all the new fields of legal metrology. Regional networks will then constitute virtual legal metrology institutes;
- This will also be necessary in order to build a shared metrological infrastructure for developing countries, so as to set up a network that is able to answer the needs of these countries at a reasonable cost.

In regions in which such a network has not been developed, countries will not be able to answer the needs for legal metrology correctly and will face difficulties in their economic and social development.

These regional networks will have to base their activities on mutual international and inter-regional exchange of information, mutual confidence and international harmonization. The role of the OIML will be to provide harmonization of the technical and metrological requirements, but also to combine all these cooperations into a global legal metrology system and to move towards a global international conformity assessment scheme based on mutual confidence among its members.

The acceleration in the rate of technical progress will also have to be answered by a considerable acceleration of OIML technical work. This is a challenge for our Organization as it is an outstanding challenge for all standardization bodies. New information technologies will be widely used by the OIML and new working methods will have to be implemented.

7 Between now and 2020

The metrology community should study these trends and be prepared for these developments.

To face the questions raised by technological developments, the OIML must considerably accelerate its technical work, since the typical period required for the development of measuring instrument types is not longer than just a few years. The requirements laid down in OIML Recommendations must be as functional as possible so that they do not depend on changing technologies, and when necessary these requirements must be revised very quickly.

The OIML must also urgently begin to study the general structure of conformity assessment procedures in order to adapt them to new technologies, to the new structure of measuring systems and to that of production and maintenance. An OIML Document should be produced to give guidance on the new skills required by enforcement authorities and conformity assessment bodies. Such skills are required for legal metrology authorities, enforcement officers and conformity assessment officers, due to the evolution in technologies.

Member States must seriously consider the present redundancy of legal metrology institutes at international level and should engage in a thorough reflection on the need to reorganize and coordinate them so as to be more effective. Some redundancy is necessary for exchanging experience and information and to maintain mutual confidence. But too much redundancy is a waste of resources and does not allow all the necessary fields of concern for legal metrology to be covered. The current mentality is not yet ready to envisage such reorganizations at regional and international levels.

The OIML has not yet developed a guidance document concerning the fundamental tasks of governments and public administrations in legal metrology. This policy issue is close to being a political issue and is rather difficult to elaborate on. However the revision of OIML D 1 *Law on Metrology* should succeed in starting such a discussion.

Increasing the awareness of metrology and legal metrology is an urgent need, and the OIML must work actively on this issue. It is necessary to raise the awareness of political decision makers in all countries, as well as the awareness of development agencies so that they seriously take metrology into account in their programs. It is also necessary to raise the awareness of the public as to the role of metrology and legal metrology.

Developing mutual confidence and mutual recognitions is also a priority for the OIML. The draft Mutual Acceptance Arrangement which is in progress is only a first step towards an international conformity assessment system. This step must be achieved urgently in order to proceed to the next steps. The final goal is that in 2020, Member States will be able to rely on and participate in an OIML conformity assessment program and take it into account in their legal metrology systems.

This will require that Member States strongly commit themselves to developing mutual confidence, not only offering elements to provide confidence to others, but also being willing to recognize other Members' certifications. Mutual confidence and recognition is necessary for all OIML Member States and requires effort, open-mindedness and a broad sense of common interest.

8 Conclusion

OIML Member States have the responsibility for legal metrology in their countries, but they also share the responsibility for the OIML's success or failure to meet these objectives. Failure in this respect would dramatically affect their national metrology systems.

All those who participate in OIML work must consider that the progress of our projects is of common interest. They do not have to put aside national interests, but they must be highly committed to building an international and global legal metrology system.

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