

Metrology and Standardization to Assist Industrializing Economies

In 1971, representatives from 16 countries, from 16 international and national organizations, and from 5 industrial companies came to a conference center in Northern Virginia to meet with representatives from the Agency for International Development (AID) of the U.S. Department of State and the National Bureau of Standards. They came to discuss how NBS promotes productivity growth and innovation in the United States and how the economies of developing countries might benefit from collaboration with NBS [1]. As raw materials prices sagged worldwide, these countries looked to industrialization as a source of growth. But where would they turn for help in developing their basic infrastructure?

Such countries were generally well accustomed to international discussions such as are provided by the United Nations, and to government-to-government negotiations. They appreciated economic assistance from the U.S. AID. However, AID claimed no primary responsibility and only limited expertise in commercial technology. NBS, with its extensive links to private industry, was the agency best positioned to help these countries understand how the U.S. industrial development system works. To fulfill the dreams of industrializing economies (IEs), Glenn Schweitzer, head of AID's Office of Science and Technology, in cooperation with Edward L. Brady at NBS, developed the idea of co-sponsorship of this Seminar. The goal was to determine to what extent these IEs (this label became preferred over "Less Developed Country," or "LDC") could be given access to the knowledge and experience NBS had with measurement and documentary standards, as well as to constructive contacts with industry that were mutually beneficial. Industry is the primary source of expertise in technology in which IEs wanted to share and advance in a self-reliant way.

After experience in both research and diplomacy, Edward Brady had been brought to NBS in 1963 to establish the Standard Reference Data Program. Brady knew well that NBS had no clear Congressional mandate to assist IEs. Thus NBS, at this Seminar, wanted to listen to IEs needs and then to judge whether it was possible to devise projects that could tackle goals that were in the common interest of NBS and some IEs. The recommendations from the Seminar were strongly positive and very hopeful. The response by Lewis M. Branscomb, who had just been confirmed as NBS

Director, and two former NBS Directors, Allen V. Astin and Edward U. Condon (representing UNIDO the United Nations Industrial Development Organization), were realistically encouraging. To a few voices at NBS who doubted whether these activities related strongly to the NBS mission, Branscomb suggested that the NBS staff, by guiding IEs, could better understand its own relationships with industry, standards associations, and the public [1, p. 7].

The activities that were taken in response to the Seminar received a general evaluation after seven years [2]; it strongly favored continuation of the projects that had been started. During the remaining years of the 20th century, assistance to IEs grew rapidly and became a significant and flourishing operational feature of NBS and NIST, which now publishes biennially a volume summarizing the International Activities [3].

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Among the topics in which assistance was given, pride of place belongs to measurement standards and their use in measurement science (metrology). In the United States, NBS/NIST has a primary responsibility in this field, including ensuring international conformance under the Convention of the Meter, a treaty adopted by the United States and 42 other signatories. The International Bureau of Weights and Measures [4] operates under that Convention as the technical laboratory that enables national metrology laboratories to intercompare their national measurement standards. At the time of the Seminar [1], BIPM was engaged in the dynamic process of refining and introducing

the International System of Units (SI). NBS helped many IEs to follow and understand the mathematically beautiful, but really quite complex, recommendations of BIPM. NBS/NIST style calibrations link measurements in a chain of comparisons with BIPM standards. Through familiarity with the technical rigor of NBS metrology, the concept of self-evaluation with self-assurance of measurement quality spread to many IE laboratories.

However, the highest levels of metrological technology, required for international comparisons of measurement standards representing the base units, does little to ensure equity in the retail markets of IEs or to bring credibility to their international trade. Nevertheless, the possession of a platinum-iridium kilogram standard, or an interferometer that compares wavelengths of laser emissions directly with a national meter bar, received undue attention in many of the least developed countries. These problems were addressed during an NBS arranged seminar in Korea [5] with the title: "Metrology in Industry and Government: How to Find Out Who Needs What Services."

Another topic in which NBS/IE collaboration has been very strong is that of documentary standards for health, safety, the environment, products, buildings, etc. Most such standards are not published by NBS, but by the hundred or so important national and international standards-writing organizations. They often look to NBS to provide expertise, technical experimentation, and a reference collection. In the early 1970s, NBS technical staff members served as unbiased technical experts on some 1500 voluntary technical standards committees. A part of this work was devoted to dissemination of standards information, and a portion of that played in the international arena through many joint seminars such as those cosponsored with the International Organization for Standardization (ISO). The first of these had the title of "Technological Knowledge Base for Industrializing Countries" [6]. It had the dual purpose of helping to prepare the U.S. for the UN Conference on Science and Technology for Development (UNCSTD) in Vienna, with the benefit of constructive input from IE representatives who had experience of NBS assistance. Former NBS Director Lewis M. Branscomb was a member of the U.S. delegation to the UNDP conference in Vienna.

A special feature of the NBS/NIST influence, with which many IEs were initially uncomfortable, is the American preference, wherever possible, for voluntary instead of mandatory standards. Experience has shown that consensus is more easily achieved when voluntary standards are developed. Furthermore, they are then better understood and adhered to by industry and the

public. Tort law acts to compel compliance with well established voluntary, as well as mandatory, standards.

The Standard Reference Materials program has been another topic for strong collaboration [1, p. 95-105]. Standard Reference Materials (SRMs) bring great benefits to industries. Measurements on materials are needed for raw material selection, process control, and quality assurance. By virtue of SRMs, good measurements are no longer simply the prerogative of the highly industrialized nations with primary metrological laboratories. High-quality measurements can now be made locally in IEs just as they are made in manufacturing centers of highly industrialized countries. One or more of the material properties of SRMs are determined by NBS/NIST with high, generally certified, accuracy. SRMs can then be used for calibration of measuring equipment or direct comparison with closely similar local materials. NBS is the world leader in the supply of reference materials. The optimization of selected SRM candidates, their manufacture, and their introduction are demanding. Assistance from physicists and chemists from IEs who help to certify and use these materials continues to be significant.

Essential to industry is also the availability of evaluated data, especially on material properties. Through the National Standard Reference Data System, NSRDS, Congress gave NBS a leadership role. To evaluate such data from the primary literature and make them available in a user friendly mode is a task for which NBS has received help not only from scientists throughout the United States and other industrialized countries, but from IE specialists as well. China, for instance, has taken a significant part, first on a bilateral basis with NIST and, more recently, through membership in CODATA, under the International Council of Scientific Unions, in which Lewis Branscomb, David Lide, and John Rumble of NBS/NIST have successively taken leadership positions.

To understand how yet another aspect of IEs' collaboration has benefited both NBS and the IEs, we should turn back in the history to former NBS Director G. K. Burgess [7], who instituted the innovative Guest Worker Program almost 75 years ago. After the Seminar [1], L. M. Branscomb permitted the Guest Worker Program to be extended to include staff members of counterpart IE institutions, provided their stay at NBS/NIST was at least six months and provided they worked on NBS' own projects and, initially, provided the cost was not borne by NBS. After their return home, these visitors often introduced projects in their own institutions that were similar to their assigned NBS studies. Both NBS and the IE institutions benefited from this more efficient

use of scarce scientific talent. In the ten years following the Seminar, guest scientists came to NBS from 43 countries. Since then that program has expanded. Today, about one fifth of the NIST technical staff are guest workers, many of them from IE countries, sharing the commitment to accuracy, reliability, and quiet confidence in service to the United States and to their home institutions.

Even before the Seminar [1], in 1967, President Lyndon Johnson, on a visit to Korea and Taiwan, called for NBS to send an advisory team on measurement and standardization. A small team under Forest K. Harris responded by brief visits to both countries. On consideration of the reports by the team, AID wondered whether similar studies, that is surveys of standardization and measurement services, were potentially helpful to a wide range of IEs, while also in the interests of NBS and the United States. That possibility came up again during the Seminar [1] and found a strong affirmative response. Eventually, 10 countries were so “surveyed” (one per year until 1980) with respect to their individual standardization and measurement service needs. In sequential order, these countries were: Korea, Ecuador, Turkey, Bolivia, The Philippines, Thailand, Guyana, Indonesia, Pakistan, and The Sudan. The survey events followed a general pattern set at NBS’ request: The government of the target country requested the survey and committed itself to all in-country expenses for the NBS team and its own counterpart team. The target-country team leader also became committed to be available, on request by NBS, for one or more similar future surveys of other countries in a different part of the world. An NBS team member then visited the country to meet with the counterpart team leader. Jointly they identified the most important needs and outlined a team itinerary. The NBS team leader identified the most suitable team members from NBS or other agencies and representatives from other target countries. The entire multi-country team assembled at NBS for a week’s workshop to examine critically and debate NBS measurement and standardization services, with emphasis on voluntary standards, calibration programs, certified reference materials, standard reference data management, and NBS relations in support of industry. The team was then ready to spend two weeks in the country with a full program of visits and discussions. With target country approval, a detailed final report was issued on the results achieved. In subsequent years, evaluation and follow-up programs were commonly requested and executed. Literature references exist for the 10 survey reports, the respective preliminary workshops, and any follow-up seminars.

It was a special feature of the original Seminar [1] that, at the invitation of the Scientific Apparatus Makers Association, the delegates from abroad were given the opportunity to remain at NBS for an additional week when the IE visitors could observe NBS operations and visit a number of scientific instrument manufacturers. These workshops have been so well appreciated by AID and the IEs themselves that they have become with little change, but with suitably updated content, a regular, continuing feature at NIST.

Whereas most of the above projects are essentially bilateral, a significant portion of continuing AID/NBS assistance to IEs is aimed at multilateral collaboration. An early example is the Seminar in Bolivia on “A System of Standardization and Metrology for Latin America” with advisors from Turkey, Thailand, and Korea. [8]. From this modest beginning the Interamerican Metrology System (SIM) evolved with 34 member countries. It celebrated its 20th anniversary in 1999. A regional seminar that focused on a more specific problem was that in Singapore on “Testing and Certification for Export Products in Industrializing Countries” [9]. South-East Asia is another region which has since instituted strong contact with NIST. Being unable to maintain active bilateral relations with the many countries of Africa, NIST has started regional mechanisms in South Africa, Kenya, Ghana, and Egypt.

NBS collaboration in the Middle East has a long history that precedes the original Seminar [1] to the time when the Congressional PL 480 Program was established. It freed certain non-convertible local currency assets for use in science research of interest to U.S. federal agencies. During the 1970s, NBS received such funds in Israel, Yugoslavia, India, Pakistan, Egypt, and Tunisia [10]. This NBS program had 67 research projects and was particularly successful in Israel, where it led to a continuing binational agreement for industrial research cooperation. After about 1979, most of the remaining PL 480 projects naturally melted into the regional IE cooperations. With India, for example, projects are continued under the U.S.-India Forum in Science and Technology and received strong support from an initially independent effort by Peter Heydemann of NBS/NIST.

Heydemann had been a member of the NBS/AID team survey of Pakistan’s standardization and measurement services (see above). Subsequently he arranged seminars and training courses in Pakistan and India. His many contacts in India prompted the Department of State to appoint him as Science Counselor at the U.S. Embassy in India (1988-1993), resulting in expanded collaborations between U.S. and Indian

technical organizations. At the same time, Heydemann had the opportunity to collaborate with U.S. companies trading with India, with a focus on standards and measurement problems. After Heydemann's return to NIST as Director of Technology Services, he established a Standards in Trade Program to assist U.S. companies to overcome technical barriers in foreign countries. From this program's initial activities in Saudi Arabia, it expanded to countries in the Middle East, Europe, and Latin America. Five NIST standards experts placed in foreign markets, together with the staff of the Global Standards Program in the Office of Standards Services, have been credited with adding almost one billion dollars per year in U.S. exports. Very recently, the Secretary of Commerce confirmed the policy of NIST's support for international trade by making a special award to the NBS Director for International and Academic Affairs, B. Stephen Carpenter, "... an ambassador of goodwill for U.S. measurement capabilities all around the globe."

Among other projects that NBS carried out with AID support was a successful 3-year interlaboratory collaboration across national boundaries with Instituto de Pesquisas Tecnológicas of São Paulo, Brazil. Although relevant notes exist, this NBS/IPT program is not well documented, partly because Brady hoped after retirement to write a small book on that experience. The time was no longer given to him.

Generally, since 1971, NBS/NIST has been the only technical institution in the U.S. government that IEs could look to for guidance on technology-based development strategies. Not only the directors, but virtually all senior staff members of NBS/NIST have actively participated in these IE projects. It is an unheralded but highly significant role with the result that NBS/NIST is much better known in foreign capitals than in our own.

Edward L. Brady (1919-1987) received a BA and an MA from the University of California at Los Angeles and a Ph.D. at the Massachusetts Institute of Technology, under the guidance of Martin Deutsch. His thesis on angular correlations between successive nuclear gamma rays is still regarded as an important contribution. In 1942 he joined the Manhattan Project at the University of Chicago. Later he was assigned to the Clinton Laboratories in Oak Ridge and the GE Knolls Atomic Power Laboratory in Schenectady. Brady enjoyed work in international relations, where, in addition to his scientific knowledge and experience, his human qualities and tact made him outstanding. He

served as U.S. Atomic Energy Commission Representative to the United Kingdom and as Advisor to the U.S. Mission to the International Atomic Energy Agency in Vienna. He came to NBS in 1963 as the first Director of the Standard Reference Data program and later became NBS Associate Director for Information Programs. Brady was a man of compassion, dignity, culture, and grace. His life's early end occurred after a struggle with cancer which his wife, Evelyn, associated with exposures to radiation during his work on atomic-energy projects.

Prepared by Lewis M. Branscomb.

References

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