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## FEATURE ARTICLE:

### Expanding the Role of NIST: Reconnecting Government to Standards Development

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**Abstract:** *Over the past 100 years, the United States has evolved a unique separation of responsibilities in the standards area: the private sector standards development process provides almost all of the standards needed by government as well as the marketplace, with the governmental agencies (since 1995) obliged to participate in that process, and to report annually to Congress on their compliance with this charge. In parallel, since 1901, the National Institute of Standards and Technology (NIST) has performed a multipurpose role supporting industry and science, including by defining and providing the means to test for weights and measures. However, the advent of the Internet and other recent technological advances presents complex, cross-sectoral, standards-reliant opportunities, as well as challenges to the national interest at home and national competitiveness abroad that this existing system is ill-equipped to address. A new bill in the House of Representatives would provide an important first step towards creating the type of public-private collaboration needed to address such challenges.*

If the governments of the major industrialized nations of the world were to be tested for sophistication in matters involving standards, the United States would score poorly in comparison with many of its peers.

Strange to say, such a sorry showing would not trouble much of the private sector, because over much of the last century private industry has made the most of its opportunities to develop the standards it needs, largely unhindered (except in the case of standards involving health and safety) by federal intervention. Over the past thirty years, American national, and especially multinational, companies have shown increased innovation by launching most of the hundreds of global standards consortia that now supply the great majority of the myriad information and communications technology (ICT) standards that have enabled the transformation of the American economy from one based on traditional manufacturing to one relying on modern technology and the remote provision of services.

Such a system of identifying, developing and adopting standards within the private sector as the need arises is usually referred to as a “bottom up” system, and

contrasts with systems that operate in the opposite direction, with the same functions being assumed by the government. Such a system, inevitably, is referred to as a "top down" system. Most countries operate somewhere between these goal posts, with some (such as China) being very government oriented, and others (most notably the United States) being almost entirely industry-driven.

Historically, the bottom up approach has served U.S. interests very well. But the same motivations that led industry to assume the burden of developing its own standards also resulted in the creation of standard setting organizations (SSOs) that are very sector-specific, and often turf conscious as well. And in fact, until now, the national interest has not required a different system. To the extent that there has been a need for SSOs to collaborate, those needs have typically been limited to a desire to maintain communications to avoid redundancy, or to collaborate on the development of a single standard. These goals are usually met by the establishment of ad hoc networks among self-selecting SSOs using high-level, typically non-binding liaison agreements. Such systems are far too limited in sectoral breadth, commitment and resources to address challenges such as creating a SmartGrid, either within the ambitious time frames set by the current administration, or indeed at all.

In contrast, a "top down" approach should be capable of addressing such challenges, and in fact might be expected to have more (if not all) mechanisms needed to achieve such goals already in place.

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To an important extent, the American National Standards Institute (ANSI) has been able to ameliorate this lack of a formal, collaborative infrastructure by providing a venue within which the many traditional SSOs that it accredits can meet and address matters of common concern.<sup>1</sup> However, the global consortia that create the great majority of information technology standards, and to a lesser extent communications standards, have to date been hesitant to participate widely in activities sponsored by the representative of a single nation.

ANSI has been successful in bringing both consortia and traditional SSOs together with varying degrees of success in the several "standards panels" that it has launched in recent years, in some cases unilaterally, and in others in cooperation with government agencies. These useful exercises have focused on areas such as biofuels, homeland security and nanotechnology. In the case of the Health Information Standards Panel launched with public funding and defined goals in October of 2005, the initiative represents the type of formal, public-private partnership contemplated by this article. In others, the goals have been more general.<sup>2</sup>

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<sup>1</sup> It must be noted that while I am a member of the Board of Directors of ANSI, all characterizations of, and observations regarding, that organization are mine and mine alone.

<sup>2</sup> A list of [ANSI Standards Panels](http://www.ansi.org/standards_activities/standards_boards_panels/overview.aspx?menuid=3) can be accessed at [http://www.ansi.org/standards\\_activities/standards\\_boards\\_panels/overview.aspx?menuid=3](http://www.ansi.org/standards_activities/standards_boards_panels/overview.aspx?menuid=3) The

Despite the recent innovative examples of HITSP, the SmartGrid and EHRs, what remains lacking is an in-place mechanism that can not only identify and prioritize cross-sectoral standards-dependent issues before the need to resolve them becomes urgent, but also identify those existing SSOs competent to assume the duty of supplying specific categories of standards, recruit them to the task, resolve the inevitable differences that will arise between them, and then promote the results to industry and government for adoption – all within the space of a few years when the national interest depends on rapid action.

Although the lack of such an infrastructural mechanism has been exposed as a serious weakness in the process of launching the SmartGrid and EHRs, the significance of this weakness has not been widely appreciated, perhaps because few have realized that such efforts will need to be launched with increasing frequency in the future. What has become clear is that in order to reap the benefits of the complex, interactive, Internet-based systems that such initiatives seek to create, new ways are needed to integrate, control, secure and analyze their operations. In order to do so, an unprecedented number and variety of stakeholders, with more divergent needs and interests, must be brought into the pool within which consensus must be established before standards can be developed that must ultimately be voluntarily adopted or supported by all.

It is also clear that successfully accomplishing aggressive and complex standards-dependent initiatives will often require active government participation for additional reasons, since not only “top down” facilitation and coordination are crucial, but regulatory and financial support will be required needed to guarantee rapid, pervasive and effective adoption. The Obama administration has found it necessary to incentivize the private sector by providing huge subsidies to ensure that the resulting standards are actually implemented in order to achieve these ambitious goals within the aggressive schedules set out for them. The same will be likely to hold true to a greater or lesser extent in order to address other standards-dependent challenges already in view, such as tackling systemic cybersecurity vulnerabilities, enabling open government, and monitoring and addressing global warming.

In a definitively top down country like China, such challenges can be addressed within existing systems and utilizing traditional lines of authority. But when the Obama administration committed to its multi-billion dollar SmartGrid and EHR initiatives, it found that it had few tools at its disposal to generate the complex standards frameworks needed to make such systems viable. As a result, it found it necessary to jury-rig a process from whole cloth, convening ad hoc meetings of stakeholders (even at the White House) to gather input in an effort to achieve consensus, and then legislatively charge the National Institute of Standards and Technology (NIST) with selecting and overseeing private contractors hired to coordinate the creation of guidelines and frameworks that can be populated with standards already developed, and with others identified as needing to be developed, by existing SSOs.

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[HITSP Web site](http://www.hitsp.org/) can be found at <http://www.hitsp.org/> All on-line resources cited in this article were last accessed on May 21, 2010.

While recognizing and crediting the creativity, speed, and rapid progress of these ad hoc efforts, it must also be acknowledged that this is not the wisest and safest way to expend tens of billions of dollars of public funding. Given that the SmartGrid and EHRs are only the first challenges that will require public-private collaboration, it is important to face up to the fact that if such efforts will be required on a periodic basis, a methodology should be developed and institutionalized to ensure that they will be met efficiently and well. Ad hoc measures such as those being employed to launch the SmartGrid and EHRs can be excused once, and perhaps even twice. But to make a habit of the practice would be to betray the public trust.

***Top down, bottom up (or something else?)*** If it is accepted that a reliable way of addressing such challenges should be institutionalized, the next question is how? Should it automatically be assumed that the United States should convert to a top down system, or is a different solution possible? Similarly, would new bureaucracies be needed to fill the gap?

The experience to date with the SmartGrid and EHR initiatives suggests that the answer to each of these questions is “no.” In each case, it is instructive to note that Congress opted to create a new type of collaborative, incentive-based partnership between the public and private sectors rather than to invert the control pyramid. And in each case, it selected the same, existing federal agency to establish and administer that partnership – the National Institute of Standards and Technology.

In fact, Congress had almost nowhere else to turn. Despite the essential role that the approximately one million standards in use today play in making just about everything we use useful, or even possible, throughout our national existence the federal government has maintained a remarkably aloof attitude towards their creation, investing essentially nothing in their development while relying heavily on their availability. This has been especially so since the passage of the Technology Transfer and Advancement Act of 1995<sup>3</sup>, which directs the federal agencies to replace, wherever possible, “government unique” standards in their procurement activities with private sector standards, and to participate in their development. The result is that rather than having systemic knowledge across government regarding standards, there are only isolated pockets of competence within individual agencies.

***The historical role of NIST and standards:*** Despite the word “standards” in NIST’s name, the United States has tasked this single agency with an astonishingly diverse range of duties. Among the remits that have accumulated under NIST’s mission of promoting “U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life” are activities as varied as managing multiple scientific laboratories, operating over 400 local offices throughout the country to support small businesses, providing more than 1,300 reference materials from the mundane to the exotic<sup>4</sup> to industry, and administering the Malcolm Baldrige

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<sup>3</sup> 15 U.S.C. 3701. [The Act](http://ts.nist.gov/standards/information/113.cfm) may be accessed at <http://ts.nist.gov/standards/information/113.cfm>

<sup>4</sup> And sometimes even downright bizarre, as I explore I explored in a [Consider This](#) essay titled [For Your Reference](#) (June 22, 2005), at <http://www.consortiuminfo.org/blog/considerthis.php?ct=29>

National Quality Awards program. For all of these purposes, NIST has been given a budget of less than \$1 billion per year.<sup>5</sup>

Given this broad current offering of duties and services, it is easy to forget that NIST's role in the traditional world of standards harks back to Section 8 of the U.S. Constitution, which grants Congress the power to "fix the standards of weights and measures." Notwithstanding this charge from the founding fathers, it was not until 1830 that the first (unofficial) U.S. office of weights and measures was established. It took Congress another 70 years to take action to support the development of federally determined, national standards of weights and measures to replace the welter of local and regional standards that had emerged in the vacuum of the national marketplace. Such measurement against standards as was performed was via instruments that had to be sent abroad for calibration, because the domestic competence to perform that function did not exist.

The NIST of today therefore traces its direct descent only from the National Bureau of Standards that Congress created in 1901 under the Department of Labor and Commerce.<sup>6</sup> From the beginning, only some of its activities focused on standards. Indeed, as NIST explains its own origins in the "Welcome" paragraph of its Web site, it was not created as the nation's first bureau of standards, but as America's first "federal physical science research laboratory." The introduction goes on to note:

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Over the years, the scientists and technical staff at NIST have made solid contributions to image processing, DNA diagnostic "chips," smoke detectors, and automated error-correcting software for machine tools. Just a few of the other areas in which NIST has had major impact include atomic clocks, X-ray standards for mammography, scanning tunneling microscopy, pollution-control technology, and high-speed dental drills. We invite you to explore our web site to learn about our current projects, to find out how you can work with us, or to make use of our products and services.

When compared to the agencies that are charged with standards development in other nations, it may seem surprising that NIST's self description places so little emphasis on its standards capabilities. The reason harks back to its origins.

When NIST was created, the challenge in establishing standards for commerce was not so much in defining the standards themselves as in developing the capabilities of testing compliance with them, and to calibrate the equipment used to do so. The exact weight assigned to the word "pound," after all, is irrelevant. But it is

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<sup>5</sup> A very readable [history of the evolution of NIST's role during its first 100 years](http://www.100.nist.gov/cent_toc.htm) can be found at [http://www.100.nist.gov/cent\\_toc.htm](http://www.100.nist.gov/cent_toc.htm)

<sup>6</sup> When Commerce and Labor were later separated, NIST not surprisingly followed Commerce, where it remains today.

essential that when a vendor assigns a weight to a product in pounds, it does so accurately.

NIST's greatest challenge in its earliest days, then, was to not only define standards, but to perform the research and development necessary to provide the marketplace with the tools needed to reliably utilize these standards. That role has continued through to the present in such areas as the definition and calibration of time, and essential duty that NIST has addressed using technologies of increasing scientific sophistication, including (since 1949), atomic processes. Its current atomic clock is accurate to within one second every 20 million years. So precise is the measurement of time now required to be that the on-line Internet Time Service provided by NIST to scientists and commercial interests, such as commercial aviation, is updated 3,000 times *per second*.

The example of time determination illustrates the clearest historical demarcation between the roles assumed by the public and private sectors in this country. First, the development of means to test weights and measures is quite expensive. Second, ensuring that weights and measures are properly utilized in commerce is a traditional government regulatory function. Third, from its earliest days, NIST's mission has been to actively support commerce, and not simply engage in an isolated technical exercise. And lastly, the foundational responsibility established by the Constitution was limited to weights and measures.<sup>7</sup>

A final point bears mention in even so brief a review of the varied history of NIST, because it figures prominently in the context of the current discussion. Since its inception, NIST has played a remarkably agile role in supporting government and the public interest, taking on both new and transitory duties as the times have demanded. Those duties have changed and expanded as new industries have emerged that needed NIST's unique support (e.g., aerospace), when new issues have arisen that required intensive research and investment to address (e.g., in connection with automobile safety), when wars have placed sudden demands on the nation's industrial capabilities, and as more and more areas of scientific endeavor became essential drivers of national competitiveness.

In each of these cases, Congress has called upon NIST to step in to address new needs. Along the way, NIST therefore has been required to become not only a jack of many trades (and an expert in each of them), but to repeatedly step in as a pinch hitter when sudden needs have arisen.

At the same time that NIST was tackling the capital intensive and research-dependent standards-related tasks, industry was stepping in to create the types of standards (e.g., to enable interoperability) that can be created by private parties without great expense. The earliest private sector standards, such as those defining screw threads, did not require expensive testing at all. Other early standards, such as those regulating boiler construction and pressure, were

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<sup>7</sup> Of course, at the time the Constitution was written, weights and measures were the only empirical standards in existence. While the limitations on government powers in the standards arena that Congressional "strict constructionists" might nonetheless impose can be imagined, those limits will be left to the imagination of the reader.

developed by commercial firms in order to lower the frequency of well-publicized explosions, and therefore the insurance costs of their potential customers as well.

Industry came to appreciate the benefits of developing standards, and also the fact that the private sector could create them more quickly than government. Government, in turn, was happy to allow industry to assume the burden of this quasi-governmental function, while reserving to itself the right to set standards (via regulation) where it felt the need, as in areas of safety and public health. Even then, however, it was happy to incorporate private sector standards where they were appropriate and available.

Over time, private industry formed hundreds of dedicated standards bodies, trade associations, and more recently, industry consortia to create the thousands of standards that commerce required to permit healthy, successful, well-insured industries to develop and prosper. And NIST continued to do the basic research, laboratory development, and (when needed) actual testing of those standards that science, industry and government needed, but that required significant monetary and physical resources.

At the same time that private industry was developing broad competence in standards development, the federal agencies were developing their own unique standards for use in procurement. Often, these standards duplicated private sector standards in coverage, if not in detail. The result was that while competition drove the prices of private-sector standards compliant products down, the costs of government procurement continued to rise.

This bifurcation between public and private standards development was largely eradicated when Congress passed the Technology Transfer and Advancement Act in 1995, later augmented by the Office of Management and Budget's Circular A-119.<sup>8</sup> The thrust of these two enactments was that the federal agencies should use private sector standards wherever possible, and also participate in their development.<sup>9</sup> For most purposes, therefore, government had opted out of the standards development business, except to the extent that its employees took their place next to industry representatives in SSO technical working groups.

***Congressional authorization of NIST:*** NIST's specific areas of authority arise under the National Institute of Standards and Technology Act (15 U.S.C. Ch. 7), originally enacted on March 3, 1901 upon NIST's creation as an agency within the Department of the Treasury.<sup>10</sup> The Act, and NIST's authority and duties under it, have been often been amended since 1901, with the most extensive, recent revision of the Act occurring in 1988.<sup>11</sup>

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<sup>8</sup> [Office of Management and Budget Circular No. A-119](http://www.whitehouse.gov/omb/rewrite/circulars/a119/a119.html) (Revised February 10, 1998), Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities, may be accessed at <http://www.whitehouse.gov/omb/rewrite/circulars/a119/a119.html>

<sup>9</sup> The Act also requires NIST to report annually to Congress on the Agencies compliance with the Act.

<sup>10</sup> NIST was later moved to the Department of Commerce and Labor, and when that agency was divided, NIST remained with what is today the Department of Commerce.

<sup>11</sup> The [full text of the NIST Act](http://uscode.house.gov/download/pls/15C7.txt), with amendment history, may be accessed at <http://uscode.house.gov/download/pls/15C7.txt>

Section 271(a) of the NIST Act establishes NIST as “a science, engineering, technology, and measurement laboratory.” The Congressional findings supporting the adoption of the Act in the same Section read as follows (the most directly standards-related sections are highlighted):

(a) The Congress finds and declares the following:

(1) The future well-being of the United States economy depends on a strong manufacturing base and requires continual improvements in manufacturing technology, quality control, and techniques for ensuring product reliability and cost-effectiveness.

(2) Precise measurements, calibrations, and standards help United States industry and manufacturing concerns compete strongly in world markets.

(3) Improvements in manufacturing and product technology depend on fundamental scientific and engineering research to develop (A) the precise and accurate measurement methods and measurement standards needed to improve quality and reliability, and (B) new technological processes by which such improved methods may be used in practice to improve manufacturing and to assist industry to transfer important laboratory discoveries into commercial products.

(4) Scientific progress, public safety, and product compatibility and standardization also depend on the development of precise measurement methods, standards, and related basic technologies.

(5) The National Bureau of Standards since its establishment has served as the Federal focal point in developing basic measurement standards and related technologies, has taken a lead role in stimulating cooperative work among private industrial organizations in efforts to surmount technological hurdles, and otherwise has been responsible for assisting in the improvement of industrial technology.

(6) The Federal Government should maintain a national science, engineering, and technology laboratory which provides measurement methods, standards, and associated technologies and which aids United States companies in using new technologies to improve products and manufacturing processes.

The second section of the NIST Act that is worthy of note is Section 272(b), which provides a list of the 13 functions that NIST is currently authorized to fulfill (the list has grown over time). Those sections that relate most directly to standards are as follows:<sup>12</sup>

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<sup>12</sup> The purposes of the NIST Act also bear mention:

(b) It is the purpose of this chapter -

(1) to rename the National Bureau of Standards as the National Institute of Standards and Technology and to modernize and restructure that agency to augment its unique ability to enhance the competitiveness of American industry while maintaining its traditional function as lead national laboratory for providing the measurements, calibrations, and quality assurance techniques which underpin United States commerce, technological progress, improved product reliability and manufacturing processes, and public safety;

(2) to assist private sector initiatives to capitalize on advanced technology;



(b) Functions of Secretary and Institute

(2) to develop, maintain, and retain custody of the national standards of measurement, and provide the means and methods for making measurements consistent with those standards;

(3) to compare standards used in scientific investigations, engineering, manufacturing, commerce, industry, and educational institutions with the standards adopted or recognized by the Federal Government and to coordinate the use by Federal agencies of private sector standards, emphasizing where possible the use of standards developed by private, consensus organizations;...

(6) to assist industry in the development of measurements, measurement methods, and basic measurement technology;...

(9) to assure the compatibility of United States national measurement standards with those of other nations;

(10) to cooperate with other departments and agencies of Federal Government, with industry, with State and local governments, with the governments of other nations and international organizations, and with private organizations in establishing standard practices, codes, specifications, and voluntary consensus standards;...

(13) to coordinate Federal, State, and local technical standards activities and conformity assessment activities, with private sector technical standards activities and conformity assessment activities, with the goal of eliminating unnecessary duplication and complexity in the development and promulgation of conformity assessment requirements and measures....

Two aspects of the language above bear mention in the context of the current discussion. This first is the tight focus on certain limited areas of standardization. But the second is the assigning to NIST of the role of facilitator in standards matters among the federal agencies, between the federal agencies and the private sector, and between the federal agencies and domestic as well as foreign governments.

***Expanding the future standards role of NIST:*** Under a bill now in committee in the House of Representatives (H.R. 5116), two new functions would be assigned to NIST that are crucial to allowing it to become an ongoing public partner in the type of public-private partnership that will be needed to address future complex, cross sectoral standards challenges.

Under the current form of the draft bill, those functions would be as follows:

(14) to promote collaboration among Federal departments and agencies and private sector stakeholders in the development

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(3) to advance, through cooperative efforts among industries, universities, and government laboratories, promising research and development projects, which can be optimized by the private sector for commercial and industrial applications; and

(4) to promote shared risks, accelerated development, and pooling of skills which will be necessary to strengthen America's manufacturing industries.

and implementation of standards and conformity assessment frameworks to address specific Federal Government policy goals; and

(15) to convene Federal departments and agencies, as appropriate, to—

(A) coordinate and determine Federal Government positions on specific policy issues related to the development of international technical standards and conformity assessment-related activities; and

(B) coordinate Federal department and agency engagement in the development of international technical standards and conformity assessment-related activities.

The first of these two new functions accurately describes the role that NIST is currently playing under separate Congressional authority with respect to the SmartGrid. By institutionalizing this role within the NIST Act itself, Congress would not only permit the administration to call upon NIST more quickly as future needs arise, but would also encourage NIST to invest in the creation of the type of human and other resources, and accumulate the type of experience, needed to support those requests as they arise.

H.R. 5116 would also require NIST to compile and deliver a new annual report to Congress, identifying:

(1) current and anticipated international standards and conformity assessment-related issues that have the potential to impact the competitiveness and innovation capabilities of the United States;

(2) any action being taken by the Federal Government to address these issues and the Federal agency taking that action; and

(3) any action that the Director is taking or will take to ensure effective Federal Government engagement on technical standards and conformity assessment-related issues, as appropriate, where the Federal Government is not effectively engaged.

Of greatest interest for current purposes is subsection (1), which would allow NIST to not only coordinate activities as requested by the administration, but to independently bring issues to the attention of Congress that NIST believes may impact national competitiveness.

**Conclusions:** Two of the great strengths of the American economic system are the robust, bottom up standards infrastructure that has been developed within the private sector, and the highly skilled, capital intensive resources of NIST, which provide standards-related tools and services that the private sector is not likely to

develop on its own. Both of those resources should be preserved at all costs, but they should be supplemented by new, more direct public-private infrastructures that will allow American industry to meet policy needs at home while remaining competitive abroad.

Among all existing agencies, NIST is the most experienced and most obviously empowered public body to provide the public half of this equation. While H.R. 5116 is perhaps more modestly worded than might be hoped, it sets the tone, and would provide sufficient authority to take up that challenge. Hopefully, its passage by both houses of Congress, without diminishment, will be rapid.

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