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

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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.