NMIJ STRATEGIES TO FACE THE INCREASING NEEDS IN METROLOGY

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Abstract: Japanese NMI is on the way to establish around 500 measurement standards by 2010 according to the national program for metrological standards, has already been successful in more than 450 items and expected to complete the target in advance to the schedule. However, the recently emerging regulatory needs for sustainable society requires far wider scope in the program as seen in chemical reference materials and forces the NMI practical measures. In order also to deliver the provision of measurement standards to its end user, the NMI is required to be still active in fostering accredited calibration laboratory, facilitation of new calibration service and development of technology expanding the scope of reliability in measurement according to cost and delivery time allowed to end users. Its new strategy aims these objectives done under close cooperation with National Accreditation Body and the government.

1. BACKGROUND

Competitiveness in industrial products and technologies and their cooperation are facilitated by the reliability of measurements. The needs for their improvements and maintenance of the reliability sometimes force renewal of measurement standards and their dissemination system in terms of legislation and global acceptance. In 90's, Japanese government implemented the establishment of the national measurement system guaranteeing the globally accepted result of measurement and its technical infrastructure. Implementation of the program, JCSS (Japan Calibration Service System) includes, renewal of metrology institutes, which had long been serving for the legal metrology, effective measurement law allowing the governmental accreditation on quality of calibration services in private laboratories, dissemination of national measurement standards conforming to international standards and the dissemination of the concept of traceability.

The metrology institutes were unified to NMIJ in 2001 and the national accreditation service started for the calibration laboratories. The national program listed 500 measurement standards to be developed and disseminated by 2010. Among many dissemination activities for the concept of traceability to potential metrological sector, the publication of the list with detailed schedule was appreciated to be most effective. The NMIJ, having the governmental supports, expanded its size, enhanced its activities and has successfully achieved its mission according to the program. Now, at the beginning of Fy 2006, it has successfully established more than 450 items in the lists. The achievement convinces the metrological sectors of benefit of broad utilization of the national measurement standards and facilitated their creative business in new technical services.

The contents of the national program was initially fixed according to the requests from the metrological sectors (such as semi-governmental authorities for testing services and leading measuring instrument manufacturers), the list of key comparisons and CMCs planned in CIPM-MRA and the calibration lists in other countries. After the initial phase of the program, the output of the dialogues with metrological sectors, intended to have the program responding correctly to the requests from end users in the industries, studied on evolution of measurement technologies in the industries and on progress of international societies for certification and standards have had to be continuously fed to the maintenance of the program. The Metrology Management Center (MMC) of NMIJ serves for the maintenance on the program and controls the progress in the laboratories of NMIJ engaged in the development by monthly interviews. Stimulated by the achievement of NMIJ, the quality assurance sections in the big manufacturers capable of high level calibration joined the JCSS and some of them began new calibration business for other industries. Other new calibration businesses for lower level calibration service or using higher level calibration service were created, too.

The measuring instrument manufacturers has 0.5% share in national GDP and 10% of their products are exported, while the same portion of measuring

instruments are imported. This industrial sector has the highest interest by nature to JCSS.
NMIJ is playing important technical roles in the mutual acceptance arrangement (MAA) for global legal metrology societies and the successful cooperation between NMIJ and weighing instrument manufacturers for the national traceability system achieves great contribution for the role.

2. INCREASING NEEDS AND HOW NMIJ PLANS TO RESPOND TOTHEM

250 out of 500 items for the program is reference materials for chemical analysis and the program had been aware from the beginning insufficient scope for the end user of chemical analysis over whole national needs. The scope of items were then subject to the affordable hum an resources of chemistry section of NMIJ and limited to basic chemical reference materials for general purpose, for leading edge industries and environmental regulations. Inorganic standard solutions, pH standards, gas analysis standards, environmental compounds, high polymer, nano-materials traceable to SI are all related to the manufacturing industries for their regulations and competitiveness. The items for regulations on other industries and society, such fields as water, air, soil and waste pollutions, product liability, food safety, medical diagnostics and biological safety, could not be counted.

The technical support for the metrological sectors contributing to the national metrology system is still important subjects addressed to NMIJ in order to facilitate the application of traceability. Development of calibration technology with automated system, training on calibration technique, on the uncertainty analysis and for quality control on the service and application of internet for the calibration are all direct contributions of NMIJ. Among them are special urgent request for new national measurement standard mostly from regulatory authorities. Calibration standards and technology of NMIJ for the ear radiation thermometers used for screening the patients of SARS timely helped the quarantine authorities in south and east Asian countries. Development of reference materials for the analytical testing in implementing RoHS directive, rf power measurement standards in a high frequency bands range necessary to quite urgent implementation of new legislation for telecommunication regulation, high capacity water meter national standards for cooling regulation in nuclear plants and various measurement standards for fuel cell evaluation are other example of urgent needs successfully responded by NMIJ. Systematic management on high potential researchers can allow such quick responses to order-made measurement standards from demanding request.

Although the implementation of CIPM-MRA started, the expansion of the scope and improvement in the environments for sound utilization of its benefit are still international problems. The certification on the quality of the products from domestic industries and the technology transfer over the border needs the close dialogues with the NMI on the other side in order to facilitate the practical application of the product of mutual recognition to quality assurance between end users over the border. For example, a new production line of automobile manufacturer transferred to foreign country has to establish their traceability path to NMI there and make parts industries there understand how to comply to the traceability requirements on their products under cooperation with other NMI.

2.1. FACILITATION IN APPLICATION OF TRACEABILITY AND STUDY ON NEEDS AND, IMPACTS

The increase in new items of measurement standards must be planned with prioritization based on the needs and impact study over the end users. So far, metrology management center of NMIJ circulated many questionnaires to metrological sectors (DI, Measuring instrument manufacturers, calibration laboratories and local metrological authorities) and fed the results of their analysis on the maintenance of the program. However, the technical fields investigated were limited to the manufacturing industries and the sectors were to the metrological sectors whose responses were quite reasonable because they were well aware what traceability does mean but could not foresee quite changeable and ambiguous needs of end users. Questionnaire study will not work in polling the needs of end users unless they are aware of traceability and the relationship of JCSS to the quality of their products. Detailed dialogues with end user only can predict the national needs for the measurement standards and consequently to global standards.

NMIJ has started metrology club system since last year for close dialogues in individual metrology field by encouraging the researchers to disseminate the concept of traceability in their own field, to transfer

the measurement technology, to investigate the needs at end user to measurement standards and technology and to estimate the impact of their measurement standards. After one year's operation, more than 30 clubs were established with total 1000 members from industries, regulatory sectors and consumers association as well as the metrological sectors. Each club corresponds to the consultative committee and its technical working group and the globally and regionally international activities for traceability are all reported to members and their needs are all fed to international and domestic policy of the government. This bottom up mechanism of the club works in various functions as had been successfully experienced in NPL and KRISS.

Domestic publicity activity is getting much more important especially for the measurement standards applied exclusively domestic end users or, sometimes, end users oriented to a specific technical field.

Counting the resources for establishing SI traceability for national measurement standard or establishing mutual recognition with foreign NMI, these local or bottom up measurement standards cost less resources and spend practically short time while the users must be well informed of the direction of use and scope of application. The club activity supports sound traceability to such bottom up measurement standards.

For example, a widely used and high-quality reagent with assigned calibration result can be national reference material as a source of traceability for comparability in a specific chemical field. It must be assumed that no other reference material authorized either as SI traceable or internationally recognized status is present in the countries, also that the process of calibration is reasonable, still also that the stability and uniformity are clear. The recognition in the specific field of users will facilitate quality assurance of end users in the field using common scale over the field. NMIJ has started new service to evaluate the quality of such bottom up measurement standards and notify it as domestically acceptable source of traceability, starting with the notification on the reference material for dioxin used for implementation of a Japanese Industrial Standards for regulation on the environmental fields.

The evaluation by NMIJ is based on the document submitted by the supplier of the reference material qualifying the level of quality control for safety, stability and uniformity and close study by NMIJ for the traceability of the calibrated results and sometimes with experimental comparison for equivalence with those from other suppliers.

This service is certainly intended to meet increasing national needs for chemical field to the recognized source of traceability and also to facilitate R&D in the future for leveling up the status to SI traceability or international recognition.

As the recent outcome of club activities, national promotion program for new order-made calibration and testing service supporting manufacturing in small and medium enterprises was discussed in each club for possible new business in calibration and testing and more than 12 new businesses succeeded this year in winning the governmental financial support.

2.2. TECHNICAL COOPERATIONS WITH OTHER BODIES

The limited resources of NMIJ cannot allow it to disseminate whole measurement standards of national needs and the cooperation with other organizations are inevitable. The option, DI(Designated Institute), of CIPM-MRA functions helps NMIJ in giving them the international status. Whenever coordinating the roles of DI and accredited calibration laboratories, the evaluation on their technologies for calibration, administrative responsibilities and feasibility of economical management is critical because the calibration capability of private laboratories in Japan are as high as DI and in this respect, NMIJ must keep high metrological potential not only to disseminate the national measurement standards but also evaluate their high calibration technology.

The activity, mentioned in the last section, to evaluate and notify the national reference materials requires the same potential to NMIJ. In some case, the national research institutes engaged in other regulation sectors of other ministries with high potential in related scientific field, like food for example, collaborate with NMIJ to back up the evaluation of NMIJ. The disseminations also by such national institutes with DI status are envisaged. Most of notified reference materials for increasing needs are to be disseminated by private industries, as seen in the case of dioxin, and several other candidates from two pharmaceutical industries are currently applying.

Being one of the research units in the larger organization, AIST (National Institute for Advanced Industrial Science and Technology), NMIJ has a lot of daily chances to cooperate with other research fields, such as environmental, energy-related, information, device and bio- technologies. It participates in the wider project of AIST to establish technical base for evaluation and regulation on the influence of nano-technology to human and other living bodies by developing physical property reference materials of nano-particles and carbon nano-tube, and also, by supplying them to other cooperated research units. The cooperation with information technology units allows NMIJ to develop the technology for verification and authentication on the software in measuring instruments and calibration technology. Those with device units provides NMIJ with Josephson Array for voltage standards and silica layer reference materials with highly controlled interface with silicon substrate and, with biological units, gives, analytical technology necessary for DNA quantification and cooperation for metrology in bio-luminescence.

2.3. INTERNATIONAL COOPERATION

Cooperation with other NMIs is one of important responsibility of NMIJ for international activities of domestic industries and society of Japan, such as trading and technology transfer. Especially, experience of active participation to global and regional metrology society since conclusion of CIPM-MRA contributed greatly to implant international view points to all researchers in NMIJ. The requirements for participation to key comparison and for transparent evaluation on the quality system have been advocated by NMIJ, and will be so in the future, to international society and to NMIJ itself to be met for CMC registration.

In order also to support the quality assurance of manufacturing industries in the factory transferred to foreign countries, NMIJ must cooperate with NMIs there not only in mutual recognition on national measurement standards but also in facilitating the training on quality evaluation for the parts industries supplying to the factory and sometimes the communication of the industries with the metrological society there. Such cooperation with NMIs in ASEAN countries for supporting international industries and with NIM of China especially for Shang-hai area has been quite productive for the last 5 years. In order to study general needs and impacts of international industries, a new club activity of NMIJ is planned.

As for the technical contribution to the improvement of global measurement standards, NMIJ conducts several projects with around 5 years term. Spectroscopy for atoms on the optical lattice for optical frequency standards, calibration technology by optical comb for wider range in optical frequency, programmable Josephson voltage standards using Josephson array, ultra-high temperature fixed points using eutectic alloy melts, determination of Avogadro constant for new definition of the kilogram and determination of viscosity of water are going on in NMIJ.

Recently NMIJ finished the first phase of the project “E-trace” intended to provide fast and cheap calibration tool using remote IT technology and together with the second phase for finalization, it proposes the mutual recognition by international metrology society to the application of the technology. The main concept is to enable the remote calibration, remote evaluation on the transfer standard and remote-operated support for reviewing in accreditation, by direct transfer of calibrated measurand converted to frequency or phase of cw signal, by transfer of digital information of the result of measurement and by transfer of the environmental and operation information for the calibration. The project was successful in developing and evaluation on calibration apparatus for remote site and on the stable and compact transfer standards for many measurement standards applications and practical application to frequency calibration in measuring instrument manufacturer in Shang-hai, optical interferometer in precision engineering manufacturer, calibration in AC/DC converter, calibration on 3DCMM, calibration on platinum thermometer and fixed point.

3.CONCLUTION

Many national measurement systems traceable to NMI and recognized by CIPM-MRA have been created and started their operation over the world but still needs facilitation for complete and effective implementation lead by NMIs. The geographic facilitation needs closer international cooperation between NMIs and the facilitation over whole range of industrial fields and social regulations needs the cooperation of NMI with other technological societies. Current major issues for all NMIs are a number of missing reference materials waiting for

this facilitation. We, NMIs, still have missions for never ending facilitation for application of traceability system by publicity, training and needs and impact study.

NMI society will cooperate in these facilitations and will be successful in providing wide range of choice to the end users according to cost, time of delivery and reliability of measurement results.

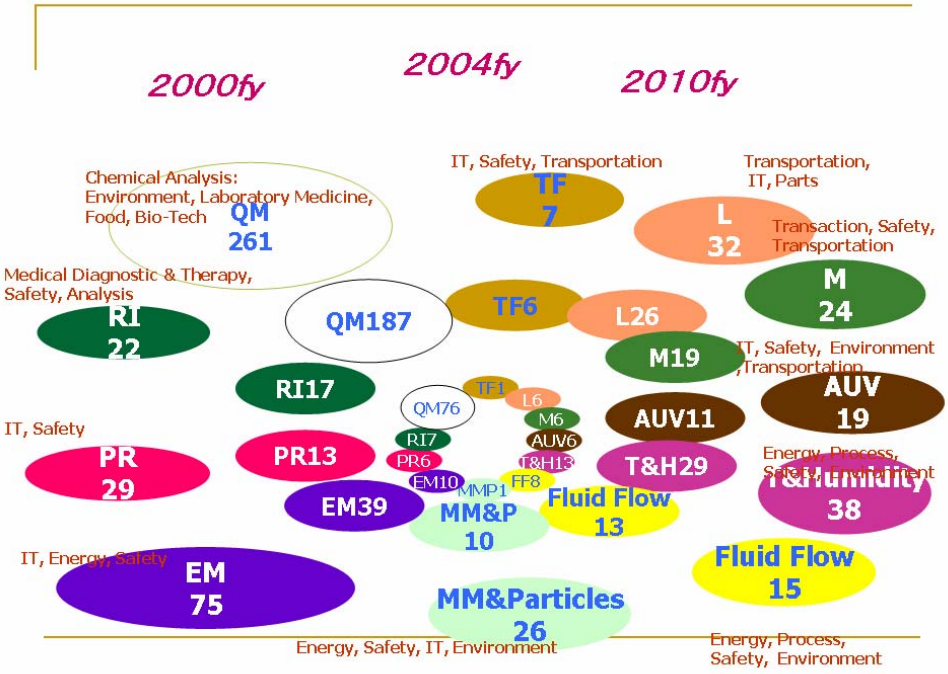

Fig.1. National Program for Establishing National Measurement Standards.

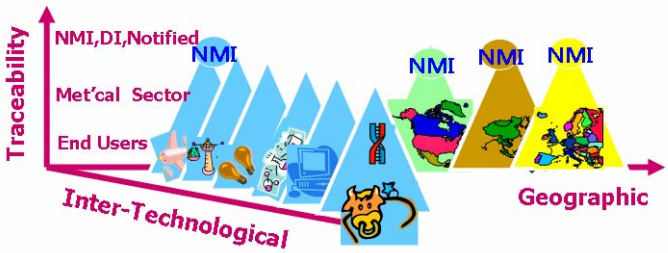

Fig.2. Facilitations for Increasing Needs