

# Current Conditions and Issues in International Strategy from the Perspective of the International Standardization of Materials

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## 1 Introduction

The development of a material with new characteristics and advanced performance can be a major scientific and technological breakthrough, however, no matter how good the new material may be, in itself it is merely a “substance.” Only substances that are widely used in the market deserve the name “material.” Design standards are a major factor in determining whether or not a material is used. In recent years, Europe has been attempting to set new design standards, and materials development and preservation technology development are proceeding in accordance with them. There is concern that in the future they may hold a dominant position. In relation to materials, a high quality is not sufficient in itself for market acceptance. It could be said, “Whoever controls international standards, controls the world.” In various foreign countries, “international standards” are recognized as an important trade strategy and are used as a means of protecting limited markets and of capturing new ones.

While Japan is a major economic power, it remains a minor power in terms of international standards. Awareness of international standards within Japan remains low. Although there are sectors, such as the development of fuel-cell batteries and advanced materials, in which Japan is engaged in intense competition with Europe and the USA, and is seeking to expand its market share and to develop standards, such areas are few in number. There is also concern that in the near future the number of sectors in which countries like South Korea and China take the

lead in Asian standardization will increase.

“Standards” are a structural element of an intellectual infrastructure. With respect to the intellectual infrastructure, decoded genomes have recently been recognized as a type of industrial intellectual property, the rights to which can be secured, and which are seen as important means of securing future profits. In the materials sector as well, promotion of database preparation and standardization are being asserted, and their issuing to global society is taking place. Possession of independent data is vital for these activities to receive international recognition.

In this article, we will examine how international standardization can be used as a tool that more effectively reflects Japanese science and technology in industrial and economic activities. We will review European and American standardization strategies relating to materials, summarize Japan’s activities, and propose concrete remedies for problems related to standardization.

## 2 Trends in international standards

### 2.1 *Types of international standards*

Broadly speaking, there are “de facto standards” (standards by common acceptance) and “de jure standards” (standards by law), as shown in Table 1. De facto standards are often based on the attainment of a dominant position by a corporation competing with others for a particular market. In contrast, de jure standards are set by national and international agreements. Because industry and consumers in a country that

does not respond fully can face disadvantages, countries respond to standards strategically. Although it can sometimes be difficult to distinguish between de facto standards and de jure standards, in the process of creating international standards, European countries and the USA-and their corporations-attempt to have their own technologies made into international standards in order to leave competitors behind and to place themselves in advantageous positions in markets. This article will primarily discuss the importance of “de jure standards” (or

“international standards”).

2.2 Recent trends in international standards

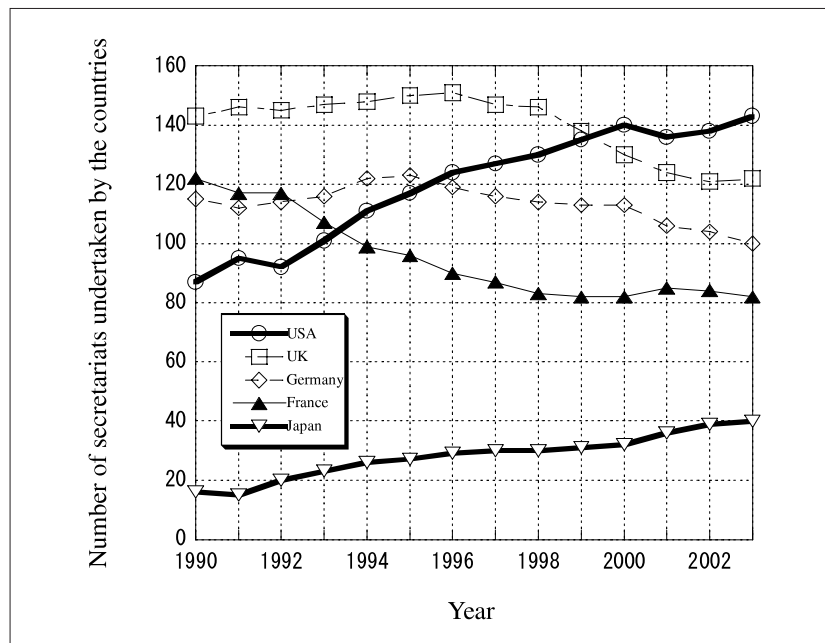
Overviews of trends relating to the international standards of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC), and the importance of the measures that Japan takes in relation to them have already been published<sup>[3-9]</sup>. In this article, we will emphasize an examination of measures that can improve the situation to obtain favorable results for Japan.

Table 1: Definition and characteristics of standards

Type	De jure standard	De facto standard
Definition	Set by a standardization institution, a de jure standard is based on a clearly designated process and is set through the wide participation of relevant members.	A standard that has come about as a result of a high market share captured through corporate competition.
Examples	JIS standards, ISO and IEC standards	Microsoft Corporation's Windows personal computer operating system
Characteristics	(1) The designation process is transparent, and the standards are clear and open. (2) In principle, a single standard is provided. (3) Membership is relatively open.	(1) The designation process is faster than with de jure standards. (2) Standards and products disseminate simultaneously. (3) Those whose standards are adopted can dominate the market.
Defects	(1) Decision making is by consensus, so time (up to 5 years) is required for standardization. (2) There is a time lag between dissemination of standards and products. (3) Technology is diverted.	(1) Information is not fully open. • There is no guarantee that all interfaces will be open. • The company that developed the standard may limit access. (2) Membership tends to be closed. (3) The revision process is not transparent.

Source: Authors' compilation from reference<sup>[3]</sup>.

Figure 1: Change in the number of secretariats (TC/SC) undertaken by the countries<sup>[10,11]</sup>



**(1) A period of upheaval for standards**

Since the World Trade Organization's Agreement on Technical Barriers to Trade came into force in 1995, member countries have agreed in principle to bring their national standards [for example, Japanese Industrial Standards (JIS) in Japan] into accord with international standards, such as those of the ISO and the IEC. The intent is to improve the freedom of the flow of goods across national borders by making standards identical in each country. International standards have been acknowledged by international treaty as a means of eliminating trade barriers, so international trends related to standardization activities have entered a period of upheaval.

**(2) Trends in Europe**

Through its support for the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC), the European Union (EU) has made clear its policy of presenting a unified European view to organizations such as the ISO and the IEC. The EU has signed agreements with the ISO and the IEC, and has built an aggressive policy that aims to spread European technology around the world through enactment of international standards based on European standards (EN Standards).

**(3) Trends in the USA**

The USA had given preference to the American Society for Testing and Materials (ASTM) and MIL Standards (US military standards), but it sensed danger from the European standardization strategy and started to take de jure international standardization more seriously. In September 2000, the American National Standards Institute (ANSI) released the National Standards Strategy for the United States, which called for aggressive action to ensure that the ISO, the IEC, and other international standardization organizations enact standards in which US technology is reflected. This trend can be seen in the increased amount of technical work undertaken by the USA as the technical committee secretariat country. The number of technical committees in which the USA participates as the secretariat country has increased sharply since 1992, and it has been the

leader in this respect since 2000.

**(4) Trends in Japan**

The need for unified implementation of standardization activities and research and development is pointed out in documents such as the November 1997 report of the International Subcommittee of the Japan Industrial Standards Committee to the then Minister of International Trade and Industry, Optimal Future of Japan's International Standardization Policy, the National Industrial Technology Strategy announced in April 2000, and the Science and Technology Basic Plan decided by the Cabinet in March 2001. There is an annual budget of ¥1 billion for international standardization, including grants from the New Energy and Industrial Technology Development Organization for the international standard-creation sector, and the assignment of international standards development in the form of support for new industry. Moreover, as part of the 1998 emergency economic countermeasures, the then Ministry of International Trade and Industry's technology-related budget allocated ¥16.1 billion for the improvement of the intellectual infrastructure and the accelerated promotion of international standardization: however, although the number of times Japan undertakes secretariat country work at the ISO has gradually been rising since 1992, this figure is still less than half that achieved by the United States and the leading countries of Europe. While this large gap remains, Japan cannot be considered highly active in international standardization. With standards being formed in 1,000 cases each year, policies to close the gap are needed.

**2.3 *The necessity of dealing with international standards***

If JIS are revised to match international standards, products manufactured in accordance with JIS will have to change. If standards such as those of the ISO and the IEC are adopted as national standards in many countries, export corporations in the particular country that originated the standards will have an advantage over those of other countries. In other words, trends in international standards influence market conditions and can deliver heavy blows

**Table 2:**Cases where Japan did not obtain international standards

Case	Summary
Watt-hour meters IEC 60521 IEC 61036	The electric meter technical committee was led by Europe, where indoor meters are the norm. Technical knowledge regarding the requirements of the outdoor meters widely used in Japan was lacking, and standards for weatherproofing were not considered.
Cash cards (bank ATM cards) ISO 7810 ID card physical features	Japan's banks and manufacturers had led the world in card development. In Japan, a magnetic stripe was placed on the front of cards, as was then the strongest proposal for an international standard. For design reasons, however, cards with magnetic stripes on the back became the international standard. Because cards with magnetic stripes on the front were already so widespread in Japan, it was not economically feasible to switch.
Washing machines (drying function) IEC 60335-2-4 Japan exported 17 million vertically separated washing machines annually.	Cases of Asian countries directly adopting IEC standards are increasing. From the perspective of strictly following the WTO/TBT Agreement, almost all countries prohibit the import of Japanese products for noncompliance with IEC standards. (This is different from a stoppage due to safety standards.) Japan's proposal to the IEC TC 61 of adding JIS standards was rejected. It has been resubmitted. The following are the two reasons Japan was not successful. <ul style="list-style-type: none"> <li>• JIS was widely accepted in Asia, and Japan mistakenly believed there was a market for products with superior technology that met the needs, even without following international standards.</li> <li>• Because they did not recognize the importance of international standards, Japanese corporations thought attendance at standard-setting conferences was burdensome and they did not have the personnel for such tasks.</li> </ul>

to the competitiveness of Japan's manufacturing industry. As can be seen in Table 2, there are many cases in which Japan did not obtain international standards, even though it was advanced in the development of the particular product and technological areas. Although Japanese standards were only slightly different from international standards for mobile telephones, these form another area in which Japan lost the competition over international standards, with the result that Japanese mobile telephones can only be used in Japan. In sectors like information technology-related industries, technical progress is remarkably swift and quick response to standardization is needed. Quality and environmental management standards such as ISO 9000 and ISO 14000, respectively, have become areas for business growth. Although the measures to be taken on international standards in other sectors will differ, it is vital that the lessons of the past be applied to future activities.

**(1) The case of materials**

In the past, the calculation of the standards for the strength of pressure-vessel materials was performed according to the American Society of Mechanical Engineers (ASME) code. Japanese materials were ignored, and Japan was unable to build its own nuclear reactors. Today, the quality of Japanese materials is recognized but competition to set international standards, such as ISO TC 11 (pressure vessels), and to capture international

markets is under way. The USA, Japan and Germany control the world market for pressure vessels, and which country will set the international standards has been a matter of international attention. The standard proposed by the USA and Japan was approved at a meeting attended by experts from various European countries; however, in an international vote, European nations collaborated to oppose it, so that it did not become the international standard.

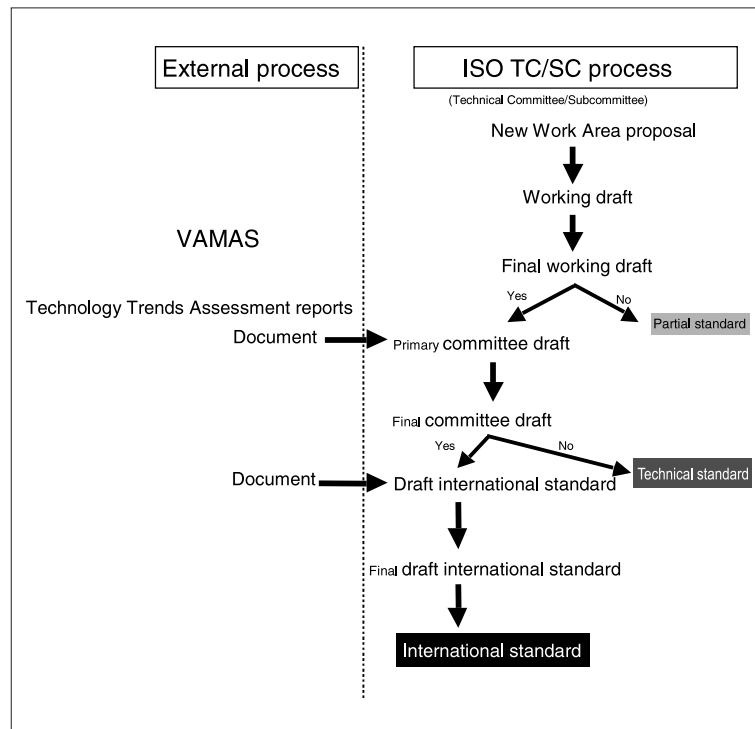
Japan has taken leadership in activities relating to the Versailles Project on Advanced Materials and Standards (VAMAS) in sectors related to advanced materials, such as ceramics, superconducting materials, and surface chemical analysis.

**(2) The right to speak**

To demonstrate its contribution to international standards and to ensure its right to speak, Japan in 1996 sought permanent membership on the Council Board of the IEC, but was initially turned down on the grounds that Japan was behind Italy and only in fifth place in undertaking work as a secretariat country. (Finally, the amounts of funds contributed were taken into consideration.)

When a standard is proposed, there must obviously be data to support it. There must also be a technical basis when opposing a proposal, and without such data opposition cannot be voiced.

To increase its ability to propose new standards and to enhance its right to speak out on standards

**Figure 2:**The ISO standard setting process and the VAMAS liaison

proposed by other countries, Japan needs to make steady efforts to accumulate research data, to undertake work as a secretariat country, and to make international contributions. It must build networks among Japanese data gatherers and people in foreign countries who are understanding and cooperative.

In ISO debates, Japan often has a different stance to Europe or the USA and, being midway between the two powers, it is often sounded out about taking on secretariat work. Because of language barriers and other issues that make the work tedious, Japan often declines such offers. Serving as the secretariat for, or chairing of, technical committees (TCs) or subcommittees (SCs), however, offers opportunities to take leadership by putting Japanese proposals on the agenda, or by deciding on the location of meetings.

### (3) Differences in awareness in Japan and other advanced countries

Even when the necessity for activity relating to international standards is pointed out, as we have above, Japanese industry has long and strongly held the views that industrial technology is something that comes from overseas, that exports should be adjusted to the standards of the importing country,

and that standards do not earn money. By simply using the standards given, Japan puts itself on the same level as developing countries; it is controlled by standards.

In contrast, European countries and the United States view standards as a type of trade weapon. They try to use the international standards that they set to eliminate the trade barriers posed by the standards of other countries. They also give priority to making “standards that sell” (those that will be used by many companies). Furthermore, industry leaders from Europe and the USA consistently attend international standardization meetings, demonstrating the effort that European and USA corporations put into international standardization. They regard standardization as more important to the future development of their companies than short-term profits, and consider it to be an investment that gives full returns.

### 2.4 The process of international standardization

International standards are like international treaties in that they have great efficacy and pass through a process of debate and consensus on their way from proposal to establishment. The process by which a proposed new ISO standard is enacted is shown in Figure 2.

**(1) Proposals**

Because of the need to take responsibility for the costs of several years of discussion before a standard is established, a standards organization from an ISO member country must normally adopt a proposal.

**(2) Conditions required for a new proposal to be adopted**

A majority in the relevant technical committee must approve a new proposal, and at least five countries must be willing to put forward members and funds to deliberate on the proposal in a working group. (Responses in each country are determined in light of the need for the standards body to support the costs of meetings and personnel. In Germany, for example, whether the standard will “sell” is the criterion for judgment. If requested by the Central Secretariat to deliberate, Germany will decline unless at least five German corporations make clear their willingness to fund the deliberations.)

**(3) Creating drafts**

Draft standards are examined in the order of; working draft, committee draft, and final committee draft. To be accepted, they must be changed to comply with the comments of each country and, in principle, there must be no final opposition. Draft international standards (DIS) require the approval of two-thirds of active participants and three-quarters of all members. Each vote takes at least three months, and it ordinarily takes three to five years to turn a proposal into a finished standard.

**(4) Review**

Established standards are reviewed every five years, and unworkable ones are eliminated. The results of this system are that a standard will not be created without the agreement and understanding of experts and industry from several countries, and that transient data or passing fads will be weeded out during the course of the process.

3

**The meaning and current status of VAMAS in the international standardization of materials**

*3.1 Formation*

Science and technology were major subjects at the G7 summit held in June 1982 at Versailles, where it was agreed that they are keys to a vigorous world economy, and that they should be actively promoted through international cooperation. Representatives of the summit nations and the EC signed a memorandum of agreement on VAMAS activities, to be continued every five years by the signatures of the participating countries. In 1997, a nonexpiring agreement was signed. Japan’s representatives on the VAMAS Steering Committee are the director of the Office for Materials Research and Development of the Ministry of Education, Culture, Sports, Science and Technology, the chief of the Advisory Group for Materials Research Policy of the National Institute of Advanced Industrial Science and Technology, and the supervising researcher of the National Institute for Materials Science.

*3.2 Objectives*

VAMAS is positioned as an international collaboration project on standards for advanced materials. It promotes international standardization related to advanced materials, including technology and special testing methods, and supports trade in advanced technology products.

*3.3 Results*

The results that VAMAS has achieved include national standardization, through submissions to each nation’s standardization body, as well as international standardization, through submissions to bodies such as the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). Because the creation of international standards takes years, VAMAS is only now beginning to show results after ten years of activity. It has contributed to the formulation of about 60 ISO,

**Table 3:** Summary of standards initiated by VAMAS TWAs <sup>[14]</sup>

TWA	Standards
TWA 01 Wear Test Methods	CEN: 1
TWA 02 Surface Chemical Analysis	ISO: 11, ASTM: 2
TWA 03 Ceramics for Structural Applications	ISO: 5, CEN: 8, ASTM: 4, JIS: 2
TWA 05 Polymer Composites	ISO: 3
TWA 13 Low Cycle Fatigue	ISO: 4, BSI: 1, JIS: 1
TWA 14 Unified Classification System for Advanced Ceramics	ISO: 1, CEN: 1, ASTM: 1
TWA 16 Superconducting Materials	IEC: 8
TWA 17 Cryogenic Structural Materials	ISO: 1
TWA 21 Mechanical Measurements for Hardmetals	ISO: 1
TWA 22 Mechanical Property Measurements of Thin Films and Coatings	ISO: 3, CEN: 1
TWA 25 Creep/Fatigue Crack Growth in Components	BSI: 2, ASTM: 2

BSI: British Standards Institution

ASTM, and other standards. (See Table 3.)

As VAMAS's international reputation has grown in recent years, cooperation with the ISO has strengthened, and VAMAS and ISO have formed a relationship in which each respects the other's results, so that the results of VAMAS, which comprises the G7 nations, are being promoted in ISO standardization. As shown in Figure 2, Technology Trends Assessment (TTA) reports based on VAMAS's international round-robin tests can shorten deliberation times. In these tests, identical test materials are distributed to each country's participating body for tests and the results are then compared.

### 3.4 Characteristics

VAMAS tests and evaluates a wide variety of materials, including metals, inorganics, macromolecules, and biomaterials. As shown in Table 4, there are currently 18 technical working areas (TWAs). Japan serves as international chair for four of these. Collaboration with VAMAS, and aggressive action related to international standardization of advanced materials and their testing methods, contributes to a stronger Japanese voice in the ISO. This makes it easier to propose standards led by Japan. (Japan's voice or vote counts as one of more than twenty on ISO technical committees; in VAMAS, it is one of seven.)

### 3.5 Recent trends in VAMAS

The VAMAS Steering Committee meets once

a year to discuss overall policy, the progress of each TWA, the creation of new TWAs, and the dissolution of existing ones. The 2002 meeting was held in Japan and hosted by the National Institute for Materials Science. The 2003 Steering Committee was held on May 12-14, and was hosted by the EU at the European Joint Research Center in Petten, the Netherlands. As described below, each country presented reports on aspects of materials research to which it is paying particular attention. Development and assessment of nanomaterials and biomaterials were given research priority by all the countries, and proposals for their international standardization were made.

- Canada: Major trends in materials research are eco-materials, biomaterials, nanomaterials, virtual materials, fuel-cell batteries, and titanium foam for medical applications.

- Germany: The proportion of ferrous materials in automobiles is decreasing, while those of aluminum and polymers are increasing. Like lead and mercury, the use of cadmium and chromium (VI) is prohibited. Testing the service life of over 3,000 parts is also an issue, so Germany proposed the testing of the short-term decay of automobile materials as a new area.

- Italy: Interests include materials database languages, fuel-cell batteries (an EC priority), and nanomaterials.

- Japan: The four major categories of life sciences, nanotechnology, environmental science, and information technology, from the eight

**Table 4:** Active technical working areas in VAMAS (TWAs)

TWA 01	Wear Test Methods
TWA 02	Surface Chemical Analysis
TWA 03	Ceramics for Structural Applications
TWA 05	Polymer Composites
TWA 07	Biomaterials
TWA 10	Computerized Materials Data*
TWA 13	Low Cycle Fatigue
TWA 15	Metal Matrix Composites*
TWA 16	Superconducting Materials*
TWA 17	Cryogenic Structural Materials*
TWA 20	Measurement of Residual Stress
TWA 21	Mechanical Measurements for Hardmetals
TWA 22	Mechanical Property Measurement of Thin Films and Coatings
TWA 24	Performance Related Properties for Electro-Ceramics
TWA 25	Creep/Fatigue Crack Growth in Components
TWA 26	Full Field Optical Stress and Strain Measurement
TWA 27	Characterization Methods for Ceramic Powders and Green Bodies
TWA 28	Quantitative Mass Spectroscopy of Synthetic Polymers

\* Japan serves as chair.

science and technology categories decided by the Council for Science and Technology Policy, were presented. Japan's system for domestic response to VAMAS through NIMS was also presented, and titanium dioxide photocatalysts were introduced as a topic.

- United Kingdom: Nanomaterials, biomaterials, functional materials, software, modeling, quantum physics, light metal alloys, foam materials, single crystals, polymers, powders, and liquid metals were presented.

- United States: Nanomaterials classification and target materials, nanotubes, titanium dioxide films for photocatalysts and windows, biomaterials, modeling verification, micromagnetism, photoelectron semiconductors, thermoelectrons, thermal shock, magnetic measurement, and fuel-cell batteries were presented.

- EC: Biohealth, information technology, food safety, nanomaterial/nanotechnology, multifunctional materials, aerospace safety and reliability, and fuel-cell batteries were among the subjects presented.

### 3.6 VAMAS international

It has been proposed that to transform VAMAS from an activity associated mainly with the

summit nations to one that is responsive to global standards in every part of the world, it should deepen participation of, and collaboration with, countries that are not part of the G7 summit meetings. A response from each country is being sought. In practice, this will allow South Korea, which has been participating as an observer and has been actively working with VAMAS, to join it as a full member.

### 3.7 Issues in VAMAS participation

VAMAS was agreed upon at a summit meeting as an international cooperation project relating to standards. It requires large amounts of funding for the procurement and evaluation of advanced materials and for international coordination. Japanese participation was funded as part of the science and technology promotion-coordinating fund of the former Science and Technology Agency. It involved up to 50 domestic institutions with 200 researchers, and received annual funding totaling ¥100-¥300 million. Each TWA received large amounts of international cooperation funds from Japan. Sustaining it through promotion-coordinating funds was judged difficult, however, and funding ended in fiscal year 2001. Replacement funding



has not been found, so the level of activity has fallen. It is difficult to find funds for the activities of Japanese contact persons, and the number of Japanese people serving as chairs or participating in TWAs has also fallen. For a time, Japan reluctantly considered withdrawing from G7-VAMAS. Because continued participation in VAMAS offers a favorable path to developing international standards, it is considered effective in promoting other international standardization activities. Participation in VAMAS is being treated as an international standardization enterprise of the National Institute for Materials Science, which responds piecemeal to TWAs, and the national VAMAS response committee is currently being restructured.

## 4 Issues in international standardization

### 4.1 *Developing personnel*

Ordinarily, it takes about five years from the proposal of an international standard to its adoption. To respond responsibly to this fact, researchers from corporations or national research institutes, who transfer less often and can join in technical discussions, are preferred as attendees for working groups and technical committees over bureaucrats from government ministries. However, corporate restructuring over the past few years has reduced and eliminated laboratories, which reduced the numbers of personnel along with the amount of data generated that could serve as a basis for discussion. The Agency of Industrial Science and Technology of the then Ministry of International Trade and Industry had industrial testing labs that provided a foundation for testing work, but most testing labs became research labs during restructuring about ten years ago and most test personnel became researchers. Furthermore, with the exceptions of the Agency of Industrial Science and Technology, institution working mainly on standards, and the National Institute for Materials Science (described below), most national laboratories have become independent administrative institutions, so the results that they value are the numbers of articles

published in important journals. Work related to standards is unlikely to be highly valued. Because operating budgets are nonexistent, institutions doing standardization-related work are disappearing. Many of them depend on the willingness of volunteers, who work without proper sleep because they believe themselves to be irreplaceable. Furthermore, even though they work on the frontline in international committees by presenting the opinions of Japanese industry, defending existing Japanese domestic standards, and holding their ground against the arguments of foreign countries, they receive no more than meager travel expenses. This makes it that much more difficult to find the next generation of able successors.

### 4.2 *Corporate responses*

Corporations in the manufacturing sector are spinning off subsidiaries in testing and measurement. For example, domestic steel manufacturers are creating subsidiaries to outsource mechanical testing. Separate companies are formed because of the demand for detailed cost rationalization. This results in a decrease in the resources that can be put into experimentation and investigation not directly related to income. For example, in the case of the coordination of Certified Reference Materials (CRM) being advanced by Eurolab, and experimentation on the influence of the speed of tension tests on such materials, it would seem necessary that Japan should also perform experiments in this area because of its exports of ferrous materials. However, there is neither a body to sponsor the work nor is there any budget to coordinate joint experiments on CRMs and Japan's matching ferrous materials.

### 4.3 *University responses*

VAMAS designates contact persons in each country, who are expected to gather relevant domestic researchers and arrange round-robin tests. In most cases, a university professor will represent a sector. Since they receive no payment for such activities, however, there are some sectors in which there is no Japanese contact person.

#### 4.4 *Government agency responses*

In the VAMAS Steering Committee, when a proposal for a new TWA, for example, is discussed on the basis of national science and technology policy or standardization policy, a statement is expected from the government officer representing Japan. Expounding Japan's position in such a situation is Japan's contribution, and it will have a major impact on subsequent technical proposals.

#### 4.5 *Research institute responses-the example of the National Institute for Materials Science*

An independent administrative institution, the National Institute for Materials Science (NIMS) maintains a materials basic information station with the following major functions:

- obtaining materials data and creating materials datasheets;
- pre-standardization research, international standardization research; and
- coordination and opening of materials databases.

For over 30 years, since its days as the National Research Institute for Metals, NIMS has created and published datasheets on creep and fatigue characteristics, and has distributed them to about 400 Japanese organizations and over 200 overseas organizations. These data are used in European and US standards databases, and are reflected in design standards. Beginning this year, datasheets on corrosion and space-related materials will be included, which will make important contributions to the compilation of data on corrosion resistance in structures older than ten years and to improving the reliability of Japanese rockets. The pre-standardization research and international standardization research, which are among NIMS's major functions, have been included in medium-range plans because of NIMS' success in materials research and its strong collaboration with VAMAS and the leadership there. Evaluation of NIMS personnel is based on the "3 P's," (papers, patents, and products), with datasheets and activities related to standardization considered as the products. However, because

there is no way of quantitatively measuring such steady, concrete activity, it is not highly regarded outside of the NIMS.

## 5 | Conclusion

We have examined the trends regarding international standards, which will greatly influence the Japanese economy's ability to secure markets, primarily in terms of the international standardization of advanced materials. Our findings can be summarized by the following three points.

- The relevant departments and bureaus of the ministries and agencies concerned need to recognize the importance and urgency of international standards. However, budget measures are individualized and short-term, and long-term measures, including personnel development, are inadequate.
- In principle, industry should lead the responses to international standardization, but the urgency and necessity of such response varies by sector. When industry cannot provide sufficient support, in many cases it is necessary, for the sake of future national interest, that the government provides heightened-active interministerial support as part of an intellectual infrastructure strategy. In other words, rather than viewing standardization as something that is imposed, the government should see it as an investment bringing valuable returns. Industry, academia, and government must join together to raise consciousness regarding standards and the scientific and technical contributions that they make. National research institutions must provide more research data that can be linked to new proposals, giving an increased ability to speak out on the frontlines of international standardization activities.
- To promote international standardization activities more aggressively in the future, expanding cooperative relationships with Asian countries, as well as with Europe and the United States, would be useful.

Among the possible policies for handling these issues, the following could be implemented using

the current systems.

(1) Inclusion in the medium-term plans

of independent administrative institutions

Include activities related to international standards within the medium-term plans of government research institutions relevant to international standardization. Recognize that obtaining data that can be the basis of proposals, debates, and committee activities is a part of their work. This could bolster activity in industry, academia and elsewhere, and foster the development of new personnel.

(2) Preparation of an infrastructure

for standardization activities

Policies on the evaluation of contributions to, or influence on, proposed or adopted international standards should be set, and work should be actively evaluated. We also recommend that the relevant institutions secure long-term operating funds related to domestic and overseas committee activities and the application of existing research to standards.

(3) Formation of a national response committee on international standards

Responding on and individualized, one-at-a-time basis to international standards cannot be expected to bring about effective results. Relevant government bodies, industry, and academia should cooperate to form a national response committee to deal with the situation regarding international standards.

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