The Strategic Value of Standards Education

A Global Survey conducted by

The Center for Global Standards Analysis

August 2008

Edited by

Donald E. Purcell, Chair

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Acknowledgement

In the spring of 2008, the Center for Global Standards Analysis ("Center") conducted a global survey concerning the question: *Do standards education programs have a strategic value?* Survey invitations were sent to corporations, standards development organizations, government departments, agencies, universities and firms worldwide.[1] The Center received 11 responses to the survey. Respondents included the following standards developing organizations, universities, government agencies and firms: American Society of Mechanical Engineers, ASTM International, BSI British Standards, China National Institute of Standardization, CSK Holdings Corporation, Hitotsubashi University, Institute of Electrical and Electronics Engineers, Japanese Standards Association, McDermott, Will & Emory, U.S. National Institute of Standards and Technology and the University of Colorado (Boulder). Note virtually all respondents indicated their comments expressed their personal views rather than the organization that employs them. The Center is very grateful to the individuals and organizations for the time and effort used to respond to the survey.

The Center for Global Standards Analysis

The Center is a nonprofit corporation located in Washington, D.C. The purposes of the Center are to conduct research, establish education programs in the field of global standardization, and make presentations on the strategic value of standards education programs around the world. Since 1999, the Center has supported the graduate course *Strategic Standardization* in the Catholic University School of Engineering program for Engineering Management. The course on *Strategic Standardization* is only one of four courses on standardization offered among the 2,500 universities and colleges in the United States. Other standardization courses are offered at the University of Colorado (Boulder) Center for Advanced Engineering and Technology Education, University of Pittsburgh School of Information Sciences and Telecommunications, and Yale University School of Law.

Members of the Center include: Jean-Paul Emard, Alliance for Telecommunications Industry Solutions; William Fox, Purcell & Fox, LLP; John Kenny, The Eluminate Group; Barbara Kotschwar, Peterson Institute for International Economics; Stephen Lowell, U.S. Department of Defense; Donald Purcell, Catholic University of America School of Law & School of Engineering; Ronald F. Silletti, IBM Corporation; James Walters, Air-Conditioning, Heating, and Refrigeration Institute; Mary Saunders, U.S. National Institute of Standards and Technology (Liaison).

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[1] *See* The Center's Invitation To Comment, Appendix A.

Introduction

Significance of Standards and Standardization

From the Center's perspective, significant global economic, political and social circumstances are being driven by technology, science and globalization. The Center anticipates a future which is more complex, competitively intense, and in which standards and standardization systems will play an increasingly important role.

For example, since 1999, it has been generally accepted that private sector standards and government technical regulations directly affect at least 80% of world trade.[2] In 2005, Congress estimated that private sector standards and government technical regulations directly affected at least $7 trillion (US) of world trade in 2003.[3] In a world dominated by rampant globalization that will remain so for the foreseeable future, technology standards play a critical role. (*The World is Flat*, Thomas Friedman (2005)).[4] Standards influence everything we do (UK National Standards Strategy (2003)).[5] Standards control markets (German National Standards Strategy (2005)).[6] Moreover, standardization is one of the most powerful sources of competitive economic intelligence available (French Standardization Strategy (2006); Canada National Standards Strategy (2005)).[7] Put simply, the evidence is overwhelming that standardization programs offer one of the best, most important means to evaluate current technology and provide a glimpse of where future technology innovations may occur.[8] Standardization programs are indispensable for the strategic evaluation of technology and the analysis of competitive issues. In strategic terms, "If you control an industry's standards, you control that industry lock, stock, and ledger" (Out of the Crisis, by W. Edwards Deming, Center for Advanced Engineering Study, published by MIT Press at 302 (1986)).

Purpose of Survey

For many decades, most nations and industries have employed on-the-job training ("OJT") programs to address and resolve standardization issues. This global management tradition raises several significant questions related to the survey. First, given the growing complexity and intensity of globalization, can nations continue to rely on OJT programs? Second, it is expected there will be a significant demographic shift among individuals with significant standardization skills and experience in the near future (3-5 years) because of retirement. Estimates are that for some nations at least 50% of experienced standardization practitioners will retire in the near future.[9] This transition poses these significant questions: (1) how will the next generation be educated and trained to replace the current generation of standardization practitioners? (2) How will critical standardization knowledge and experience be transferred to the next generation?

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[2] *See* Report on *Regulatory Reform and International Standardization* (OECD 1999).

[3] U.S. House of Representatives Congressional Hearing: China, Europe and the Use of Standards as Trade Barriers: How should the U.S. respond? (May 11, 2005)

[4] http://www.thomaslfriedman.com/worldisflat.htm

[5] http://www.nssf.info/resources/documents/Guide_to_NSSF.pdf

[6] http://www.din.de/sixcms_upload/media/2896/DNS_english%5B1%5D.pdf

[7] http://portailgroupe.afnor.fr/v3/pdf/strategystandardization_2010.pdf ; http://www.scc.ca/en/nss

[8] *See* IEC Case Study Analysis, "*What the world says about us*," http://www.iec.ch/benefits/worldsays

[9] For example, see *AT&L Human Capital Strategic Plan v3.0* (2008) published by the U.S. Department of Defense at 9-12, http://www.dau.mil/workforce/hcsp.pdf

From the Center's perspective, standardization will continue to play a significant role in future globalization. The Center does not believe, however, that it is possible to effectively address standardization needs of the global marketplace without affirmatively addressing the strategic value of standards education programs for international standardization issues. In addition, the Center does not believe that continued exclusive reliance on OJT programs will be successful, and that comprehensive standards education programs addressing the needs of the global marketplace are necessary. The Center recommends that all nations establish a combination of comprehensive standards education programs in their private, public and academic sectors.

The Center also believes that this survey and the recent International Standards Education Workshop held by NIST in February 2008, *Global Perspectives and Strategies for Education about Standardization Workshop* offer significant support for the proposition that a growing number of nations now recognize the need to develop comprehensive standards education programs to facilitate their national interests.[10] The scope, quality and range of perspectives presented in the NIST workshop from around the world make clear that important changes are going on in the field of standards education, and that all nations must reevaluate their current standards education programs to ensure they remain competitive in a world dominated by globalization, technology and science.

Invitation to comment

All interested parties are invited to review and comment on the enclosed survey responses. These survey responses are published and made available as part of the Center's mission to promote awareness of the value of standards education and to stimulate discussion and the exchange of ideas in this important area, however, survey responses do not necessarily reflect the views of the Center. The Center believes the survey responses represent a unanimous view that standards education programs have a strategic value. The Center considers responses to the survey to be a valuable asset and benchmark in understanding the strategic significance of standards education. Each survey response provides unique perspectives on the strategic value of standards education programs and their importance to globalization, technology and science.

About the Editor

Donald E. Purcell is Chair of the Center. He is a member of the adjunct faculty at the Catholic University of America School of Engineering where he teaches a graduate course, *Strategic Standardization*, and the School of Law where he teaches *Cyber Law*. In 2008, the Standards Engineering Society conferred the Fellow Award upon him in recognition of his dedication, leadership and valuable contributions to the principles and practices of standardization. Since 1999, he has been teaching, giving lectures and presentations on the strategic significance of education programs for global standards and standardization systems in North America, Europe and Asia. *See* www.strategicstandards.com to review the curriculum, course content and graduate student research papers for *Strategic Standardization*. Interested parties who have comments on the survey should submit their comments to: donpurcell@strategicstandards.com or purcelld@cua.edu.

[10] *See* http://ts.nist.gov/Standards/ICES-Workshop-Presentations.cfm for workshop presentations.

Highlights

American Society of Mechanical Engineers

- We believe that standards must be integrated into engineering and engineering technology courses, be a part of design and manufacturing-oriented competitions, and be embraced by faculty as important to preparing students as practitioners.

- Stand-alone courses in standards exist in a few universities, but the occurrence is rare.

- Because of the global nature of engineering, exposure must include both national and international standards such as those from ISO, IEC, and ASME.

- Protecting the safety, health and welfare of the public is part of the Code of Ethics for Engineers. The application of standards plays a major role in satisfying this.

- Little, if any, attention is paid to standards in graduate schools of engineering. It must be acknowledged that over 54% of the students pursuing doctoral degrees in engineering are not U.S. citizens and the great majority of those students received their undergraduate education outside the United States. Chances are greater that foreign national students, as opposed to U.S. engineering students were exposed to standards in their undergraduate studies. South Korea for instance begins exposing all students to standards in grade school, regardless of their interest in engineering. That exposure continues through high school. The graduate students of today are the engineering faculty of tomorrow. So it is especially crucial that these efforts be applied at the graduate level, as well as the undergraduate level.

ASTM International

- The United States Standards Strategy (USSS), published in August 2000, identified strategic and tactical initiatives to be used by diverse interests to meet their own national and individual organizational objectives. Point 10 of the USSS established standards education as a high priority within the United States' private, public, and academic sectors.[11] This goal signaled to leaders and top executives the strategic value of standards education.

- Globalization is pushing students to learn more about international business and how standards play a critical role in companies' being successful in the global economy. These days, students in international business are learning that the World Trade Organization (WTO) has established criteria for developing international standards in its Technical Barriers to Trade Agreement.[12] Students learn about standards that are sometimes used inappropriately as "non-tariff" barriers. In their study of imports and exports, they also learn the benefits of being active stakeholders in standards development and the costs when duplicative standards interrupt the flow of goods' crossing borders. International business students learn there is strategic value in being aware of an area that has traditionally been a part of the engineering and science disciplines.

[11] United States Standards Strategy, http://www.ansi.org/standards_activities/nss/usss.aspx?menuid=3
[12] http://www.wto.org/english/tratop_e/tbt_e/tbt_e.htm

- Not only can engineering and pre-engineering students benefit from the knowledge of standards, but students studying public policy can realize a strategic value as well.

BSI British Standards

- The significant growth of standards Education programmes is symptomatic of the increasing interest in international standardization. Worldwide, ISO standards on quality and environmental management (ISO 9001, 14001) have become commonplace terms in the business sector. The Education sector in the UK is keenly interested in this topic, typified by the high volume of enquiries BSI British Standards (BSI) receives from students and teachers.

- The benefits of education on standards and standardization in any country are reaped in many different ways. The ever-increasing need for skilled participants in the standards creation process itself is reliant on those people being knowledgeable and keen to engage with the National Standards Body (NSB).

- The continued success and development of the UK economy has a need for students to understand the significance of standards within it. Standards form a common language, a dialogue in which all can participate and from which all can benefit.

- The key benefits of developing a strategic education plan, nationally or internationally, are numerous: raising awareness from a young age of the benefits and uses of standards; influencing future participants in standards creation and future purchasers of standards; furthering the research base on the impact of standards.

China National Institute of Standardization

- According to our case study and field practice, the Standards Education Programs (SEPs) are of great significance for standardization academic institutions. For the progress of a developing country, the answer for this issue is essential. Making knowledge of standardization widely available provides the fundamental knowledge and the driving force for the rapid development of the economy and society in China.

- CNIS believes, as the most authoritative institution on research of standardization in China, it is not enough to open up the SEPs directly. To fully expand the strategic usage of standardization, CNIS needs to conduct and explore those questions: Do standards education programs have a strategic value? How do they work? How to propel the development of SEP and set up the discipline construction of the studies on standardization?

- As the most authoritative institution in China for over-all, strategic and comprehensive standardization issues of national economy and social development, CNIS would be willing to constantly pioneer adaptation of the SEP, to realize the overall stretch-out of standardization's value. And we are looking forward to show the power of standardization education program on the progress of the society, economic developments and the science innovation with anybody who is interested.

CSK Holdings Corporation

- We also note that the effect of the quality and quantity of the output of an education program is profound and wide, and its results may affect the society and its economy for many years.

- Let us accept that standards, especially global standards have strategic value in the sense that they affect not only the current marketplace or product/service production, but also the industry and government planning because they will promote the specific lines of products/services that conform to the standards. In other words, those products/services that fail to conform to the standards will have big handicaps in the global marketplace which may hit the bottom line of companies/industries/countries over the long duration.

- Standards education programs are handicapped. As of today, in most countries standards education programs do not have solid departments or institutes to provide educators a framework within the educational institutes.

- To overcome the continuation principle, we should adopt a different principle and focus on change, that is, the principle that everything will change, nothing will stay as it is. You must be different tomorrow from yourself of today, that is, the earth will continue to change and evolve.

Hitotsubashi University

- The strategic involvement of national governments in international standardization in high-technology areas from an industrial policy perspective is now critical for countries to succeed in a world dominated by technology and science.

- The globalization of the world economy and the establishment of the WTO have vastly increased the social influence of international standards in every field.

- The standards world has radically changed over the past two decades especially in international standardization, with an increased impact on business and society. Rapid globalization of markets and accelerating technological innovation has brought a new need for multidisciplinary education in standards and standardization not only in the developed countries but also in the developing countries in order to improve international competitiveness of their industries and to solve various socioeconomic and environmental issues facing them. Academic sectors need to meet the challenge of newly emerging educational needs for the future generations and prepare a comprehensive interdisciplinary curriculum with support from industry, government and international organizations.

Institute of Electrical and Electronics Engineers

- Technical standards are consensus documents that define the solution of complex technical problems taking into account economic, ethical, and societal constraints. A large part of the world's trade today involves products that comply with one or more standards. This has made education about standards, both at the college level and among the workforce, of significant importance. At the same time education about standards faces significant challenges. These challenges include increasing technology complexity and rapid evolution of standards.

- While the critical role of standards is generally recognized, surprisingly little has been reported about the critical role of standards education. Not only are standards of critical importance, but standards education is of strategic value to industry and the society.

- Behind a winning standards strategy there are well-trained and experienced technologists and marketers who have mastered the art and science of standards in industry. Most often, these employees have learned the practice of standards at best, from a company mentor or at worst, by trial and error. It can take many years of "on-the-job training" for a professional who is unfamiliar with standards to become fully proficient.

- Some companies will shun standards activities altogether, thinking that standards activities are a waste of time and money. Employees at these companies who wish to work in the standards arena have to "steal" time in order to participate. They often see personal value in joining standards committees and must do so without using company resources. An employee in this situation who is formally trained in standards has perhaps the best opportunity of all to make a significant impact on his or her company. Putting the knowledge of standards to work for this type of company could result in a major shift in its thinking and thus, its strategy.

- At the college level there are deep connections between standards education and the ABET's requirements. These connections have not been fully realized by the academic community. Teaching standards is an efficient way to teach engineering design, science and engineering principles; it is also a means to integrate these with economic, environmental, ethical, and societal contexts. Emerging evidence suggests that standards education encourages and supports collaborative work and naturally leads to recognition of the need to engage in lifelong learning.

Japanese Standards Association

- If we are to teach strategy or strategic value associated with the issue of standards in order to attract attention of corporate executives like CTOs [Chief Technology Officers], we may not be able to avoid talking about de-facto standards in many technology areas. Although de-facto standards are not standards, it is critically important for CTOs to understand that not only de-jure but de-facto standards will play critical roles in market strategy in some technology areas.

- It is critically important to clearly define a scope, goal and technology area of a standard education program in designing its contents and curriculum. And if we are to attract CTOs' interest in standards education, and if we are to talk about market strategy using standards as its tool, the standards education program would need to include issues related to de-facto standards

in it, and this would put us in a situation where we need to teach issues far beyond those relating to de-jure standards. Thus, again, issues relating to ISO/IEC/ITU will become only a tiny part of the curriculum.

- Certainly, standards education programs would be very valid and useful because this subject can provide trainees with important knowledge on standards and useful and practical information on standards development. But we need to have very clear idea and understanding that what kinds, aspects and/or roles of standards, about which technology area, and to what kind of people we would like to teach before designing and developing a scope and framework of standards education program. In addition, I would like to point out that we have to be very careful in using the words of "strategy" or "strategic value" in conjunction with standards education.

McDermott, Will & Emory

- When clients enter the world of standards for the first time as a result of a new manufacturing venture or a new area of business, they are faced with a number of legal issues. Few lawyers appreciate that a product as simple as a child's yo-yo is manufactured to specifications found in a number of different national and international standards. Clients, regardless of their level of sophistication, often are clueless about the standards process. Even Microsoft, a formidable and sophisticated competitor, has admitted to its lack of expertise in the area. Stuart McKee, Microsoft national technology officer, commented earlier this year on the standard setting process in the International Organization for Standardization (ISO).

  > We found ourselves so far down the path of the standardization process with no knowledge. We don't have a standards office. We didn't have a standards department in the company…I think the one thing that we would acknowledge and that we were frustrated with is that, by the time we realized what was going on and the competitive environment that was underway, we were late and there was a lot of catch-up.[13]

  Mr. McKee was not discussing the early days of Microsoft, but rather the involvement of his company in the ISO process developing the OOXML standard in 2006 and 2007. Microsoft's experience provides a warning to lesser-experienced companies trying to understand the complexity of the standard setting systems that have developed around the world.

- One would have to be hopelessly naïve to believe that differences in individual manufacturing capabilities and strategies do not influence the standards development process. One manufacturer may well have a competitive advantage in one type of material and vociferously argue that it provides a much safer product than another. If it can demonstrate that its product is preferable to the alternatives, albeit marginally, what should a standards committee do? Should it give a clear market advantage to one company? Should it endorse the marginally safer product even if it shuts certain competitors out of the market? In the case of safety standards, should the committee balance safety issues with competitive ones, or does that portend a future lawsuit?

[13] http://news.zdnet.co.uk/software/0,1000000121,39437722,00.htm

- Participation in international standardization requires multidisciplinary skills and experience. Because legal issues may develop during the course of a standardization project, participants should have a basic level of awareness to recognize such issues. Many standards development organizations provide briefings to participants to create a basic level of awareness concerning potential legal issues. Given the growing complexity of a world dominated by the emergence of new technologies and a significant increase in international trade, international standardization participants should have a basic level of awareness concerning potential legal issues as part of their multidisciplinary skills.

U.S. National Institute of Standards and Technology

- Heightened national awareness of the importance of standards activities has been reflected by U.S. enactment of the National Technology Transfer and Advancement Act (NTTA) of 1995 which directs Federal agencies to use voluntary consensus standards to carry out policy objectives or activities determined by the agencies and departments, except where impracticable, and by recommendations presented in the National Research Council's report "Standards, Conformity Assessment, and Trade into the 21st Century." This body of evidence has convinced industry, academia and governments of the strategic importance of standards - hence the development of many comprehensive standards education programs in the United States and around the world.

- In its efforts to promote standards usage by federal agencies and standards education in general, the Department of Commerce has identified the need for Federal agencies to:

    1. Partner with colleges/universities on the research and development (R&D) aspects of new technologies to be able to influence the content of standards at the earliest stages of their development, and
    2. Expand the inclusion of standards curricula in engineering and business schools through partnerships with organizations such as the Accreditation Board for Engineering and Technology (ABET), American National Standards Institute (ANSI), National Science Foundation (NSF), engineering societies, and trade associations.

- Recognizing the importance of understanding how standards impact trade, one of the goals within NIST's international engagement strategy is to provide education and training on standards to increase competitiveness and market access.

University of Colorado (Boulder)

- The current focus of most standards and standardization education is on standardization, the process of creating, implementing or using a standard, usually with examples of different standardization processes. Such courses do not offer the student a theoretical basis to understand standards or standardization. A "standard" is an established reference which may be studied as a concept or a realization. Studying standards as a concept and its impact on standardization is largely an academic endeavor, while the actual processes of creating, implementing or using standards requires mostly practical skills.

- Balancing the multiple interests represented in a standardization committee requires some form of fair standardization. Each standardization participant must find their interest acceptably represented before they can agree to a new standard. In this light, the concept of the "best" standard does not really exist. Standardizing two or more ways to achieve the same result (where the standard is imbedded in a programmable micro-computer), while less energy efficient, may minimize both short term risk (meaning that the standard is more likely to be completed) and long term risk (meaning that two or more ways to achieve the same result provides options should one way turn out to be less desirable in the future, e.g., due to higher royalties). Determining how to balance multi-party interests and single standard efficiency is often the most difficult task in a standardization process. Existing standardization courses do not address this issue.

- An example of the need to balance efficiency and interest is a "standards war," when two different technical approaches to a standard vie to be defined in the standard. Standards wars usually occur when the different technical approaches represent economic value to different organizations or groups of organizations. The public does not care about who wins a standards war. The public only cares about receiving the product or service that a needed standard helps define (Shapiro, 1999).

- Successful standardization entails recognition that the “best” may be what is politically possible rather than what is technically most efficient. In standardization today the idea of “the politically possible” is fraught with negative connotations. It is more productive to understand it as the solution that provides the lowest risk to the largest number of participants.

- The possible effects of standards are very broad and include expanded communications, increased quality and decreased cost (for the manufacturer, service provider and consumer), increased trade (local, regional and international), increased uniformity, new markets (innovation or location), information dispersion, market control and regulation. The widespread use of standards increases compatibility, interchangeability, interoperation and usability. Some describe standards as limiting innovation and others describe standards as enhancing innovation. In micro-economics literature, the impacts of different standards have been identified as coordination, scaling and learning, network, and gateway effects (Arthur, 1988). Each of these different effects may have significant ramifications on society. And these effects increase as technology becomes more critical to society. Trying to comprehend such a broad range of effects without an effective model of the causes is not realistic. This is major reason for the low interest in existing standardization courses; they do not offer a way to understand standards.

American Society of Mechanical Engineers

Do Standards Education Programs Have A Strategic Value?

David J. Soukup, P.E.[14] and Thomas J. Perry, P.E.[15]

Introduction

ASME's response to the question above is a definite "Yes." Recent discussions with industry representatives have pointed to the strong need to give engineering and engineering technology students more exposure to standards during their academic careers.

The outcomes-based criteria that ABET has adopted to evaluate academic programs in engineering includes the statement that students must be familiar with standards. So too is the need for standards exposure noted in the TAC (Technology Accreditation Commission) of ABET criteria for engineering technology programs. One of the items in the ABET self-study report that universities must complete as part of the accreditation process asks, "Describe the culminating major design experience, including how it is based on the knowledge and skills acquired in earlier course work and how appropriate engineering standards and multiple realistic constraints are incorporated in the experience."

We believe that standards must be integrated into engineering and engineering technology courses, be a part of design and manufacturing-oriented competitions, and be embraced by faculty as important to preparing students as practitioners.

Integration into Courses

Stand-alone courses in standards exist in a few universities, but the occurrence is rare. Adding an entire course to an already full curriculum is quite challenging. However, adding modules on the applications of standards into existing courses would be much more feasible. Often these can be integrated as 'case studies' to exemplify the applied nature of a problem where standards awareness accentuates the solution. These case studies are available from a variety of sources, including ANSI's www.standardslearn.org, among others.

Even with existing courses, it is challenging to determine how to modify course syllabi to incorporate new material and to develop meaningful learning assignments to reinforce the course content. However, in the extreme case, if the outcomes assessment finds that one's graduates are not being prepared to handle real-world problems, and the program's accreditation is in question, instructors would be more likely to take action. In the more normal case we must invest in useful curriculum resources and faculty development methods to actually bring about increased attention to engineering standards.

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Thanks to the internet, a vehicle exists for content to be readily added to a course. Modules can be prepared that students and faculty would be able to download. The material will need to be visually exciting, incorporating graphics and simulations to give the students a sense of "hands-on" work.

The material also needs to be user-friendly for the instructors. An instructor's guide, completed homework problems and possible examination questions and their answers will need to be provided. Case studies with discussion points could also be provided.

Because the modules are on the internet, the reach would be global and the updates, additions and enhancements could be readily incorporated. Admittedly, security questions would need to be addressed to ensure the integrity of the instructor's guide, but the challenge is not formidable.

Strategically it is important to determine which standards have the strongest application to the most common elements of the engineering curriculum and also which standards have a direct connection to contemporary engineering challenges, principally environmental sustainability, energy use and conservation, and safety. Because of the global nature of engineering, exposure must include both national and international standards such as those from ISO, IEC, and ASME.

Design Competitions

Design competitions and design awards are very popular among students and faculty alike. The individuals who create the design challenges or set award criteria could be urged and supported in encouraging the application of standards in the rules of the competition/award. Students would see that without acknowledging the use of standards in their designs, the quality of the designs would be called into question.

Protecting the safety, health and welfare of the public is part of the Code of Ethics for Engineers. The application of standards plays a major role in satisfying this.

Often these design competitions and awards serve as the basis for the capstone design course that is a requirement for graduation. Giving the students the tools to address potential standards interfaces with their designs will pay dividends.

Faculty Involvement in Standards

Little, if any, attention is paid to standards in graduate schools of engineering. It must be acknowledged that over 54% of the students pursuing doctoral degrees in engineering are not U.S. citizens and the great majority of those students received their undergraduate education outside the United States. Chances are greater that foreign national students, as opposed to U.S. engineering students were exposed to standards in their undergraduate studies. South Korea for instance begins exposing all students to standards in grade school, regardless of their interest in engineering. That exposure continues through high school. The graduate students of today are the engineering faculty of tomorrow. So it is especially crucial that these efforts be applied at the graduate level, as well as the undergraduate level.

Opportunities need to be provided for both graduate students and faculty to become more active in the standards process. For instance ASME has already begun naming students to their US TAGs to ISO, with the hope of growing interest in standards development. Standards-setting bodies should conduct special outreach efforts to bring faculty onto their committees and conduct standards education webinars. Faculty could also be made aware of consulting opportunities in the area of standards.

Conclusion

ASME has the experience and resources to deliver standards-related content to engineering and technology schools. We have initiated our research into the best way to deliver this content by reaching out to mechanical engineering and mechanical engineering technology academic departments in the United States and abroad. We look forward to supporting the Center for Global Standards Analysis in its efforts.

ASTM International

The Strategic Value of Standards Education

Jim Olshefsky[16]

The United States Standards Strategy (USSS), published in August 2000, identified strategic and tactical initiatives to be used by diverse interests to meet their own national and individual organizational objectives. Point 10 of the USSS established standards education as a high priority within the United States' private, public, and academic sectors.[17] This goal signaled to leaders and top executives the strategic value of standards education.

One only need look as far as Public Law 104-113, The National Technology Transfer and Advancement Act of 1995 (signed into law on March 7, 1996), to find one very important public policy developed in the United States covering standards strategy.[18] The law requires federal agencies to use consensus based, voluntary standards as alternatives to specifications that had previously been developed only for government use. This strategy has saved the federal government billions of dollars in procurement costs and has lessened overlap and conflict in regulations.

Likewise, industry is realizing the strategic value of being engaged in the voluntary standards effort. A paper presented at the American Society for Engineering Education's (ASEE) 2008 Annual Conference [19] pointed to the fact that one company's principal devotes 25% of their

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[17] United States Standards Strategy, http://www.ansi.org/standards_activities/nss/usss.aspx?menuid=3
[18] NTAA, http://standards.gov/standards_gov/index.cfm
[19] AC 2008-353: Sustainability and International Standards, ASEE 2008 Conference Proceedings

time to standards development activities. Industry leaders now know that participation in the voluntary consensus process can contribute significantly to a company's bottom line by facilitating commerce, developing new markets, and protecting the company from litigation.

The academic community has similarly recognized the importance of technical standards education in engineering curriculum. The Accreditation Board for Engineering and Technology (ABET) criteria for engineering curriculum now requires that faculty must ensure that their engineering program curriculum incorporates appropriate engineering standards. ABET's criteria are intended to assure quality and to foster the systematic pursuit of improvement in the quality of engineering education that satisfies the needs of constituencies in a dynamic and competitive environment.[20]

Many fear that the wave of retirements of engineers, who were baby boomers and who have spent 25 to 30 years on the job, will create a significant shortage of engineers over the next 5 years. Enter organizations like "Project Lead the Way" (PLTW), a non-profit established to help schools with pre-engineering curriculum to increase the number and quality of graduating engineers.[21] PLTW is strongly supported by industries that demand qualified engineers prepared for the workplace. PLTW's project based curriculum lends itself very nicely to incorporating the use of standards to help set the boundaries for solving real life engineering problems.

Not only can engineering and pre-engineering students benefit from the knowledge of standards, but students studying public policy can realize a strategic value as well. The Washington Internships for Students of Engineering (WISE) program is a successful summer internship program made possible through the collaborative efforts of several professional engineering societies and standards developers.[22] Each student researches and presents a paper on a topical engineering-related public policy issue that is important to the sponsoring society. The interns learn how government officials weigh complex technological issues and how standards play a key role in legislative and regulatory public policy decisions.

Additionally, globalization is pushing students to learn more about international business and how standards play a critical role in companies' being successful in the global economy. These days, students in international business are learning that the World Trade Organization (WTO) has established criteria for developing international standards in its Technical Barriers to Trade Agreement.[23] Students learn about standards that are sometimes used inappropriately as "non-tariff" barriers. In their study of imports and exports, they also learn the benefits of being active stakeholders in standards development and the costs when duplicative standards interrupt the flow of goods' crossing borders. International business students learn there is strategic value in being aware of an area that has traditionally been a part of the engineering and science disciplines.

ASTM International, the largest US based international standards developer, continues to develop its multi-faceted academic outreach initiatives. "ASTM Campus" is a focused area of the ASTM website for students and professors to access resources and programs that support standards

[20] ABET Criteria for Accrediting Engineering Programs, http://www.abet.org/forms.shtml#For_Engineering_Programs_Only
[21] http://www.pltw.org/index.cfm
[22] http://www.wise-intern.org/
[23] http://www.wto.org/english/tratop_e/tbt_e/tbt_e.htm

education.[24] Other ASTM academic activities include campus visits, webinars, scholarships and internships. ASTM is committed to cultivating and educating a new generation of technical experts and business leaders through standards education that adds strategic value for private, public, and academic sectors.

BSI British Standards

Kim Edmondson[25]

Do standards education programmes have a strategic value?

Introduction

The significant growth of standards Education programmes is symptomatic of the increasing interest in international standardization. Worldwide, ISO standards on quality and environmental management (ISO 9001, 14001) have become commonplace terms in the business sector. The Education sector in the UK is keenly interested in this topic, typified by the high volume of enquiries BSI British Standards (BSI) receives from students and teachers.

BSI learns much from the variety off queries over the years. Additional content has been placed on the BSI Education website and BSI is continuously updating the information as necessary.

BSI has had an Education programme in place for a number of years and feels it is an important service to students and teachers at all levels. This paper attempts, from a UK perspective, to demonstrate the value of standards and the benefits of standards educational programmes, both at national and international levels.

The Value of Standards

The benefits of education on standards and standardization in any country are reaped in many different ways. The ever-increasing need for skilled participants in the standards creation process itself is reliant on those people being knowledgeable and keen to engage with the National Standards Body (NSB). To have each student leaving education for business-minded pursuits not only recognizing BSI's name but actually understanding what standards are and why they are important is the foundation of BSI's educational activities.

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[24] http://www.astm.org/campus/

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National Standardization Strategic Framework (NSSF) (2003-2006)

In 2003 the UK government set up the National Standardization Strategic Framework (NSSF) as part of its commitment to innovation and technology. The 3-year project was funded by the then Department for Trade and Industry (DTI) and led jointly by the DTI, BSI, the Confederation of British Industry (CBI) and the United Kingdom Accreditation Service (UKAS).

The aim was to secure a step-change in the understanding and use of standards and standardization, for the benefit of business, government and society. The BSI Education programme benefited from the Framework in the following ways:

- Website restructured, re-branded and redesigned
- Material made available for all age groups from age 7+ including higher education
- New content added to increase understanding about relevant standards to more curriculum subjects
- Increased use of website by a wider student and teacher audience
- School implementation demonstrated by repeat visits to lesson plans/support material downloads demonstrates implementation in schools
- Site structure improved for future expansion of content

Outside the Education arena, the NSSF had many other successes in the areas of engagement, committee infrastructure, international activities and innovation.

The Empirical Economics of Standards

In 2005, the then UK Department for Trade and Industry (DTI) commissioned and published an economic report, *The Empirical Economics of Standards*. It reveals that:

- Standards make an annual contribution of £2.5 billion to the UK economy
- 13% of the growth in labour productivity is attributed to the role of standards
- Standards are an enabler of innovation and a facilitator of technological change
- The economic return from investment in standards makes sound business sense at both a macro and micro-economic level.

The report has helped to validate what most of the standards industry already knows: that standards can help drive the economy by providing a framework for growth, by promoting market access and by encouraging innovation. And what better way to help get that important message across than by allowing access to information on standards from a young age?

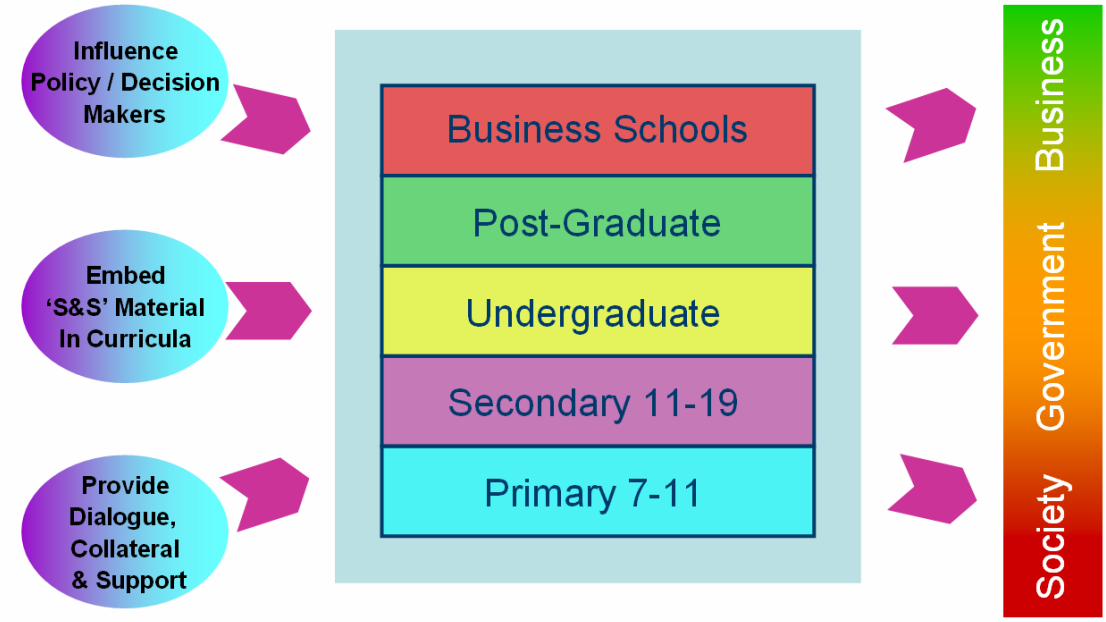
BSI Education Strategy

The overarching BSI Education strategy has at its heart these main aims:

- Influence policy makers to include standardization as an element of the formal education curriculum from primary to tertiary levels
- Embed standardization into the curriculum

- Manage dialogue with the education communities through website, publications, leaflets, competitions and enquiries
- Foster standardization research

The following diagram illustrates this UK national strategy and its levels of engagement within education and out to other sectors:



The continued success and development of the UK economy has a need for students to understand the significance of standards within it. Standards form a common language, a dialogue in which all can participate and from which all can benefit. Bringing standardization into teaching curricula at every level represents a committed investment of intellectual capital. As students gain knowledge and skills and move into employment, involvement in standardization will prove essential. Furthermore, an understanding of the benefits standardization offers the business world can open doors internationally to those students equipped to engage in the process.

Educational communities have an important role, alongside business and government, in ensuring that standardization is effective and practical. Their specialized knowledge can provide a vital contribution to standards development, whilst integrating the principles of standardization into educational curricula allows students to carry them forward into the workplace, thus ensuring an investment in the future.

Communication Tools

BSI currently uses a variety of tools through which it communicates information on standards and standardization.

Website

The main portal of information is the BSI Education website, www.bsieducation.org. The website offers teacher and student-tailored content with comprehensive background information, lesson plans, case studies, testing sheets and interactive games on a range of topics for 7-19 year olds, all supporting National Curriculum subjects. There is also significant content for the Higher Education sector. The majority of the resources are geared towards engineering, manufacturing, applied science and design and technology courses, which lend themselves quite easily to introducing technical standards. There is also a fair amount of content relating to quality management and sustainability, two cross-curricular topics of particular current interest.

As a part of the Higher Education website content, the *International Journal of Quality and Standards* provides authoritative and supportive resources about quality and standards for students and academics alike. It includes classroom materials, teaching notes, PowerPoint slides, starters and plenaries.

In addition, further and higher education students are given guidance on researching standards and the importance of British, European and International Standards to business.

Website statistics show that the number of visitors to the BSI Education website continues to increase year on year, with an average of 61,000 hits per month in 2007 and 66,000 to date in 2008.

Educational establishments and young people must be engaged with standards in a way that facilitates and encourages learning. Linking with the UK National Curriculum set of learning outcomes ensures teachers can justify spending valuable classroom time on the topic of standards. Furthermore, providing the information at no cost via the medium of the internet helps to meet a wide target audience.

Engaging young people in the area of standardization and giving them the tools to explore its implications worldwide has the capacity to facilitate standards work in the future.

Publications

There have been three to four educational texts (designated by the 'PP' preceding the standard number instead of the 'BS' for technical standards) published each year by BSI. Generally, these publications provide guidance and explanatory notes to teachers and students on particular standards that are relevant to secondary and tertiary level courses. For example, PP1990:2007 *Extracts from the Structural Eurocodes for students of structural design* is being used at the tertiary level as an overall guide to the ten Eurocodes (new European construction standards) now in place in the UK. Interestingly, this publication is also being purchased by construction sector professionals who are finding it useful.

Programmes & Engagement

Strategic links with various industry forums, government departments and Sector Skills Councils are proving to be fruitful. As BSI Education's main goal is to widen the reach standards have within all areas of education, BSI recently undertook an initiative based on BS 8901:2007, the recently-published standard on sustainable event management. Inspired by the country-wide reach

of Japan's Educational Programme on ISO 14001, BS 8901 was adapted and set out as a challenge to all UK schools to run a school event based on the principles of the British Standard. GetGreenGo™, in its first year, attracted the interest of over 130 primary and secondary schools across the UK. Key support from sponsors such as Department for Environment, Food and Rural Affairs (DEFRA) and Manchester United Football Club has helped to make BSI's first competition such a success. Not only is it raising awareness of BS 8901, students and teachers are also learning more about environmental sustainability.

Higher Education (HE) Activities in the UK

BSI Education actively engages with various members of the HE community in order to explore how we could work more closely with the sector.

Previous work within the HE arena has included seminars on HE participation in standards and standards research, as well as producing course content and materials for a pilot course on *Risk Education in Engineering*. There is also involvement in international standards development relating to the education sector, for example in ISO Technical Committee 232 Working Group "Learning services for non-formal education and training".

There exist some excellent examples of programmes that can be used as examples to further develop relationships with HE institutions: departments dedicated to standards and standardization such as at Erasmus University, extensive amounts of standardization courses in Korea and China, educational programmes such as at the Standards Council of Canada. Additionally, the ISO awards for HE in Standardization should help stimulate universities as well as NSBs to consider what could be done to increase exposure to the practical tools standards can provide across many different sectors.

Conclusion

The key benefits of developing a strategic education plan, nationally or internationally, are numerous: raising awareness from a young age of the benefits and uses of standards; influencing future participants in standards creation and future purchasers of standards; furthering the research base on the impact of standards. All educational programmes supported by various standards-related organizations are helping to increase the visibility and understanding of the "why" and the "how" of standards, which BSI considers as vital to its long-term success.

China National Institute of Standardization (CNIS)

Standards Education Programs' Strategic Value and CNIS Practice

Zhao Wenhui[26]

As a National Research Institution, one of the missions for the China National Institute of Standardization (CNIS), defined by the Government of China is "National Training base of Chinese Standardization Talents". CNIS has always been focusing on chasing the progress of Standardization Education of China, and has also committed to propel its development.

According to our case study and field practice, the Standards Education Programs (SEPs) are of great significance for standardization academic institutions. For a developing country, the answer for this issue is essential. Making knowledge of standardization widely available provides the fundamental knowledge and the driving force for the rapid development of the economy and society in China.

The aspects of Standards Education Programs' strategic value

Do standards education programs have a strategic value? Perhaps seldom people would say no. And how could the education programs act upon the standardization?

The standardization is a product of reciprocal actions of society, economics, technology, and this function could only be accomplished well when combining with practice experience and theoretical knowledge. However, in the time of today that all categories of knowledge and information are rapidly increasing, very few of people could naturally have a good command of this precision knowledge structure which covers broad fields. SEP is absolutely a bridge to assist people to establish this kind of knowledge structure.

In order to improve the level of standardization activities, the training should be provided for staffs of technique and management as soon as possible. Carry out the SEP to the potential workers at the early stage of their career, which can, improve the quality of the change from technique innovation to the standards and reduce the period of the change.

We can point out many advantages of SEP as below. The CNIS makes a systematic study about it, which has divided the SEP into several levels. The different type of program has the different aspect of its strategic value:

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Different Types of SEP and Their Values

Types of SEP	Designed Group of People	Value of the Project
General SEP	One who anticipates for the standards knowledge	To increase the acknowledgement of standardization, to form a standardized consciousness and to better utilize the standards.
Vocational SEP	Vocational school, undergraduate education	To provide the principle and the theory of standardization; Help understanding the major standards in their field; Prepare for the future career life by using standardization as a tool.
Academic SEP	Postgraduate education, Doctoral education	Transfer the technology into standards during the study, and the theoretical study of the standardization.
Continue-education SEP	People on-the-job	Help the staffs to utilize the standardization in their works; Establish better information system with updated knowledge.

The practice and efforts made for SEP by CNIS

For SEP, CNIS has a strategic scheme: To combine the discipline construction, the theory and principle study of standardization with all kinds of training for the stakeholders by integrating the resources, while integration of theory with practice.

Actually, China has relatively mature experience in the SEP progress. In 1979, the Chinese expert began to compile the *Introduction to the Standardization* which is the first monograph book and also the classic teaching material of standardization in China. Now this book has been edited and reprinted for 4 times, and each time the related research staffs in CNIS participate in the revised work. But this is just a small part of what CNIS has achieved for the SEP. The specific programs of standards education in the CNIS are listed as below:

Types of SEP	The specific programs in the CNIS
General SEP	● To compile books and textbooks; ● To propel the popularization of standardization curriculums and lectures.
Vocational SEP	● To provide a platform for stakeholders' communication in China; ● To participate in their discussion on curriculum design, and give them all kinds of technique supports.
Academic SEP	● CNIS plans to carry out the collaboration cultivation on the postgraduates;

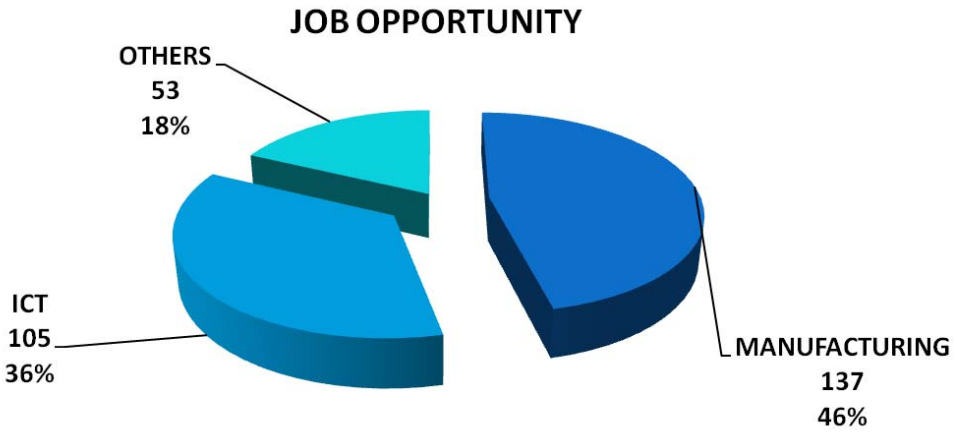
	• Plans to set up the postdoctoral program.
Continue education SEP	• To develop all kinds of Standards Education projects for the CNIS staffs; • To set up the standardization innovation base with corporations; • To cooperate with universities to cultivate the on-the-job postgraduates; • To dispatch the expert to instruct the knowledge of standardization. • To provide the training position for other standardization research institutions in China, and open up the exchange scholars program; • To provide the training program for the developing countries, this is devolved on by the SAC. 26th May 2008, for the national standardization body of African States.

CNIS believes, as the most authoritative institution on research of standardization in China, it is not enough to open up the SEPs directly. To fully expand the strategic usage of standardization, CNIS needs to conduct and explore those questions: Do standards education programs have a strategic value? How do they work? How to propel the development of SE programs and set up the discipline construction of the studies on standardization? These are questions that CNIS is working hard to answer. Set forth below are completed, current and future CNIS SEP efforts:

Time	Works	Effects
August, 2005	Formed the complete concept of "To establish the standardization brains training and election system" in the China Strategy on Technical Standards by CNIS.	Became the core part of the SEP in the strategy of China's standardization and varies categories of the developments and planning which are being implemented gradually.
December, 2006 - December, 2008	Two Research Projects："Feasibility study for construction of standardization discipline", "Research for the improvement project of Standardization Education."	Established the status of the CNIS in China's SEP; established a complete liaison channel and commanded abundant of basic data.
2008	Participated in the activities of ICES, and etc.	Fortified the international communication.
October, 2008, December, 2009	Study of the standardization basic methodology.	Intended to provide the principle methodology of SEP.

The value of SEP

CNIS had a study of the demand for standards education. From Oct.-Nov. 2007, 164 companies offered 295 job opportunities in China through the two largest job sites (www.51job.com; www.zhaopin.com).



ɪation personnel varies and the numbers are massive. It proves that the necessity of the SEP program. On the other hand, as the constant application of the SEP in China, more enterprises could realize the importance of the standardization that they would be willing to join in.

Even though CNIS is a non-profit research institution, it has achieved greatly by implementing the SEP. As the standardization programs are being promoted in CNIS, the effects and the status of the CNIS has been greatly augmented. It undertakes large sum of national research tasks and it has already reached fruition. The wide publication of the education program enables the CNIS to be more renowned and authoritative; the inside long-term SEP program made CNIS to grow constantly in power.

As the most authoritative institution in China for over-all, strategic and comprehensive standardization issues of national economy and social development, CNIS would be willing to pioneer adaptation of the SEP, to realize the overall stretch-out of standardization's value. And we are looking forward to show the power of standardization education program on the progress of the society, economic developments and the science innovation with anybody who is interested.

In the future, the China National Institute of Standardization will act: (1) as an observer concerning the international situation and the state's policy; (2) as a coordinator, improving the ties of relevant standardization shareholders and providing a platform of communications; (3) as a think tank, participating in the compilation of standardization textbooks and focusing on the exploration and support of SEP theories; and (4) as a disseminator, transmitting the knowledge of standardization, and offering training and education programs.

If you want know more about CNIS, please visit www.cnis.gov.cn .

CSK Holdings Corporation

Do standards education programs have a strategic value?

Toshiaki Kurokawa[27]

First, let us put that any education program has its strategic value, even if the value is negative. Yes, the education is the endeavor that has more strategic value than its tactic or spontaneous value, because the output of the education will come late (at least 2 or 3 years later, in some cases more than 10 years later) and also vary from individual to individual and dependent on his/her environments.

We also note that the effect of the quality and quantity of the output of an education program is profound and wide, and its results may affect the society and its economy for many years.

Second, let us accept that standards, especially global standards have strategic value in the sense that they affect not only the current marketplace or product/service production, but also the industry and government planning because they will promote the specific lines of products/services that conform to the standards. In other words, those products/services that fail to conform to the standards will have big handicaps in the global marketplace which may hit the bottom line of companies/industries/countries over the long duration.

Thus, with these two obvious theorems, we can conclude that the standards education program has strategic values. Q. E. D. However, I should better explore more subtle aspects or details of their strategic values, because when we check the real reasons/backgrounds for the question posted, it is not a simple yes/no question but actually a question on precedence. The real question behind this is "How important for the standards education programs over other education programs," or "How much money we should put into the standards education programs over other programs that also intend to promote economies and the Quality of Life of the people.

Here, we encounter a real difficulty, because, in general, there are many competing programs and it is easy to claim that a program is better than others but it is too difficult to prove that it is better than others, and, worse, it is much harder to execute a program and produce the results that meet the expectation.

I believe that a basic inference rule that most people adopt is the continuation principle, that is, what exists today will exist tomorrow. This is the principle that you believe that you will be still alive tomorrow because you are alive today. Applying this principle to education programs, we can

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infer that the existing programs will continue to exist. Thus programs that do not exist now such as standards education cannot enter the main stream of education curricula.

Standards education programs are handicapped. As of today, in most countries standards education programs do not have solid departments or institutes to provide a framework for educators within educational institutes. Old faculties such as philosophy and history have the advantage that they have a long tradition, and have established courses and graduates even though for them it would be a difficult task to answer the strategic value question.

To overcome the continuation principle, we should adopt a different principle and focus on change, that is, the principle that everything will change, nothing will stay as it is. You must be different tomorrow from yourself of today, that is, the earth will continue to change and evolve.

With this principle, the education system today must change itself to adapt to the changing world. From this viewpoint, the meaning and the value of the education may also need to change. The current education system needs to be investigated how to be more effective to match the future needs of the world tomorrow.

However, you may ask, that there is a contradiction that a standard means something that holds for tomorrow, does not mean something changing everyday. Here is an interesting observation that standards are actually change-manager, that is, a standard will control the pace of change in the system. The system can be a marketplace or a measurement system or an education system.

I have a vision that the current education system where students come to the classroom, and the education courses needs to be attended for some years until the graduation will be admitted, is not the best in this changing world. This is like a full course menu at your dinner. You need to eat all the dishes until you get the final desert and the check for the course. Instead, it would be much better that you can eat whichever dish at your convenient time, and go out for work or pleasure, and come back again to pick up other dishes. The payment will be done by each dish. (There may be special discount for some combination of dishes, or some number of dishes.)

In the current system, students and the teachers come to the special place called classroom, but the future system may provide that either a student visit a teacher, or vice versa, a teacher visit a student. This may not feasible in the real world, but surely feasible in the virtual world.

What we can envisage in the education system of the future is that the people who want/need to learn can learn when they need to. It differs current education system where you will pick-up a course which will (hopefully) provide the knowledge and skill in your future occupation. In many cases, you will find a calling which require different knowledge and skill that your course provided.

It is interesting that people appreciate meta knowledge and skills they acquired in school, that is, for the knowledge of how to get knowledge and skills to learn, study and teach. And in many courses, they are not explicitly taught but learned implicitly and more often learned from other students while attending the school and experiencing the school life.

It is also noted that the school of the future will be facilitated with real life experience and real life problems. One typical example is the project carried out in Stanford University in United States and in Hasso-Plattner Institute in Germany. They bring students to a studio-like environment where the students tackle a real problem within the controlled environment so that they can make experiments without the risk of fatal or disastrous failure.

Project-based Learning (PBL) now popular in IT courses is another example to put the real life flavor into the classroom. Some of the Japanese universities such as Tsukuba University, Kyushu University and Future University-Hakodate are providing such courses, and their students enjoy and appreciate their experiences.

The standards education program will be, in my viewpoint, another example where real life experience/problem can prosper with the academic knowledge and principle. The effort paid in Hitotsubashi University [1] in Japan is an example of this important step.

The future of the education system will migrate with the future of industry/employment system where people will be engaged in both the learning and doing research activities now provided in academy and the working and solving the real life problems now provided in industry. Educational fee and employment payment system will be quite different in this kind of future system.

There would be many other areas than standards where this kind of academy/industry migration will be beneficial. Eventually, almost all of the human activities can be picked up for these attempts. However, in the current global situation where global standards play the critical role and its importance is growing, the standards education is one of the best candidates for this new type of education.

In summary, even though the strategic value of standards education is clear in the current situation, its value will increase dramatically in the future educational system. And in the future, the execution of standards education will become much easier and more fruitful.

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Hitotsubashi University

Multidisciplinary Nature of Standards Education Viewed from the Three-Wave Model of International Standardization

Shiro Kurihara, Ph.D.[28]

This comment points out multidisciplinary nature of standards education programs based on the three-wave model of evolution of international standardization.

The First Wave Driven by Technology

Since the development of standards as industrial infrastructure to fix major characteristics of products made by individual company requires the accumulation of considerable data and expert knowledge, it has been entrusted to professional engineers in a business corporation. This is proved by the historical evolution of international standardization. In 1865, an organization concerned with the technology of sending a signal, invented by Samuel F. B. Morse, was launched, a body which has now been succeeded by the ITU (International Telecommunication Union). One of the important tasks today is the allocation of frequencies for mobile phones and the preparation of international agreements published as Recommendations. The next international organization was established in 1906 by Lord Kelvin as the IEC (International Electrotechnical Commission) to deal with the electrical technology invented at the time. The third one was set up in 1926, with the focus on mechanical technology, which is the predecessor of the present ISO (International Standardization Organization). Finally in 1987, the JTC1 (Joint Technical Committee 1) was created, together with the IEC and the ISO, in the field of information technology especially related to computer software. The start of these four organizations, each of which corresponds to the then emerging key technologies, namely communication, electrical, mechanical and information technologies, seems to characterize the technology-led first wave in the history of standards development. As a general rule, the diffusion of a key technology embodied in new products and services calls for such specifications to make them fit for use and acceptable to the times and society. In this sense, the first wave is derived from the adaptation of technological innovation to market or social needs.

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The Second Wave Driven by Corporation

The world of standards, however, has been transfigured by a new situation which occurred two decades ago.

In the first place, the rapid progress of the digital revolution brought the importance of consortium or de facto standards to complement de jure standards, the latter of which takes an average of five years to make. This pace is not suitable for shorter-lifecycle products in the info communications domain, where many competitors strategically strive to gain a predominant market position. The standards for compact discs, digital audio tapes or digital video discs were completed in consortium and subsequently absorbed into the IEC.

There are significant differences in the standardization methods and procedures used across standards organizations such as the ISO/IEC and the W3C (World Wide Web Consortium) to develop interoperable technologies for leading the Web to its full potential. Some procedures emphasize the need to reach a broad consensus while others emphasize speed. It is vital to know which procedures are best suited to developing a global standard for a particular product. Digital industries, for example, usually demand faster standardization than the transport sector. Awareness of differences in standardization can be critical for the future of a company or industry.

Secondly, the managerial angle was introduced as a new perspective for standards. In Europe, harmonization of national standards and regulations was accelerated in the 1980's for the consolidation of markets and the Quality Management System Standard, which originated in the U.K., was adopted as the ISO 9000 series of standards for quality management in 1987. This is concerned with the system and the process of decision making in organizations which try to respond voluntarily to customer requirements with respect to quality, as well as conformity to legal requirements. Such a management system standard has completely changed the old image or fixed idea of the technology standard to specify the product characteristics and testing method. This new type of standard has become the tool of corporate governance linking business and society. A similar ISO 14000 series of management system standard was introduced into the environment in 1996 at the strong urging of the Business Council for Sustainable Development, food safety in 2005 and information security in 2006 respectively, with the social responsibility standard expected to be published in 2010. The ISO has responded on a timely basis to new types of requirements, which has diversified its standards portfolio. It is not only fulfilling strictly technical requirements, but also socio-economic and ecological ones.

Thirdly, the inauguration of the WTO (World Trade Organization) in 1995 has increased the influence of international standards. The Agreement of TBT (Technical Barriers to Trade) obligates member countries to harmonize national and international standards, while the SPS (Sanitary and Phytosanitary Measures) Agreement comprises the mandatory basic rules for food safety and animal and plant health. Its annex cites the FAO/WHO CODEX Alimentarius Commission (for food), the International Office of Epizootics (for animal health), and the FAO's Secretariat of the International Plant Protection Convention (for plant health) as international standards. These two agreements, which perceive international standards as bridges to trade, rather than barriers, have given international standards a predominant position over that in the past GATT (General Agreement on Tariffs and Trade), in which member countries were not obliged to implement international standards as national standards. The nations which have abruptly shifted their stance on the strategic value of international standards are not limited to Western countries.

Fourthly, the network revolution has established the compatibility standard essential for market expansion. The networked economy, which requires interconnection to transcend national borders, has developed globally. Creating a common standard in business circles, followed by the development of a product conforming to the same, is now prevalent in the communication industry. The network externality makes the value of a product of one company, which is compatible with that of another, much higher than it would otherwise be. Such a phenomenon occurs not only in the info communications domain, but also the logistics area, targeting global transport through shipping containers.

The changes mentioned in the above form the second wave in the world of standards which is driven by a corporation's adaptation to the changes in the business environment, namely, digital innovation, the new requirements of stakeholders, a new international trading order and network development.

The Third Wave Driven by Market, Government and Society

In the fifth place of transfiguration, improved awareness of the environment, safety, health, human rights and social justice from consumers' and citizens' perspectives has highlighted the increased importance of standards. Standards for services such as maintenance, transport, tourism, information technology and construction have emerged to ensure customer satisfaction and societal security. There is significant demand for conformity to an objective standard, based on expert knowledge, or for certification by a disinterested third party. Stakeholders demand that appropriate measures be taken, not arbitrarily but based on established rules. The COPOLCO (Consumer Policy Committee) in the ISO has been actively involved in these affairs and contributed much to the publication of international standards of complaints handling, code of conducts and ADR (alternative dispute resolution) from the viewpoint of customer satisfaction. Its strategy does not involve confronting a business corporation, based on consumers' rights, but getting it to collaborate with consumers to optimally exploit the market mechanism, targeting improved performance beyond compliance with the legal minimums.

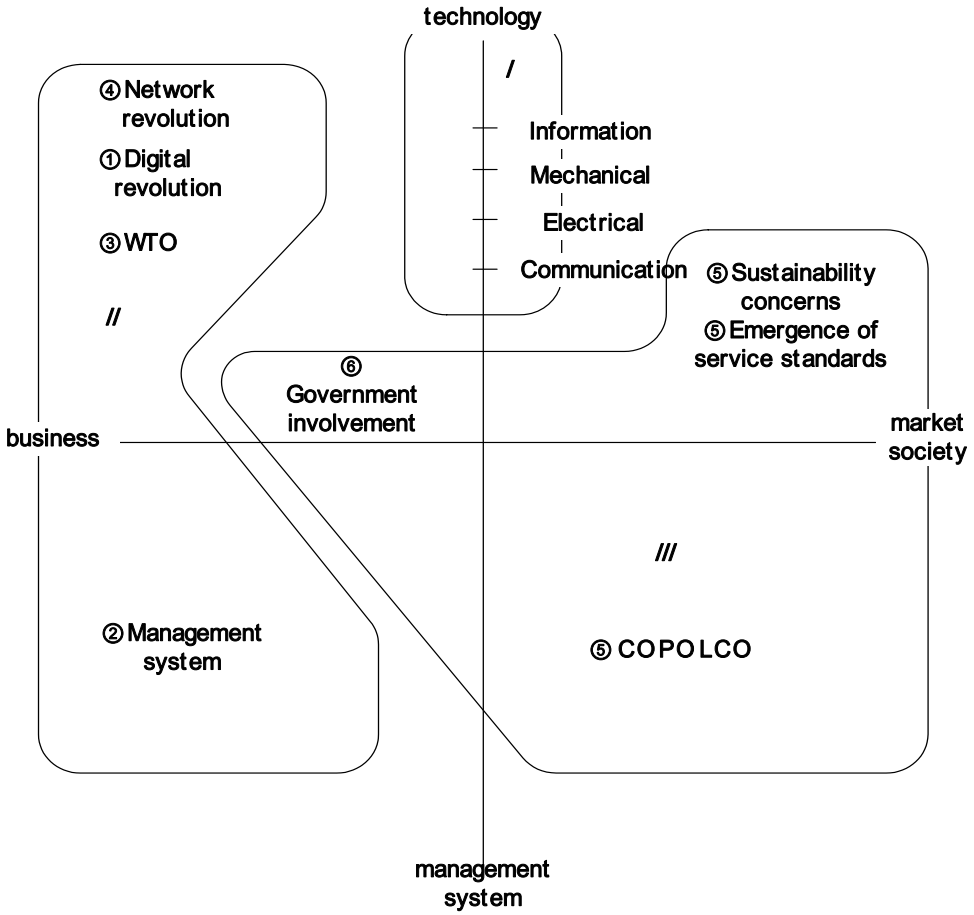
Finally as the sixth, the strategic involvement of national governments in international standardization in high-technology areas from an industrial policy perspective is now critical for countries to succeed in a world dominated by technology and science. The case of high-definition television symbolizes the scramble for top spot. Japan started to develop it in 1965 but its efforts for international standardization, which begun in 1974, were postponed without mutual consent. Subsequently, Europe launched the project as one of the EUREKA (European Research Coordination Action) programs in 1985 and the U.S.FCC (Federal Communication Committee) set up a consultative committee for next-generation television in 1987. In 1990, although the standardization was completed in the ITU, multiple formats with varying national origins were standardized in parallel. After innumerable twists and turns, the analogue transmission that has been received to date will be completely replaced by the digital alternative by the year 2011 in Japan. International competition in the development of high technology seems too intense for its standardization to be settled normally by a technical committee in the international organization.

These changes seem to form the third wave in the world of standards, which is driven mainly by the market, together with government and society, in having a major influence on standardization.

The Relationship among the Three Waves and Multidisciplinary Standards Education

These three waves are mapped in Fig. 1. The vertical axis shows the subjects or fields of standardization, which are classified into two groups, namely, the technology and management system. Moreover, the horizontal axis represents the main driving forces for standardization, namely business and society. In case of the first wave, technology itself works as driving force as well as regarded to be the subject of standardization. The six transfigurations mentioned in the above are headed by the corresponding number in each quadrant, while the Roman numerals *I~III* represent the three waves respectively. The wave *II* is superimposed on wave *I*, and the wave *III* on top of both. However, this does not mean that the old wave disappears with the advent of the new wave. Standardization of biotechnology, nanotechnology or renewable-energy technology is an urgent task in wave *I*. The three waves co-exist in such a way that each wave occupies a certain space on the same plane. This figure indicates that technology and management system standards have exerted a far-reaching influence on business and society and that these two domains, together with government, increasingly require appropriate standardization to solve the various problems facing them. This conclusion, derived so far from the evolutionary context of mainly ISO, IEC and ITU, may also be applied to other fields, like international accounting standards. The globalization of the world economy and the establishment of the WTO have vastly increased the social influence of international standards in every field.

FIG.1. Subjects and Driving Forces of International Standardization



The appearance of waves *II* and *III* transformed the world of standards from a mere technological and engineering matter to a more complicated and interconnected phenomenon, associated with business and society alongside the environment. The impacts of standards have now expanded ever further to cover virtually all contemporary affairs, namely corporate governance, international trade, network economy, logistics infrastructure, environment, safety, social responsibility and deregulation. To understand and analyze such standard-related development will require a multidisciplinary standards education ranging from engineering to public policy, business administration, economics, law and social system.

Conclusion

The standards world has radically changed over the past two decades especially in international standardization, with an increased impact on business and society. Rapid globalization of markets and accelerating technological innovation has brought a new need for multidisciplinary education in standards and standardization not only in the developed countries but also in the developing countries in order to improve international competitiveness of their industries and to solve various socioeconomic and environmental issues facing them. Academic sectors are recommended to challenge this newly emerging educational need for the future generations and to prepare a comprehensive interdisciplinary curriculum for them getting support by industry, government and international organizations.

Reference

Kurihara, Shiro "Foundations and Future Prospects of Standards Studies: Multidisciplinary Approach," International Journal of IT Standards and Standardization Research, Vol.6, No.2 July-August 2008.[29]

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[29] In his article, Professor Kurihara, *quoting* The Center for Global Standards Analysis with approval, discusses the need for education in standards education: *"The national economy of every nation depends upon its ability to develop and maintain an effective international standards system best suited to its needs. Given that standards are the essential building blocks by which every nation develops and maintains a competitive national economy, the challenge is to develop international standards education programs which meet the specific needs of a particular country in their private, public and academic sectors. For decades, private corporations, government departments and agencies have carried the burden of standards education by preparing their best and brightest employees to work in the complex field of international standardization [in the form of "on the job" training]. There is no question that international standards education programs offered by private corporations and government departments must be continued and expanded where ever possible. But in today's fast-paced and highly competitive world, are these efforts enough? A key question we must now address is whether nations need to make significant investments in creating academic opportunities for their best and brightest students to study the complex field of international standardization."* (*see* pages 15-17, emphasis in Professor Kurihara's article)

Institute of Electrical and Electronics Engineers

The Strategic Value of Standards Education

Todor Cooklev[30] and Karen Bartleson[31]

I. Introduction

Technical standards are consensus documents that define the solution of complex technical problems taking into account economic, ethical, and societal constraints. A large part of the world's trade today involves products that comply with one or more standards. This has made education about standards, both at the college level and among the workforce, of significant importance. At the same time education about standards faces significant challenges. These challenges include increasing technology complexity and rapid evolution of standards.

II. Standards Education In College Engineering Programs

Engineering graduates must demonstrate awareness and knowledge of economic, environmental, political, social, legal and ethical issues. These professional skills have been required by ABET for over ten years now, and in the last ten years, if anything, their importance has grown.[32] Understanding of standards requires the exercise of these same skills, as well as knowledge of government regulations, intellectual property, etc. In fact, there are few topics other than standards education where the issues of professional and ethical responsibility, the impact of engineering solutions in a global context, and knowledge of contemporary issues are so prominent and are interwoven with the technical content.

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[31] Member, IEEE Standards in Education Committee (SEC), Member of the IEEE Standards Association New Standards Committee (NesCom), Member of the IEEE Corporate Advisory Group (CAG) which oversees the development of entity-based standards, and Officer of the IEEE Design Automation Standards Committee (DASC), which sponsors most of the IEEE-SA's design automation-related standards. Previously, she was an active member of the Electronic Design Automation Consortium's interoperability committee and a participant in several IEEE standards working groups, including IEEE P1076, P1364, P1481, P1800, and P1801. She is also an officer and board member of the Accellera standards-setting body which feeds the IEEE-SA. She has 28 years of experience in the semiconductor industry.

[32] *See ABET Accreditation Criteria* (2007), http://www.abet.org/Linked%20Documents-UPDATE/Criteria%20and%20PP/E001%2008-09%20EAC%20Criteria%2012-04-07.pdf

Given the importance of standards, and the associated job opportunities, students are actively interested in learning more about the relevant standards in their technical areas. Knowledge of standards and the ability to apply them are "hard skills" and therefore very important. These are also related to the "soft" or "professional" skills engineers must demonstrate.

Beyond the students' interests, after examining accreditation requirements for engineering programs, there are several reasons why standards education is important. First, ABET accreditation criteria specifically require students to be prepared for engineering practice through a "curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints." Therefore some knowledge of standards is directly required. In addition to this direct requirement, education about standards is related to most other accreditation requirements. These additional accreditation criteria require engineering graduates to be able to solve engineering problems and to design systems. These are the so-called "hard skills".

Teaching standards touches another important area – engineering design. Integrating engineering design into the curriculum is considered very desirable. Most engineering science courses include "design examples" to emphasize theoretical principles. Each design example typically emphasizes a single concept. Engineering design, however, involves more than design examples. The engineers of today must deeply understand economic, global, cultural, and societal contexts. Standards education communicates these concepts better than most traditional engineering courses, because these concepts are naturally integrated with standards.

It is important to understand that knowledge of engineering science is not sufficient to understand the thought process that leads to successful design, and that studying these thought processes is critical to improving design education. It is precisely during the process of developing standards that engineers generate, evaluate, and select novel ideas. In fact, standards can be considered as the ultimate in this process.

Although ABET criteria are specifically for the United States, global expectations with respect to culminating capstone projects in engineering, computing, and technology education tend to mirror the ABET expectations on global, economic, societal, and cultural issues.

III. Standards Education In Industry

Standards are playing an increasingly important role in the high-tech and electronics industries. Companies are including standards in their strategic plans, recognizing that standards can be leveraged into a competitive advantage. There are countless examples of how business climates have been changed as a direct result of using standards to establish "winners" and "losers" in the marketplace. A classic example is VHS versus Beta. Today, it's BluRay versus HD, and the stakes are high. Imagine all the goods and services that will thrive or become defunct based on which format ultimately becomes the winner.

Behind a winning standards strategy there are well-trained and experienced technologists and marketers who have mastered the art and science of standards in industry. Most often, these employees have learned the practice of standards at best, from a company mentor or at worst, by trial and error. It can take many years of "on-the-job training" for a professional who is unfamiliar with standards to become fully proficient.

Companies can benefit greatly by employing newly graduated employees who already have education in the area of standards. The savings of costly on-the-job training and prevention of even more costly blunders can be tangible. For the graduates, industrial job opportunities can improve with standards knowledge as part of their educational portfolio.

In industry, standards are employed in two fashions. The first – and arguably, the easier – is in product development. Technologists must be able to invent new products that are compliant to standards which enable them to be safe, efficient, and interoperable with other products. Marketers must be able to demonstrate the increased value of the products because of their standards compliance. Business strategists must be able to leverage existing standards to enter markets, capitalizing on work performed by others, including (and especially) competitors.

The second way standards are used in industry is through developing the standards themselves. Creating standards is a complex and often thorny undertaking. Employees uneducated in standards-setting may think it is a purely technical task. However, this is but a small element of developing standards in industry. There are several additional and crucial aspects including legal, process, governmental, organizational, political, business, and even personal relationships. If a person isn't aware of all of these aspects, he or she can make mistakes in standards development that can have serious consequences, both for their company and for their own reputation. Companies almost always indemnify their employees, but a costly error in standards-setting will not bode well for career advancement. There are famous – or rather, infamous – legal cases of individuals participating in standards committees and putting their company's patents at risk. Patents, trade secrets, and other intellectual property are extremely valuable to an enterprise, and losing rights to them can seriously harm a business.

In both of these aspects of standards in industry, laying a foundation of formal standards education can better equip a person to enter the standards-setting process and contribute to the strategic direction of their company.

There are three typical views of standards taken by companies. The most advanced companies view standards as having strategic value to the success of their businesses. These companies assign highly-qualified, experienced professionals to determine and execute their standards strategies. They usually place both technically-advanced and market-savvy people into the standards process to ensure success in all aspects of standardization. Employees with formal standards education can be "fast-tracked" into these strategic positions within the company.

Companies less versed in the strategic value of standards will tolerate standards activities as a necessary evil. They may choose to assign less-valued employees to sit on standards committees and monitor their progress, lest the company be caught by surprise. An employee in this position who has formal standards training can leverage his or her knowledge to bring an unexpected and positive return on investment to their company. Generating a positive ROI for a company usually means the employee responsible for it becomes more valuable, and this can translate into better performance reviews and rewards.

Lastly, some companies will shun standards activities altogether, thinking that standards activities are a waste of time and money. Employees at these companies who wish to work in the standards arena have to "steal" time in order to participate. They often see personal value in joining standards committees and must do so without using company resources. An employee in this

situation who is formally trained in standards has perhaps the best opportunity of all to make a significant impact on his or her company. Putting the knowledge of standards to work for this type of company could result in a major shift in its thinking and thus, its strategy.

IV. Concluding Comments

While the critical role of standards is generally recognized, surprisingly little has been reported about the critical role of standards education. Not only are standards of critical importance, but standards education is of strategic value to industry and the society.

At the college level there are deep connections between standards education and the ABET's requirements. These connections have not been fully realized by the academic community. Teaching standards is an efficient way to teach engineering design, science and engineering principles; it is also a means to integrate these with economic, environmental, ethical, and societal contexts. Emerging evidence suggests that standards education encourages and supports collaborative work and naturally leads to recognition of the need to engage in lifelong learning.

Japanese Standards Association

Do Standards Education Programs Have A Strategic Value?

Bunro Shiozawa[33]

My short answer to this question is YES, but with a number of reservations.

What do you mean by saying "standards"?

The first reservation concerns about the scope of the "standards." Standards in general sense could mean not only de-jure standards but also de-facto standards. As de-facto standards are not standards as they are so named, we may say that we should forget about de-facto standards in standards education programs, although I do not know if this is a right assumption. At any event, I will get back to this point later.

If we talk about de-jure standards strictly following the definition of "standards" of the WTO Agreement on Technical Barriers to Trade (hereinafter, referred to as WTO/TBT Agreement), what we have to take up as issues to be taught in standards education may be limited to the issues related to ISO, IEC or ITU. But, even in such rather narrow discussion framework, some Standard

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Developing Organizations, such as ASTM International, IEEE, ASME, API, and SAE may raise serious doubt about this view.

In addition, "technical regulations" are distinguished from the "standards" in the WTO/TBT Agreement; however, we should not forget the fact that "technical regulations" in general can be conceptually included in de-jure standards[34]. Moreover, conceptual and actual technical works required in developing and compiling both "technical regulations" and de-jure standards are practically not different. Furthermore, those "technical regulations" are often playing far more important roles than "standards," depending on areas of technology. For example, when I engaged in the management of health, safety and environmental risk aspects of chemicals, standard developing activities conducted in OECD, WHO, etc were far more important than those in ISO/IEC. The same applies in many other technology areas, for example, automobile technology – UN/ECE; aviations – ICAO; maritime transportations – IMO; food safety – WHO and FAO, to mention only a few. Thus, depending on areas of technology, matters related to de-jure standards should be taught in standards education would vary.

Therefore, if we are to provide standard education, we have to recognize that taking up only standardization activities conducted in ISO/IEC/ITU would not be sufficient, and we should tell students or trainees that these ISO/IEC/ITU standards are only a part of de-jure standards and need to show a map of various de-jure standards (including "technical regulations") which cover different parts of technology area.

Strategy; in what sense and in which technology area?

But if we are to teach strategy or strategic value associated with the issue of standards in order to attract attention of corporate executives like CTOs, we may not be able to avoid talking about de-facto standards in many technology areas. Although de-facto standards are not standards, it is critically important for CTOs to understand that not only de-jure but de-facto standards will play critical roles in market strategy in some technology area.

This is particularly the case in information technology. Rather, someone might say that a role of de-facto standards would be far more important than that of de-jure standards in this area. Furthermore, CTOs would require having good knowledge on roles and functions of forum standards and patent-pool agreements, as well.

Therefore, it is critically important to clearly define a scope, goal and technology area of a standard education program in designing its contents and curriculum. And if we are to attract CTOs' interest in standards education, and if we are to talk about market strategy using standards as its tool, the standards education program would need to include issues related to de-facto standards in it, and this would put us in a situation where we need to teach issues far beyond those relating to de-jure standards. Thus, again, issues relating to ISO/IEC/ITU will become only a tiny part of the curriculum.

[34] In fact, definition of "standards" in the ISO/IEC Guide 2 includes "technical regulations" as well as "standards." See Explanatory Note regarding the definition of standard in Annex 1of the WTO Agreement on Technical Barriers to Trade.

What did you intend in considering strengthening of standards education?

Having made discussions above, we have to ask ourselves here again why we have thought that standards education needs to be strengthened.

What we originally aimed at in strengthening of standards education must be to disseminate understanding on the important roles of de-jure voluntary standards (i.e. "standards"), which provide infrastructure of technological development and international trade, by harmonizing terminologies and test methods, by maintaining interchangeability and interoperability of products and interfaces, and by increasing understanding of consumers on performance or specifications of products. We must also have wanted to teach validity and value of bottom-up collaborative activities of engineers to develop such infrastructure as an international pubic asset. Moreover, we must have thought that we need to train and increase engineers or students who will engage in such valuable international collaborative endeavors. For this purpose, it would be sufficient to include issues related to ISO/IEC/ITU standards in a standards education curriculum[35], although the matter of how we deal with issues related to SDO standards still remains unsettled.

Of course, when dealing only with issues relating to de-jure voluntary standards, one could still talk about "strategy" in relation to international standardization activities to develop ISO/IEC/ITU standards. However, if we are meant to say that "strategy" is to manage any affair well for his/her benefit, we have to recognize the fact that he/she should not and can not always employ such "strategy" in order to gain quick harvest only for his/her benefit in such activity. International standardization activity being taken place in ISO/IEC/ITU is basically multi-lateral collaborative endeavor to develop international infrastructure for technological development and international trade as our common asset. So, if he/she lost other participants confidence in his/her credibility and reliability by engaging in such selfish "strategy," he/she will never be able to play a key and influential role in it.

Probably the best strategy among others in the international standardization activities in developing voluntary de-jure standards would be to participate in and contribute to the activity in a constant, technologically neutral and fair manner. If this is right, I think that we should not use the word of "strategy" or "strategic value" without very clear clarification on their intended meaning otherwise the word of "strategy" could imply many things and confuse the discussion as we have seen above.

What has a value to be taught in standards education?

Now, if we are to focus this discussion on the matters related to de-jure voluntary standards in standards education, what has a real value to be taught in the education?

Rules and procedures regarding standardization activities being applied in ISO/IEC/ITU can of course be the matters to be taught. However, is this appropriate topic or material to be taken up as a part of academic education? Isn't teaching such technical and procedural knowledge more suitable

[35] Although "technical regulations" or mandatory standards are included in the notion of de-jure standards, they can be dealt with differently in a standard education program as they are normally developed by top-down processes in closed circles, which are very different from the developing processes of voluntary de-jure standards.

for skill training? Or, isn't the most effective way to train such things be providing opportunity for on-the-job-trainings?

Another approach to teach engineers or students regarding voluntary de-jure standards would be to design an education curriculum for trainees to acquire good technological sense and ability to judge if maturity of the technology would be appropriate to be standardized and standardization at this stage will not stop its further progress, if there is real needs in the society to standardize it, or what kinds, series and system of standards need to be developed if the technology can be standardized, in addition to teaching some facts and knowledge regarding ISO/IEC/ITU. This approach would be more suitable for education in the engineering school or college.

Therefore, types and contents of "standards education" can vary again, depending on kinds and types of schools or institutions where standards education is carried out.

Conclusions

Certainly, standards education programs would be very valid and useful because this subject can provide trainees with important knowledge on standards and useful and practical information on standards development. But we need to have very clear idea and understanding that what kinds, aspects and/or roles of standards, about which technology area, and to what kind of people we would like to teach before designing and developing a scope and framework of standards education program. In addition, I would like to point out that we have to be very careful in using the words of "strategy" or "strategic value" in conjunction with standards education.

McDermott Will & Emery LLP

Brian A. McGill[36]

In law school, law students are offered courses on a wide range of legal topics. Law schools must train thousands of future lawyers whose eventual practices will span a wide range of disciplines utilizing widely divergent skills. While most schools offer legal instruction in areas including administrative law, legislation, and other disciplines related to the making of law itself, little attention is paid to a particularly significant area. That area is the law of voluntary standards development, a field that merits only a passing mention in most law schools. Lawyers, and often their clients, do not fully appreciate that national and international standards affect nearly all product manufacturers in some way. Aside from a reference or two in an antitrust course, at most law schools virtually no mention is made of national or international standards or how they are created. The purpose of this article is to create a basic level of awareness for standards project participants and those who manage national and international standards development projects concerning potential legal issues associated with standards development. For more specific information or advice, participants or project managers should contact their counsel.

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Standards in the World

A lawyer's ignorance of national and international standards is not uncommon and is reflective of the lack of understanding of them by society at large. Voluntary standards have been around for over a century in the United States. One of the oldest standards development organizations, the American Society of Testing and Materials (ASTM), began voluntary standards development in the late 1800s when trying to develop specifications for industrial materials for use in the railroad industry.[37] The first standard promulgated by the American National Standards Institute was the American National Safety Code in 1921 which codified eye and head protection for industrial workers.[38]

In the modern world, much standardization activity takes place in high technology industries such as telecommunications, computer networking, and similar industries. Standards are a natural part of industries where a national or international infrastructure is required for a particular product to function. The national system of railroad tracks provides a historic example, while modern life yields examples like the internet, the global mobile telecommunications infrastructure, wireless networking, and other areas involving multiple manufacturers whose products must be compatible.

Legal Problems Associated with Standards

When clients enter the world of standards for the first time as a result of a new manufacturing venture or a new area of business, they are faced with a number of legal issues. Few lawyers appreciate that a product as simple as a child's yo-yo is manufactured to specifications found in a number of different national and international standards. Clients, regardless of their level of sophistication, often are clueless about the standards process. Even Microsoft, a formidable and sophisticated competitor, has admitted to its lack of expertise in the area. Stuart McKee, Microsoft national technology officer, commented earlier this year on the standard setting process in the International Organization for Standardization (ISO).

> We found ourselves so far down the path of the standardization process with no knowledge. We don't have a standards office. We didn't have a standards department in the company…I think the one thing that we would acknowledge and that we were frustrated with is that, by the time we realized what was going on and the competitive environment that was underway, we were late and there was a lot of catch-up.[39]

Mr. McKee was not discussing the early days of Microsoft, but rather the involvement of his company in the ISO process developing the OOXML standard in 2006 and 2007. Microsoft's experience provides a warning to lesser-experienced companies trying to understand the complexity of the standard setting systems that have developed around the world.

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[37] http://www.astm.org/HISTORY/hist_chapter1.html

[38] http://publicaa.ansi.org/sites/apdl/Documents/News%20and%20Publications/Speeches/Voluntary%20Saftey%20Standards%20%20.pdf

[39] http://news.zdnet.co.uk/software/0,1000000121,39437722,00.htm

Voluntary Does Not Mean Voluntary?

Lawyers and clients may ask why standards are so important. First and foremost, many standards are not voluntary and end up codified in law or regulations such as the numerous standards that are part of the OSHA regulations governing workplace safety. Although many standards have been part of U.S. regulations for decades, the area of law is far from hardly static. One recent example is the Childrens' Gasoline Burn Prevention Act, passed in July 2008, which codified the requirements of the ASTM F2517 standard for gasoline cans.[40] This Act requires gasoline cans sold in the U.S. after January, 2009 to comply with ASTM's requirements.

Another recent example proved to be particularly newsworthy in 2008. In the Consumer Product Safety Improvement Act[41], Congress codified a voluntary standard for toys. The legislation was passed in response to concerns about lead content in imported toys and the large number of recalls that had occurred in the toy industry. The law made ASTM International Standard F963-07 Consumer Safety Specifications for Toy Safety a federal safety standard subject to enforcement by the Consumer Product Safety Commission (CPSC).

A toy standard may seem relatively simple compared to the standards necessary in the high tech worlds of networking and telecommunications equipment. However, the latest version of the ASTM toy standard provides specifications for such seemingly obscure topics as appropriate sound levels for sound producing toys, specifications for self-retracting pull cords, and even the appropriate sizes of balls used in toys for various age groups. In addition, the toy standard incorporates twenty-three other standards including standards promulgated by ASTM, ISO, the International Electrotechnical Commission, and the American National Standards Institute. These standards range from a standard for Test Methods for Vibration Testing of Shipping Containers to a Specification for Volatile – Nitrosamine Levels in Rubber Nipples on Pacifiers. An understanding of which of these standards apply to a particular toy product and how they affect that product is now essential to anyone manufacturing toys. While some may argue that this complexity is emblematic of an overregulated society, work on this particular standard began over twenty years ago and resulted in several prior versions that were periodically reviewed, revised, and reissued.

Yet, the Consumer Product Safety Improvement Act does not simply codify a standard. It also sets up a testing regime to ensure that toys meet that standard. A client manufacturing or importing toys cannot sell the toys until they have been certified as meeting these standards by a third party.[42] No covered children's product or toy can be manufactured or imported into the United States without a certification mark.

Obviously, there are thousands of standards that are not part of any law and simply exist as purely voluntary standards. Yet the manufacturer of products who chooses not to meet a standard is not immune from legal problems. Product liability lawsuits are often based on the theory that a manufacturer put into commerce a defective product that posed an unreasonable risk to consumers. While state laws differ on product liability, one of the key pieces of evidence is frequently whether or not the manufacturer complied with the applicable standards in place at the time of manufacture. Manufacturers that do not follow the applicable standards may leave themselves open to the

[40] The Children's Gasoline Burn Prevention Act of 2008, Pub. L. No. 110-278, 122 Stat. 2602, (2008).
[41] H.R. 4040 Enr. As of this writing in August, 2008, the Act had passed both the Senate and House and was expected to be signed into law by President Bush.
[42] H.R. 4040, Sec. 102.

common argument that they wanted to cut costs and should be required to pay significant punitive damages.

The Process of Setting Standards

An attorney with a client that would like to participate in the development of standards faces an area of law that is even more complicated. As an initial matter, a manufacturer may not be allowed to immediately join a standards setting committee. Typically, standards committees must have a balanced membership with a certain percentage of members from industry, a certain percentage from government, a percentage from public interest organizations, etc. If the manufacturer's membership would upset the balance, then the committee may not allow it to become a full voting member of the committee at that time.

Second, as a member of a standards setting committee, the manufacturer is taking on an entirely new area of responsibility. If the standards development body overlooked (or worse, chose to ignore) a significant defect or problem, lawsuits against the committee or even individual committee members who were involved in the decision making process to set that standard could follow. In one noteworthy case, a Washington court held the National Spa and Pool Institute (NSPI), developer of safety standards for swimming pools, liable in 1998 for damages for injuries suffered in a swimming pool. The plaintiff in the case broke his neck while diving in a pool and the jury awarded him 6.6 million dollars because of NSPI's promulgation of a diving board standard that was deemed inadequately protective.[43] This case illustrates the perils of the standardization process.

Intellectual property and competitive market issues

In a typical standards developing body, technical experts from different companies, governmental agencies, and public interest organizations discuss weighty technical matters relating to certain specifications. While the standards under discussion may well advance the common good by improving the safety of a product or adopting a superior technology, competitive pressures are never far from the discussion.

One would have to be hopelessly naïve to believe that differences in individual manufacturing capabilities and strategies do not influence the standards development process. One manufacturer may well have a competitive advantage in one type of material and vociferously argue that it provides a much safer product than another. If it can demonstrate that its product is preferable to the alternatives, albeit marginally, what should a standards committee do? Should it give a clear market advantage to one company? Should it endorse the marginally safer product even if it shuts certain competitors out of the market? In the case of safety standards, should the committee balance safety issues with competitive ones, or does that portend a future lawsuit?

The competitive pressures most often present in modern standards negotiations involve patents held by one or more participants. When a particular manufacturer holds a patent on a particular type of technology, most standards organizations require disclosure of that patent. If a standard requires the use of a certain type of patented technology, the organization may not endorse that standard unless the patent holders agree to license their intellectual property on "fair, reasonable and non-discriminatory" terms.

[43] *Meneely v. Smith*, 101 Wash. App. 845 (Ct. App. Wa. 2000)

The multi-year saga of Rambus and its participation in the standards activities of the Joint Electron Devices Engineering Council (JEDEC) illustrates the problems. Rambus was a member of JEDEC, a semiconductor standards development organization, during that organization's consideration of dynamic random access computer memory (DRAM) standards. JEDEC required its members to disclose patents relating to standards work and required members whose technology was used in standards to license the data on fair, reasonable, and non-discriminatory (FRAND) terms. Rambus disclosed its basic DRAM patent to committee members in the early 1990s, but said nothing about its then-pending patent applications. While participating in the standards activity, Rambus revised its pending patent applications to reflect the ongoing development of the standards. It then withdrew from the JEDEC committee in 1996, before the standards under development were finalized. In 2000, the committee adopted standards that arguably infringed Rambus' newly acquired patents. At that point, Rambus attempted to license the technology.

Then the litigation began. Rambus sued Infineon Technologies for infringement of its patent in August 2000. Infineon countered that Rambus had committed fraud. Infineon won damages and costs of $7 million at the trial court level, but Rambus prevailed on appeal saying that the disclosure rules were unclear. Then, in 2002, the U.S. Federal Trade Commission (FTC) filed an administrative complaint against Rambus alleging anti-competitive behavior. In 2004, an administrative law judge ruled that Rambus' activities did not amount to anticompetitive activity. Two years later, the FTC overruled that decision, holding that Rambus had unlawfully monopolized markets and had distorted industry standards through its deceptive conduct.

This past April, the United States Circuit Court for the District of Columbia overturned the FTC's ruling that Rambus violated U.S. antitrust laws by failing to fully disclose its patent interests.[44] The Court held that although Rambus engaged in deceptive conduct by not disclosing its patents, it did not obtain or maintain a monopoly by doing so. The Court held that the standards committee would have standardized Rambus' technologies even if it had disclosed its intellectual property. Rambus' failure to disclose allowed it to demand higher royalties, but did not injure competition. Yet, the litigation is still not over as the FTC is seeking a rehearing of that case now. Meanwhile standards organizations are left trying to define their patent disclosure policies to avoid the type of behavior that Rambus engaged in.

Even if all the participants in a standards development organization are fully forthcoming with respect to their patents, finding appropriate levels of compensation for the patent holder is extremely difficult. JEDEC's policy requiring licensing of technology at FRAND terms is the common agreement for appropriate compensation, but these terms are extremely difficult to define. A patent in a particular case may be extremely valuable if a standard adopts its technology and may be worthless if the standard adopts a different technology. For years, Nokia and Qualcomm litigated would be the amount of royalties appropriate in FRAND terms with respect to patents on mobile telephone networks. In July, 2008, after years of litigating, the parties settled for undisclosed sums. Given the settlement, the definition of FRAND terms remains vague under U.S. law. Meanwhile, the European Commission is presently investigating allegations that Qualcomm breached European competition law by failing to license its technology on FRAND terms. This area is likely to be litigated in a number of different courts and bodies for years to come.

[44] *Rambus v. FTC*, 522 F.3d 456 (D.C. Cir. 2008).

Conclusion

Participation in international standardization requires multidisciplinary skills and experience. Because legal issues may develop during the course of a standardization project, participants should have a basic level of awareness to recognize such issues. Many standards development organizations provide briefings to participants to create a basic level of awareness concerning potential legal issues. Given the growing complexity of a world dominated by the emergence of new technologies and a significant increase in international trade, international standardization participants should have a basic level of awareness concerning potential legal issues as part of their multidisciplinary skills.

U.S. National Institute of Standards and Technology

The Strategic Value of Standards Education

Erik Puskar[45]

The U.S. Department of Commerce, National Institute of Standards & Technology (NIST), has identified standards as being of strategic importance to competitiveness in global markets. As noted in the Invitation to Comment, it has been estimated that standards issues have an impact on 80 percent of world commodity trade. Because the visibility of standards and their role in economic growth, trade and competitiveness has increased significantly in the past decade, education about standardization is also emerging as a strategic priority for many stakeholders around the world – businesses, universities, standards developing organizations and governments alike.

Many have postulated that there is a linkage between standards and economic growth. A growing number of macro economic studies have confirmed this linkage. Jungmittag et. al. first studied this linkage in Germany. They found that standards were responsible for a significant proportion of the growth in output of the German business sector between 1960 and 1990. This study was followed by a U.K. study for the British Standards Institute. That study found that British standards contributed significantly to growth in the U.K. between 1948 and 2002. More recent studies in Australia and Canada have also noted this correlation between standards and economic growth. While standards have had a mostly positive impact on trade, standards may also be designed to create technical barriers to trade. Additional studies are underway to better understand and quantify the impact of specific standards. Such studies are continuing to note a mostly positive relationship between economic growth and standards. NIST has been one of those studying this issue, specifically working to identify the economic impact of a number of documentary standards development efforts supported by its laboratories.

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In addition to the link between standards and economic growth, there are a range of other factors to consider in assessing the growing strategic importance of standards. These include: the increasing role in the economy of Information and Communications Technology (ICT) – a set of technologies that are dependent on standardization for broad deployment; the further globalization of trade; the increasing need to provide confidence to customers in the form of conformity assessments (which are designed to demonstrate conformance to requirements contained in standards); and the growing focus on quality and environmental issues (ISO 9000 and 14000 series, respectively).[46] Heightened national awareness of the importance of standards activities has also been reflected by U.S. enactment of the National Technology Transfer and Advancement Act of 1995[47] and recommendations presented in the National Research Council's report "Standards, Conformity Assessment, and Trade into the 21st Century."[48] This body of evidence has convinced industry, academia and governments of the strategic importance of standards - hence the development of many comprehensive standards education programs in the United States and around the world.

What is the U.S. Government (USG) doing in the area of standards education? The National Technology Transfer and Advancement Act of 1995 directs Federal agencies to use voluntary consensus standards to carry out policy objectives or activities determined by the agencies and departments, except where impracticable. This Act also directs NIST to coordinate Federal, State and local technical standards and conformity assessment activities with those of the private sector in order to reduce duplication and complexity. Individual agencies have standards education programs for their own staff, notably the Departments of Defense and Commerce. One component of the NIST plan for implementing its NTTAA responsibilities involves working with agency standards executives to educate agency staff about their roles and responsibilities.

In its efforts to promote standards usage by federal agencies and standards education in general, the Department of Commerce has identified the need for Federal agencies to:

1. Partner with colleges/universities on the research and development (R&D)aspects of new technologies to be able to influence the content of standards at the earliest stages of their development, and
2. Expand the inclusion of standards curricula in engineering and business schools through partnerships with organizations such as the Accreditation Board for Engineering and Technology (ABET), American National Standards Institute (ANSI), National Science Foundation (NSF), engineering societies, and trade associations. [49]

Recognizing the importance of understanding how standards impact trade, one of the goals within NIST's international engagement strategy is to provide education and training on standards to increase competitiveness and market access. NIST's Standards Services Division (SSD) provides policy and planning guidance for these training programs, as well as ad hoc support for other educational efforts, such as those described below:

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[46] Hesser et. al., *Standardization in Companies and Markets* (October 2007, pp. 7-8)
[47] Public Law 104-113 (March 7, 1996)
[48] National Academy Press (1995)
[49] *Standards & Competitiveness: Coordinating for Results*, U.S. Department of Commerce (2004)

- The 3rd annual workshop for the International Cooperation on Education about Standardization (ICES) was hosted by NIST in February 2008. This brought together 70 standards professionals from all over the world to discuss and share experiences on education about standardization.
- NIST is an organizational member of ICES, with several individual members as well. SSD staff have been involved with ICES since 2007.
- NIST is actively involved in the ANSI Committee on Education (COE). The most recent COE meeting was held at NIST in conjunction with the ICES workshop.
- NIST provides support for education about standardization by providing content for course development, as well as guest instructors on request.
- NIST's Standards-In-Trade Program provides timely information to foreign standards officials on U.S. practices in standards and conformity assessment, with an educational aspect for all attendees.
- The Interagency Committee on Standards Policy (ICSP), which is chaired by NIST, seeks to promote effective and consistent standards policies throughout the U.S. Government; fosters cooperation in standards activities among government, industry, and other private organizations; and provides an opportunity for information exchange and learning among USG standards officials. ICSP officials participated in the most recent ICES workshop.
- NIST is committed to support and promote other educational undertakings as needed. As an example, the Institute would like to engage stakeholders in a broad discussion of the concept of developing a counterpart to the European Academy for Standardization (EURAS) in the Americas as a forum to promote standardization research. EURAS, an organizational member of ICES, currently has no counterpart outside of Europe.

The role of ICES is worth describing in more detail. The organization's goal is to provide a forum for organizational members to work together to promote education about standardization and improve the quality and attractiveness of the standards curriculum for all stakeholders. The ICES 2008 Workshop also identified a number of specific goals, including the need for:

- a one-stop location or portal for educational options related to standards;
- a recognized certification program;
- increased outreach and cooperation with universities;
- continued education of industry about the value of standards;
- identifying and differentiating among target groups; and
- a potential framework for standards education to serve as a guide for moving forward in a cooperative and coordinated manner.

To facilitate the accomplishment of these goals, a leadership team has been elected, and the ICES membership will meet at least annually. The next meeting will be hosted by METI/JISC in Tokyo. ICES, as well as other organizations represented at the 2008 Workshop, intend to develop a listing of case studies and lecture materials that will be useful in supporting this effort. They will also be attempting to document the experience of professionals who have been involved in the standards arena.[50]

In summary, effective and well-written standards can make a significant contribution to promoting open markets and level playing fields for U.S. industry. NIST believes that better

[50] Standards Engineering, *Report on ICES 2008* (March/April 2008)

standards education will be critical for the health of the documentary standards and conformity assessment system.

University of Colorado (Boulder)

Creating a Strategic Standards Course[51]

Ken Krechmer[52]

The problem with teaching isology today

There are basic rules that systematize the discipline of standards. If this is true the study of standards is a science and may be termed *isology* - the science of standards. The current focus of most standards and standardization education is on standardization, the process of creating, implementing or using a standard, usually with examples of different standardization processes. Such courses do not offer the student a theoretical basis to understand standards or standardization. A "standard" is an established reference which may be studied as a concept or a realization. Studying standards as a concept and its impact on standardization is largely an academic endeavor, while the actual processes of creating, implementating or using standards requires mostly practical skills.

While learning about standardization is desirable, as it offers insight into the importance of standards in every technical and commercial field, this short paper argues that academic courses would be more useful teaching the theoretical rules that underlie standards and use specific standardization examples to demonstrate that the rules function as proposed.

The possible effects of standards are very broad and include expanded communications, increased quality and decreased cost (for the manufacturer, service provider and consumer), increased trade (local, regional and international), increased uniformity, new markets (innovation or location), information dispersion, market control and regulation. The widespread use of standards increases compatibility, interchangeability, interoperation and usability. Some describe standards as limiting innovation and others describe standards as enhancing innovation. In micro-economics literature, the impacts of different standards have been identified as coordination, scaling and learning, network, and gateway effects (Arthur, 1988). Each of these different effects may have significant ramifications on society. And these effects increase as technology becomes more critical to society. Trying to comprehend such a broad range of effects without an effective model of the

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[51] A more extensive version of these ideas was published as Teaching Standards to Engineers, Ken Krechmer, *International Journal of IT Standards and Standardization Research* Vol 5 No. 2, p. 17-26, Idea Group Publishing, Hersey, (July - December, 2007).

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causes is not realistic. This is major reason for the low interest in existing standardization courses; they do not offer a way to understand standards.

Teaching standards: current Status

Rigorous theory that applies to all standards and every standardization process exists. Recognizing that every standardization process can be seen as anticipatory, participatory or responsive relative to the appearance of products and services is just beginning to be supported in the literature (Bartlett, 1986). The idea that standards can be seen as a series of successions over recorded history with each succession having a different form of economic impact is emerging (Krechmer, 2006). Recognizing that the concept of a standard can be defined in mathematical terms is new (Krechmer, 2005). These theories need to be evaluated, evolved and taught. Currently, the lack of accepted models and rules that offer insight into the field seriously diminishes the value of academic training in the discipline. Isology "will never truly establish itself as an academic discipline in its own right until those that profess the subject demonstrate that it is capable of developing, and has developed, its own theoretical foundations" (de Vries, 2002).

The lack of agreement on the models and rules underlying standards and standardization has many ramifications:

- Definitions of the terms standard and standardization are not agreed or rigorous.
- Reference standards, metrology standards, manufacturing standards, and Information and Communications Technology (ICT) standards are not linked together as a unified discipline.
- The relationship between economic theory and standards theory is not developed.
- The necessity of a priori agreements, which may be standards, for any communications is not widely understood.
- There is no broadly accepted theory explaining the layered nature of standards.

The lack of basic definitions, rules and models is a major reason that:

- There is no text book addressing all the different standards including reference, metrology, manufacturing, and ICT which introduces a unifying theory, develops common rules and models, offers examples of how the theory applies to all different standards and provides problem sets for the student.
- Standards concepts are often not included in the other disciplines they strongly impact including: business, strategic management, engineering, science, micro-economics, patent law, history of technology, public policy and social sciences.
- There is no succinct understanding of the importance of standards and standardization in the general population.

The Process of standardization: CONCERNS

Hayek (1973) notes that established references may occur by accident, assumption, convention, committee or fiat. When committees create established references it is termed standardization. The give and take of standardization under the procedures of a specific committee is a practical art learned by reviewing the committee's training materials or attending meetings.

Standardization is the selection part of a system which creates variations and makes selections - just like an evolutionary system. Evolutionary systems function to increase the likelihood of survival by minimizing risk, not by reducing the total energy used. In the standardization process different standards proposals are often combined into a final standard so that each proposal "survives," which is not always energy efficient but may be standardization efficient.

Currently engineers are trained to create energy efficient designs, not minimize risk. Minimizing risk requires a very different approach from creating efficient designs. Teaching engineers the need to balance these different goals is an important task of isology education - important enough that students are likely to recognize the need to learn it.

Balancing the multiple interests represented in a standardization committee requires some form of fair standardization. Each standardization participant must find their interest acceptably represented before they can agree to a new standard. In this light, the concept of the "best" standard does not really exist. Standardizing two or more ways to achieve the same result (where the standard is imbedded in a programmable micro-computer), while less energy efficient, may minimize both short term risk (meaning that the standard is more likely to be completed) and long term risk (meaning that two or more ways to achieve the same result provides options should one way turn out to be less desirable in the future, e.g., due to higher royalties). Determining how to balance multi-party interests and single standard efficiency is often the most difficult task in a standardization process. Existing standardization courses do not address this issue.

An example of the need to balance efficiency and interest is a “standards war,” when two different technical approaches to a standard vie to be defined in the standard. Standards wars usually occur when the different technical approaches represent economic value to different organizations or groups of organizations. The public does not care about who wins a standards war. The public only cares about receiving the product or service that a needed standard helps define (Shapiro, 1999).

Inherent in a standards war, a single standard is considered the goal to reduce inefficiency and cost. However computers (e.g., in cell phones or PCs) are changeable and therefore allow multiple choices. One example is support for both the Mozilla and Microsoft Internet Explorer browsers in a single personal computer. Where it is economically practical to support multiple implementations of the same function, when a standardization organization deadlocks over the technical approaches or when different nations (or groups of nations) wish different implementations, the choice should be to include all the economically acceptable variations. Such a choice eliminates standards wars.

Successful standardization entails a recognition that the “best” may be what is politically possible rather than what is technically most efficient. In standardization today the idea of "the politically possible" is fraught with negative connotations. It is more productive to understand it as the solution that provides the lowest risk to the largest number of participants.

Teaching standards: PROPOSAL

Some standardization courses are fragmented by attempts to address three real, but separate, needs in a single course:

1. Teaching a non-technical audience the importance of standards. Attendance demonstrates that teaching a non-technical audience the importance of standards is often unsuccessful. Non-technical students usually do not see a need to learn about standards. As technical students become increasingly interested in isology other students will recognize the value in understanding the discipline.
2. Teaching technical students what they need to know about standards in their field. This requires a technical course. Such courses currently seem to be the most successful. Serious technical students are often not interested in non-technical courses.
3. Teaching the policy and procedures of individual standardization committees. This is only valuable to people who are planning to attend specific standardization committees in the near future.

Teaching technical students about isology should occur in two phases. First, an introduction to the subject should be a part of existing technical courses. The largest problem of isology education is the paucity of discussion of the general field in secondary and undergraduate technical courses. Few physics courses emphasize the importance of standards for mass, time and space to the understanding and use of all physical phenomena. Trade and technical courses often do not address the importance of specific standards in each trade or technology. Standards are perceived much like air, necessary but not noticed, in technical education today. It is in such trade and technical classes that a recognition of standards and their impact on modern society must be first presented.

Second, with an introduction to isology in existing technical courses it is reasonable to expect an increased interest in higher level, specific courses on isology. These higher level specific courses on isology would present the theory of standards in historical, technical, economic, legal and mathematical forms using examples in the practice of standardization to validate the theory. The first people to take the higher level course should be the lower level technical instructors. Only when they understand the importance of standards will their students become interested.

isology: the discipline

Once the theory underlying isology is recognized, the scientific nature of the field becomes clear. Now an area that has been seen mostly as an application, rightfully becomes a discipline of its own. This opens the discipline to new, more rigorous and much needed research as well as attracting students who find the challenge of technical subjects interesting and desirable. As the current researchers understand isology the field will gain a recognized theoretical basis. This basis may then be imparted to educators in the technical fields. When isology is a recognized part of each technical course, the value of studying isology will be clear to many academic students.

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APPENDIX

Strategic Standards Education? - An Invitation to Comment

Invitation

The Center for Global Standards Analysis ("Center") invites all interested parties to comment on the issue – *Do standards education programs have a strategic value?* The term "standards" applies to all products and services. The Center intends to publish a journal reflecting views of interested parties from around the world on this issue. The Center will accept comments on the issue above not to exceed five pages (1,500 words) no later than July 1, 2008. Submit comments to Donald E. Purcell (donpurcell@strategicstandards.com). After reviewing comments for relevance, the Center will publish a journal no later than December 31, 2008, and send a copy to all participants.

Definition of "Strategic"

The term "strategic" is defined to include: "A strategy is a long term plan of action designed to achieve a particular goal, most often "winning". . . . Strategy is about choice, which affects outcomes. Organizations can often survive -- indeed do well -- for periods of time in conditions of relative stability, low environmental turbulence and little competition for resources. Virtually none of these conditions prevail in the modern world for great lengths of time for any organization or sector, public or private. Hence, the rationale for strategic management."[53]

Background

For decades, standards education programs have depended on corporate and/or government education programs. Typically, these education programs are "on-the-job" training ("OJT") programs in which engineers or other technical personnel with little or no standardization experience are selected to participate in standardization programs under the supervision of senior engineers or technical personnel with prior standardization experience. OJT standards education programs continue to be the most widely used standards education programs in the world today.

In recent years, however, several comprehensive standards education programs have been established around the world. For example, consider standards education programs among the following: American National Standards Institute (StandardsLearn.org),[54] APEC Standards Education Project,[55] ASTM International (ASTM International Campus),[56] American Petroleum Institute (API University),[57] China Standards Education Program,[58] European Academy of Standardization Program,[59] German Standards Education Program,[60] Greece Standards Education

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[53] http://en.wikipedia.org/wiki/Strategic
[54] http://www.StandardsLearn.org
[55] NIST International Workshop website: http://ts.nist.gov/Standards/ICES-Workshop-Presentations.cfm
[56] http://www.astm.org/campus
[57] http://www.api.org/meetings/apiu
[58] NIST International Workshop website, *supra*.
[59] NIST International Workshop website, *supra*.
[60] NIST International Workshop website, *supra*.

Program,[61] IEEE,[62] International Electrotechnical Commission (IEC and Academia),[63] International Organization for Standards (International Standardization and Education),[64] Japan's Standards Education Program,[65] National Standards Body of Brazil,[66] Organization of American States,[67] South Korea's Standards Education Program,[68] the Standards Engineering Society,[69] and North American Standards Education Perspectives.[70]

In February 2008, the U.S. National Institute of Standards and Technology hosted an International Workshop to review global standards education programs from around the world.[71] The Workshop was cosponsored by the American National Standards Institute, ASTM International, and the International Cooperation for Education of Standards. The NIST workshop was an excellent opportunity to review the substantial progress in development of global standards education programs in recent years. Interested parties should review the excellent presentations on the NIST website and the ISO Journal *Focus* (November 2007) which is dedicated entirely to standards education programs around the world.[72]

What's going on?

The Center is soliciting views of parties around the world who are interested in global standards education programs in an effort to better understand what is going on. For several years, the Center has believed there is an important relationship between globalization, international standardization and global standards education programs. The Center believes the recent substantial increase in the scope and quality of global standards education programs is evidence of this important relationship, and its growing importance. Consider, for example, the U.S. Congress determined in 2005 that standards, related technical regulations and testing procedures directly affected 80% of world trade in 2003 with an estimated value of $7.3 trillion (US).[73]

Interested parties are therefore invited to share their views to help explain more fully what is going on with the significant growth of global standards education programs worldwide, and whether such programs have a strategic value.

Questions

If anyone has questions on the Center's invitation, please send the questions to Donald E. Purcell at donpurcell@strategicstandards.com.

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61 NIST International Workshop website, *supra*.
62 NIST International Workshop website, *supra.*
63 NIST International Workshop website, *supra.*
64 NIST International Workshop website, *supra.*
65 NIST International Workshop website, *supra*.
66 NIST International Workshop website, *supra.*
67 NIST International Workshop website, *supra*.
68 NIST International Workshop website, *supra.*
69 http://www.ses-standards.org/displaycommon.cfm?an=6
70 NIST International Workshop website, *supra,* (Panel on North American Perspectives).
71 NIST International Workshop website, *supra.*
72 http://www.iso.org/iso/magazines/iso-focus-index/previous_issue/iso-focus_2007/iso-focus_2007-11.htm
73 http://www.gpo.gov/congress/house/house14ch109.html, GPO Access website, Serial No. 13 at page 14.