Standardization: A Failing Paradigm

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ABSTRACT

Standards, like the poor, have always been with us.

Also, like the poor, there have been well-intentioned attempts to create programs that will make them whole (or at least better). The authors present a proposal for one of these programs on the basis of the beliefs that (1) standardization is failing to serve the interests of the sponsoring organizations, the public, the industry, and the nation and (2) the failure of standardization (as a useful management tool) will have complex and far-reaching consequences for all of the participants. The authors primarily consider voluntary standards, namely, standards that do not have regulatory standing. They focus on and draw their sources from the Information and Communications Technology (ICT) industry. Their article is based on experiential data gained from constant and substantial activity within the standards-setting organizations of the ICT industry. Both authors have extensive experience as embedded, empowered, and occasionally neutral *(and, for at least one author, bitter) participants in ICT standardization.*

Introduction

Standardization is basically a management technique used to reduce risk and, since 1980, it has moved from being viewed as a technical discipline to being viewed as a "cool" marketing tool within the Information and Communication Technology (ICT) industry. This statement is probably an overly dramatic assertion of what has happened in the market, but we believe that it is generally defensible given our perspective of the events over the last twenty-five years. We believe that there are numerous proof points (but no rigorous studies) to support this contention.[1] Absent these rigorous studies, and using our experience and knowledge of the ICT industry and

[1] There are very few rigorous studies in the field of practical standardization—the area where the actual standards are created and used by the sponsoring organizations. We have found little rigorous study of the utility of standards in the ICT industry in which simple questions, such as "Are standards beneficial to a company in its product decisions?" or "Is the use of standards increasing or decreasing?" or "Is open source a form of standardization or is it something else?" appear not to have been considered by the academic community.

its standard-setting organizations (SSOs),[2] we briefly examine some of what we believe were the major turning points over the past twenty-five years that have made standardization a marketing handmaiden rather than a technical discipline. Much of this explanation will be based upon material contained in the following section, where the changes in the business environment, which funds a huge majority of voluntary standardization, drove the changes that occurred. We primarily consider voluntary standardization—that is, standards that do not have regulatory standing. The moment a specification becomes required by legislation, it passes out of the voluntary arena and out of the purview of our paper.

While standardization should respond to changing business requirements and needs, we believe that some of these changes—namely the excessive proliferation of specifications and SSOs—are undermining the very value of standards and the markets that they serve. Since standardization is an impure public good (one that is developed by the private sector but that has public benefits), government has an interest in and a responsibility to ensure that the system is effective and responsive to public needs. When the private sector fails to successfully manage an impure public good, as we believe they have in standardization, government may intervene. In this paper, we provide suggestions on how government can help to strengthen the standardization system through minimal intervention. We also discuss how the private sector can build upon this intervention to avoid more extensive government intervention and to reform the standardization system so that it more successfully meets the goals of all involved.

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[2] We use the term *SSO* to designate any organization engaging in standardization activities. It avoids the conflicts between the formalists who insist that only a standards-developing organization (SDO) can develop standards (and all the rest, mere specifications) and the generalists who insist that all generally used specifications, from formal standards to proprietary software in wide use, are, in fact, standards. This distinction has always appeared to us a specious argument, as we have determined that, in fact, 333 standardized specifications can dance on the head of a pin (with apologies to medievalists).

A Brief, but Necessary, History of Standardization

Standardization is an essential element to the growth of the computer industry. Most new ICT industry initiatives center on the concept of interoperability, one of the fundamental goals of ICT standardization (and most standardization, for that matter). There are no more homogeneous islands of computing that marked the late 1980s; today's environment is worldwide, fast paced, and completely heterogeneous. The impact of this changing environment on business, society, and culture cannot be overstated. Just as the common gauge for railroads changed the face of the United States in the last half of the 1800s, the creation and growth of the standards-based digital economy will have a profound effect on the nature and future of life in the United States. More than a decade ago, *The Economist* (1993, 23 February, p. 62) published the following statement in its Survey of Information Technology:

> The noisiest of those competitive battles (between suppliers) will be about standards. The eyes of most sane people tend to glaze over at the very mention of technical standards. But in the computer industry, new standards can be the source of enormous wealth, or the death of corporate empires. With so much at stake, standards arouse violent passions.

This statement, echoed in one form or another in most literature on the subject of standardization, is even more applicable today in the ICT industry. With the advent of the Internet and the World Wide Web, open standards[3] are becoming more and more a part of the *infratechnologies*[4] that "provide the technical basis for industry standards" (Leech et al. 1998, p. ES-8). As Libicki and others (2000, p. xi) of the Rand Corporation note, "[W]ith each passing month, the digital economy grows stronger and more attractive. Much, perhaps most, of this economy rests upon the Internet and its World Wide Web. They, in turn, rest upon information technology standards." This fundamental change in the focus of ICT standardization (from one of

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[3] An *open standard* is one that is not under the control of a single vendor and is easily available to those who need it to make products or services.

[4] *Infratechnologies* is a term the National Institute of Standards and Technology uses to describe a superset of technologies (the technological infrastructure) that "…provide the technical basis for industry standards." Today, Internet and Web infratechnologies serve as the basis of standards upon which e-business, e-commerce, and all of the other "e-" activities are being built.

homogeneous computing to one of interoperable information sharing) has had a significant impact on the way standardization is done.

We now briefly review specifics of how the changes in the ICT standardization process have occurred and provide some history and background on these changes as they relate to the unique aspects of ICT standardization. There are five basic variants of SSOs within the industry: (1) trade associations; (2) formal SDOs;

(3) consortia; (4) alliances;

(5) the open source software movement.

We link trade associations and SDOs because they both belong to the formal school of standards—that is, a standards process that is heavily focused on maintaining due process, openness of participation, and a comprehensive appeals process. We link consortia and alliances because both are collections of like-minded organizations and/or individuals who come together to act as advocates for a particular change. Each of the five variants has a place; there is no single optimal choice for developing standards for the entire industry.

Trade Associations and Standards-Developing Organizations

The process that trade associations and SDOs have created within the United States is a result of legal challenges to their work and is absolutely necessary for the regulatory arena or similar arenas, where there is an implied legitimacy ascribed to a specification labeled as an official standard. Of the five forms of standardization activity, the trade association activity has the place of pride for being the oldest, dating from the late 1800s. Generally, the associations were gatherings of professional men who were experts in a particular field (e.g., boilers, fire prevention, mechanical engineering). They set up these groups to create a professional discipline and to preserve this discipline by creating specifications embodying their wisdom for the sake of their colleagues. Hence, societies like the American Society of Mechanical Engineers, the Institute of Electrical and Electronics Engineers (IEEE), and the American Society for Testing

and Materials (ASTM) came into being. In most cases, the primary mission of these groups was the education of members in their professional discipline, with standards as a secondary activity to fulfill some of the training requirements.[5] These groups were directly responsible for technical practices that could affect public safety, and they needed to ensure that their specifications were correct. Peer review was not only desirable, it was necessary and expected.

In many cases, the specifications developed by the trade organizations have become the basis for codes and statutes and have acquired a regulatory patina that permits them to be used as defense in liability cases. By definition, if you follow the specifications published by the National Fire Protection Code, you are using techniques and practices that have been tested, tried, and proven to be safe. This makes trade associations an excellent source for codifying successful past practices—things that are stable, structured, and time insensitive. In the ICT industry, however, in areas that do not touch upon, for example, safety issues, looking to past practices for future guidance is usually a prescription for failure.[6]

To understand the formal standardization processes of SDOs in the United States, it is necessary to discuss the American National Standards Institute (ANSI). The U.S. government has not created a national standards body, but the formal process for developing standards in the United States is created, maintained, and administered by ANSI,[7] which is the "first among equals," the rule setter, the interface to the International Organization for Standardization (ISO)

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[5] The ASTM seems to have completely morphed into a standardization organization, and, while it maintains a yellow-page listing of consultants and expert witnesses, it does not seem to be educating testing experts. The mission statement of the ASTM (see http://www.astm.org/NEWS/Mission2.html). reads, "To be the foremost developer and provider of voluntary consensus standards, related technical information, and services having internationally recognized quality and applicability…" With a complete yearly set of ASTM standards costing nearly $7000, and with ASTM standards being cited in legislation, one can understand why the ASTM has moved entirely to standardization activities.

[6] It is necessary to note that the regulatory use of standardization has another and darker side. In two Supreme Court cases, *American Society of Mechanical Engineers v. Hydrolevel* (1982) and in *Allied Tube and Conduit v. Indian Head* (1988), the standards bodies were found to have abused their ability to affect the market. While the cases varied with respect to details, the economic power of the organization was cited as a major point of contention. In both cases, there were process violations on the part of the organization.

[7] The concept of sectorial approach in standardization is presented in ANSI's (2000) *National Standards Strategy for the United States,* Section V (http://www.ansi.org/public/nss.html).

and the International Electrotechnical Commission (IEC), and currently the only organization that can give the imprimatur of an American National Standard to the specifications produced by most U.S. standards organizations.

The formal national bodies under the auspices of ANSI in the United States and the international bodies under the ISO and the IEC are referred to as SDOs. More than 170 organizations have sought ANSI accreditation. In fact, ANSI is the primary stakeholder for the United States for all formal organizations (national or international) that currently are the primary providers of specifications used in procurement in the United States. Nevertheless, ANSI does not create standards. It has no expertise in the subject matter of standards; it has expertise only in the maintenance of its process. (For more on ANSI, please see the Appendix.)

In the Information Technology (IT) field, the initial standardization organizations were those that operated under ANSI's rules and organizational constricts; and these standardization organizations followed in the footsteps of all the other industrial standardization activities in the United States. We use the term *IT* deliberately here (and subsequently), as the IT industry and the Communications industry, in fact, did not begin to merge until the late 1980s—a period after ANSI's hegemony in IT standardization had begun to fail. For the Communications industry, the International Telecommunications Union (ITU) was the dominant player, and the ITU was not associated with the voluntary standardization processes of either ANSI or the ISO.

During this initial period of standardization, much of the fundamental hardware standardization activities were occurring—from common interconnections for the keyboard and mouse to printers and storage systems within the IT industry.[8] The negotiations that created these

[8] A significant difference between the IT sector and other sectors is that within the IT industry, we are, in the main, speaking of voluntary market-driven standards, which are left to the discretion of the provider to supply. It is important to note that the majority of unique IT sector standards are interface standards describing a particular systems interface. They do *not* deal with safety or environmental activities. They are optional in a product—depending upon the business model of the vendor. Standards of this type are (and will continue to be) one of the costs of doing business, just as is translation of instruction manuals into a native language.

standards—which were complex and confined to a relative handful of providers—were usually under the aegis of one or two standardization committees in the United States.[9] They usually dealt with things that would stay standardized for a long time.

In contrast to European nations at this time, the United States chose to encourage the private sector to enter in standards partnerships. This allowed the trade associations to continue to act as standards associations, while encouraging the formation of new organizations devoted only to standardization—such as the Accredited Standards Committees X3, X9, and X12, each of which deals with IT, Banking, and Electronic Data Interchange (EDI), respectively. (See the Appendix for a more lengthy discussion of the international and national standards developing scene.)

Consortia and Alliances

In the late-1980s, a different form of standardization activity appeared, beginning with an organization called X/Open.[10] Providers began to move technology standardization away from the formal ANSI- and ISO-recognized SDOs to those of consortia, which did not have the intricate processes of the SDOs. Consortia initially were created to deal with the "clarity and time to market" problem that was seen as a major obstacle in the formal arena. Much of the problem in the formal arena lay with its arcane rules for openness and review; several of the formal review process steps required six months and could expand to even more time. The consortia, responding

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[9] The two ANSI-accredited standards committees were Accredited Standards Committee X3, which dealt with IT, and Accredited Organization IEEE, which dealt with computer systems. Approximately 85% of the key standards were created in X3, including storage interconnect, languages, and so on. The IEEE dealt with physical interconnects (such as local area networks) and eventually moved into software interfaces.

[10] In 1996, X/Open was merged with the Open Software Foundation to create The Open Group. X/Open was originally created in Europe to embrace and extend UNIX ® to limit the spread of U.S. companies into the European IT arena. After ten years of existence, and before its merger, X/Open was largely dominated by major American IT providers, with Siemens as its sole surviving European member.

to the pressure of time being money, especially since the product life cycle was shrinking, wanted a faster system.

The processes at consortia were unlike the time-consuming and often Byzantine formal processes that the SDOs needed because "[m]ost delegates represent[ed] personal, professional, national, disciplinary, and industry goals…" (Cargill 1989, p. 117) and managing this vast and sometimes contradictory set of expectations forced the SDOs to create intricate rules to ensure that all voices were heard.

The proponents and opponents of consortia have focused on this speed issue, not realizing that increased speed was achieved in a consortium by changing the process. The argument has never been about speed; it has been about the process required to achieve the speed necessary to satisfy the market needs of the members of the organization.

Because consortia usually consisted of groups of like-minded participants (either for technical or market reasons), they did not need to have the lengthy discussions over the mission and intent of the proposed standardization activity—an organization's presence was, in many cases, proof of a general agreement. These organizations and/or individuals came together to act as advocates for a particular change, whether it is for a new specification, a new way of approaching a problem, or a new research and development activity. Consequently, consortia were also often more visible within a company than were formal organizations, because consortia were directly tied to the product success of a company. In other words, a company joined a consortium to promote the creation of a specification that it needed for market reasons—there was an imperative behind the consortia's creation. The same imperative was not necessarily found in formal organizations.

This shift to consortia was amplified by the introduction and ensuing popularity of the World Wide Web in the early 1990s. The establishment of the World Wide Web Consortium

(W3C)[11] in October 1994 was a turning point within the IT industry; after this date, consortia were the logical place to develop joint specifications, whereas before they had been the alternative place. One of the reasons for this shift was that the IT practitioners who are now leading much of the IT development are part of a generation largely focused on Internet technologies; these practitioners have had little interaction with ANSI and ISO and do not believe the SDOs can develop standards quickly and efficiently. Their world is largely bound by consortia, such as W3C and the IETF. They see little or no need for ANSI or ISO standardization—a message they carry to their companies.[12] With the maturity of the Web, an increasing number of consortia have been created to standardize Web-based technology. (Nearly all specifications that relate to the Web or to the Internet are created in arenas that are either consortia or consortia-like.)

The reason behind using consortia lies not so much in the speed of technical development but rather in the willingness of the consortia to use expedited (and hence, user-responsive) processes. The archetypal consortium is the Internet Engineering Task Force (IETF), the group that manages the Internet. The success of this group in both keeping the Internet a cutting-edge technical architecture leader as well as clear of greed, parochialism, and lethargy is a significant accomplishment.[13] The IETF has been using the Internet to communicate among interested

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[11] See World Wide Web Consortium (1999-2004) at http://www.w3.org/Consortium for a detailed description of both the creation of the underlying vision of the Web by Tim Berners-Lee and the initiation of the W3C by MIT, INRIA, and Keio University.

[12] In the case of HTML 3.2 (a specification developed and promulgated by W3C), ISO/IEC JTC1 SC 18 (the committee charged with standardization of this technology) tried to standardize HTML 3.2 with "JTC1 improvements," but only after W3C had standardized HTML 3.2 and the users had implemented it in millions of Web sites. After serious negotiations by W3C and major users and providers, SC 18 agreed not to make their standard different from the W3C standard, which was in widespread use.

[13] The IETF describes itself in the following way: "The Internet Engineering Task Force (IETF) is a large open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet. It is open to any interested individual. The actual technical work of the IETF is done in its working groups, which are organized by topic into several areas (e.g., routing, transport, security, etc.). Much of the work is handled via mailing lists. The IETF holds meetings three times per year. The IETF working groups are grouped into areas, and managed by Area Directors, or ADs. The ADs are members of the Internet Engineering Steering Group (IESG). Providing architectural oversight is the Internet Architecture Board, (IAB). The IAB also

parties, post specifications, achieve rough consensus on technical features and functions, and then move forward on standardization. The specifications the IETF adopts are usually based on extant practice, with at least two implementations required for specifications on the standards track, and are available for widespread public review and comment.

This practice—using its own technology to permit faster standardization of follow-on technology—is another step that sets the IETF apart from its contemporary organizations of the 1980s. The use of its technologies as a basis for its standardization practices ensures workable specifications that can actually be implemented, but more importantly allows the IETF to develop into a truly international organization. When a specification is complete, it is posted on the IETF Web site with free access for all.

The W3C operates in a similar, though somewhat more formal, manner and is a good model for the operation of many other consortia. These consortia realize that the key elements are speed and specification accessibility—accessibility to those who are concerned about the consortium's work. As *The Economist* (April 4-20, 2001, Special Supplement) has pointed out,

> [T]he Internet has turned out to be a formidable promoter of open standards that actually work, for two reasons. First, the [W]eb is the ideal medium for creating standards; it allows groups to collaborate at almost no cost, and makes the decision-making more transparent. Second, the ubiquitous network ensures that standards spread much faster. Moreover, the Internet has spawned institutions, such as the Internet Engineering Task Force (IETF) and the World Wide Web Consortium (W3C), which have shown that it is possible to develop robust common technical rules.

These features have made the ICT community turn to consortia and similar structures for their standardization needs in both hardware and software. The creation of highly open, highly visible specifications—widespread in their adoption and use—is essential to the continuing evolution of the ICT sector and ICT industry.

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adjudicates appeals when someone complains that the IESG has failed. The IAB and IESG are chartered by the Internet Society (ISOC) for these purposes. The General Area Director also serves as the chair of the IESG and of the IETF, and is an ex-officio member of the IAB" (see http://www.ietf.org).

Another aspect of consortia that separates them from the traditional SDOs is their dependence on the market, rather than on institutions, for relevance. A consortium succeeds or fails by its ability to attract members to accomplish its technical agenda. It receives little or no funding other than what its membership is willing to pay; money received from the government is rare and is usually in return for some exact service that the consortium renders to a specific government agency in the role of a contractor.[14] While this dependence on its members for financing can be seen as a limitation on the consortium's freedom of action, it reflects the state of the market in formal SDOs as well, except that formal SDOs do not shut down if all of the commercially important members (i.e., those who would implement the specification) walk away. There is a delicate balance between an independence that leads to an unused standard and a financial dependency that produces a constrained specification. (For more on consortia and alliances, see the Appendix.) The newest wrinkle in consortia are “Commercial Joint Ventures”, which may be described as “ur-consortia”. They have many of the features of consortia, but have a contractually defined governance body (hence, a joint venture of sponsor companies who usually qualify by paying large membership dues). They usually morph into consortia once the sponsors have achieved their initial specification -product goals.

Open Source Movement

The latest trend in standardization is the open source movement, which shies away from using any formal organization, preferring to create its own analogues of the existing infrastructure. Open Source is the attempt to use the Internet to create better (less buggy) and more open (not proprietary) code in a cooperative environment.

Open source is probably the most expensive type of standardization in which an organization can engage, since participation and use of open source code may require that an

[14] See Spring and Weiss (1995) for a discussion regarding the problems of private sector funding of formal standards organizations.

organization change its fundamental licensing principles with respect to its intellectual property (IP).[15] Open source does not disbelieve in IP rights—it merely makes the rights of the property holder the same as the rights of anyone else. In all of the other organizational types, the contributing organization can choose the terms and conditions of its giving, as long as the terms are reasonable and non-discriminatory. The difference is that with Open source the terms and conditions of the grant are mandated in the particular licensing agreement chosen by the group. This is acceptable to some; to many large organizations (including large academic institutions, the sources of intellectual freedom) it is anathema, since these organizations have patents on nearly every aspect of technology, granted by a forgiving (or forgetting) U.S. Patent Office. This battle, which we do not directly address here, bids fair to completely destroy standardization.

The reason for the allure of Open Source is contained in writings by the philosopher and activist of the Open Source movement—Eric Raymond, in *The Cathedral and the Bazaar* (2002), and Jamie Zawinski (formerly of Netscape, who convinced Netscape's management to make the source for Netscape's browser into open source and call it Mozilla). Linus Torvalds led the creation of the popular Linux Operating System in the same philosophical frame—which is open for all to use without exception or restriction, other than the requirement to act as part of the community. The movement has caught mindshare and market share, and many large corporations are embracing the Linux phenomena, hoping that later they can find the method to profit (for more on Open Source licensing, please see the Appendix).

Evolution Serves as the Business Rationale for Change

The essential element in all of these groups lies in their responses to differing market requirements. Consortia replaced SDOs as a preferred venue because they responded better to the

[15] The most popular types of licenses (Mozilla, General Public License, and Berkeley) do not require the IP owner to give up the IP rights. Rather, these licenses require that the IP owner grant broad, perpetual, and non-restrictive rights to use the IP, in effect making all of the users equal. The broad nature of the grant—in which the IP owner reserves few or no rights—is what has given many the impression that Open Source can be equated with forfeiting IP rights.

needs of business; commercial joint ventures (a variant form of consortia) emerged to compete with the older, larger, multidiscipline consortia, and the open source movement reflected yet another market requirement, the desire for a more cooperative environment with a better and more open code. The need for legislative protection given by the SDO rules was mitigated by the creation of the *National Technology Transfer and Advancement Act of 1995*, which allowed collaborative research and development. The need for speed and ease of creation led to the various forms of consortia (from those described as heavy-weight to those that are very light-weight). The confusion about IPR helped drive the open source movement. Throughout all of this, however, logical evolution served as the business rationale for the creation of various types of organization. This is not the problem, but it is the basis of the problem.

THE PROBLEM

Standardization is economically significant, as we previously noted. The major providers of ICT equipment have realized this and have initiated actions accordingly. When a constituted standardization organization blocks activities, or when it fails to meet necessary[16] expectations, it is the work of a moment to create another consortia, alliance, technical committee, or similar standardization activity that is "more in tune with the expectations of the market," which is a euphemism for an organization that produces specifications that more exactly meet the needs of the creating organization(s). The key item here is that the needs that are being met are not technical needs, but rather are the providers' market-positioning requirements.[17] This, in and of

[16] Egyedi (2001) provides an interesting and factual account of why companies tend to specification shop.
[17] An interesting phenomenon is that there are very few SSOs created by users. The major attempt to create one of which we are aware is the User Alliance for Open Systems, which was created in the late 1980s and was captured by providers within six months of its creation. The capture was effected very simply—the

itself, is not unexpected market behavior, nor is it antithetical to the good of the market. The rationale for standardization activities is based on meeting user requirements, and in many cases, users believe that the products of these organizations serve a purpose.[18] Absent user rejection of a specification produced by any of these organizations, the organizations will continue to produce specifications at the behest of their members, who are almost always major providers with substantial market position.

It is here that the real problem with standardization emerges—at least as practiced in the ICT industry within the United States. The proliferation of specifications, coupled with the lack of understanding about what a standard truly is, has led to an explosion of SSOs. As a result, standardization is failing to serve the interests of the sponsoring organizations, the public, the industry, and the nation. Its failure (as a useful management tool) has complex and far-reaching consequences for all of the participants. We will look at each part of the problem independently, starting with the phenomenal growth of SSOs.

Explosion of SSOs

During the technology boom, SSOs rose in popularity, thriving on both the membership dues of new market entrants—that saw standardization as a way to compete with major ICT companies and the expanding revenues of large ICT companies. These companies could suddenly afford to upgrade their current SSO membership levels while joining additional SSOs and even

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users, who originally wanted to discuss user requirements, were convinced that they had to "talk technology" with the vendors. For the vendors, it was merely a case of "My rules, my cards, my game, my house, and your money." There is no gambler on earth who would pass up those odds. is the gambler the User Alliance if so shouldn't it be who will take those odds? If the gambler is the vendor, then the sentence is correct, but a little confusing.

[18] An interesting discussion can be developed from the concept of "let the buyer beware – because the buyer should know what he is buying." (The second half of this proverb is usually forgotten when it is used.) The problem is that, due to the paucity of education professionally available about standardization, most people have no idea what standardization really is. This then bifurcates the discussion into whether it is the responsibility of the providers to use the term standardization correctly and educate the market or whether it is acceptable for the providers only to pander to the understanding of their users. The problem is probably intractable.

create their own competing SSOs to serve their company's needs better. The SSOs thrived in this new economy, and the standardization market grew and prospered.

When the boom ended, so did the almost unmitigated investments in SSOs. Companies became more strategic in their investments, and those SSOs that did not respond to market needs began to wither. Instead of dying, however, as was the fate of many technology companies unable to compete in the changed market, SSOs that did not have responsive business models continued to limp along. They were bolstered by a few loyal members that chose familiarity over market viability or were propped up by fortunate ownership of industry brands or essential standards. Market mechanisms that culled the weaker businesses in the rest of the ICT industry were dampened in the standardization arena, and many failing SSOs—which should have responded to conditions by revising their business models to meet market demands—continued to operate as usual, struggling for survival by grasping any revenue opportunity regardless of the long-term health of the organization, the ICT industry, or user needs.

Simultaneously, new SSOs arose that purported to meet market needs better, often in direct—and intentional—competition to existing SSOs. While some of these organizations were truly created to fulfill unmet market and user needs, others were developed and substantially supported by ICT vendors that viewed them as an easy mechanism for influencing market development and growth in a more beneficial direction than the existing SSOs could or would offer. In addition, we believe that companies that were in danger of losing market share if *any* standard was successfully developed in a given area started and/or funded SSOs with the sole purpose of producing competing standards and fragmenting the market.

Proliferation of Specifications

Today, we are in a situation in which all of these SSOs produce specifications, and few, if any of them, interoperate with specifications produced by other SSOs. They have lost sight of two

fundamental principles of standardization: (1) the purpose of standardization is to facilitate interoperability, giving users more and better product choices while expanding the overall market for vendors; and (2) the only way to achieve this goal is through cooperation and collaboration with other market players who are often competitors. In essence, we believe SSOs are taking a "do as I say, not as I do" approach, encouraging their members to cooperate to increase the growth and the health of a given market while simultaneously grasping for pieces of the standardization market with little regard for the market's growth or long-term health.

If this unmitigated output of standards, especially competing standards, continues, the market will fragment to the point where interoperability will become impossible. In the past, the ICT industry has responded to changing market conditions by creating new types of SSOs. However, if the standards industry itself undermines interoperability by exceeding the carrying capacity of the market to accommodate not only the number of standards as a whole, but also the number of competing standards, the ICT industry will likely respond by turning to alternative models for cooperation and collaboration. Indeed, this is already starting to happen as is evinced in the rise of commercial joint ventures.

The SSOs and their members are facing the dilemma of "the tragedy of the commons" (Hardin 1968). In the classic example, farmers share a common grazing ground. Each must decide whether he will add another cow to his holdings, increasing his short-term profits while ultimately destroying the pasture due to overuse, or whether to refrain from additional purchases in the hopes that the neighbors will also do the same and the pasture will continue to flourish. In the case of standards, an SSO must decide if it will seize short-term revenue opportunities and possibly push the market past its standards carrying capacity[19]—thus fragmenting the standardization industry and delaying progress in achieving interoperability. The other choice is

[19] The carrying capacity of an industry, nation, or the world to absorb standards at any one time or at what rate has not been established. The authors encourage research in this area and would like to extend special thanks to John Hill for posing this question in the first place.

to work towards a solution in which SSOs operate within the carrying capacity and interoperate with each other to produce standards that improve the overall market. While this growing problem may not yet be readily apparent to many, the trials and tribulations of the Department of Homeland Security in merging disparate systems data can be seen as a leading indicator of problems to come. Henry David Thoreau could pine for his little hand built cabin by Walden Pond and moan for the days of individualism, but a complex, interworking, mutually interdependent, and technologically advanced society needs tightly coupled interoperation to survive and prosper. Things that are actively constructed to either defeat or oppose the necessary interoperation of society lead to one of two possible endings—either chaotic breakdown or a despotic dictatorship, which (despite the best efforts of everyone from Aristotle to Beckett to Moore) is how those who achieve monopoly positions usually end up.

Lack of a Definition

Contributing to the overall problem in standardization is the lack of definition of the term *standard.* It is consistently abused by those who write about it. So, for the purpose of clarity and as a basis for presenting our solution, we define it for the ICT environment in the following way:

> A standard is a technical specification that codifies a set of interfaces which describe the necessary methodology to achieve interoperation between disparate programs. The standard does not say how the interfaces are to be met, only that the interfaces must be open (that is, not proprietary), accessible, and fall within the realm of reality. It would also be nice if the interface recognizes that there are global requirements. This specification is the result of action by an SSO.

A Possible Solution

We believe that the solution to the problem lies within the public, as opposed to the private, sector. This belief is derived from the observation that:

> Other goods, like education and ***standards***, are impure public goods. These combine aspects of both public and private goods.

> Although they serve a private function, there are also public benefits associated with them. Impure public goods may be produced and distributed in the market or collectively through government. ***How they are produced is a societal choice of significant consequence.*** (U.S. Congress 1992, p.14, footnote 23, emphasis added).

The private sector within the United States has largely failed in managing the public good that is standardization. Because of the inability to cooperate, the standards being produced are leading to either chaos or monopoly positioning. Either one, in the long run, is not good for the market in general and the ICT industry in particular.

The intervention necessary by the government is reasonably benign. To begin, the attributes of an SSO are not clearly defined. Currently, any group claiming to be a consortium or an alliance can seek protection under the *National Technology Transfer and Advancement Act of 1995.*

However, in *Circular A119,* the Office of Management Budget (1998, see **http://www.whitehouse.gov/omb/circulars/a119/a119.html#4**) has defined voluntary consensus standards bodies (with respect to procurement of goods and services for the Federal Government) in the following fashion:

> a. For purposes of this policy, “voluntary consensus standards” are standards developed or adopted by voluntary consensus standards bodies, both domestic and international. These standards include provisions requiring that owners of relevant intellectual property have agreed to make that intellectual property available on a non-discriminatory, royalty-free or reasonable royalty basis to all interested parties. For purposes of this Circular, "technical standards that are developed or adopted by voluntary consensus standard bodies" is an equivalent term.
>
> (1) “Voluntary consensus standards” bodies are domestic or international organizations which plan, develop, establish, or coordinate voluntary consensus standards using agreed-upon procedures. For purposes of this Circular, "voluntary, private sector, consensus standards bodies," as cited in Act, is an equivalent term. The Act and the Circular encourage the participation of federal representatives in these bodies to increase the likelihood that the standards they develop will meet both

> public and private sector needs. A voluntary consensus standards body is defined by the following attributes:
>
> (i) Openness.
>
> (ii) Balance of interest.
>
> (iii) Due process.
>
> (iv) An appeals process.
>
> (v) Consensus, which is defined as general agreement, but not necessarily unanimity, and includes a process for attempting to resolve objections by interested parties, as long as all comments have been fairly considered, each objector is advised of the disposition of his or her objection(s) and the reasons why, and the consensus body members are given an opportunity to change their votes after reviewing the comments.

These attributes, of course, are no longer relevant, given the Federal Trade Commission–Rambus hearings. *Openness* is a vacuous term with no legitimacy in a court; defending the concept of *consensus*—as described above—would face serious problems in a hearing. We propose a new set of criteria, which could be written into OMB *Circular A119* that derives its authority from Section 12(d) of Public Law 104-113, the *National Technology Transfer and Advancement Act of 1995*. (By expanding the scope of Public Law 104-113, Congress can define the attributes of a "legitimate" SSO.) The new criteria would be as follows:

1. The SSO must develop technical specifications.
2. The SSO must be some type of legal entity.
3. The SSO must have a well-defined, legally acceptable set of procedures and processes.
4. The SSO must have a clear and legitimate IPR policy that requires, at a minimum, RAND licensing of all IPR included in its specifications.
5. The technical specifications created by the organization must be implemented by two or more competing entities prior to specification release, following widespread, web-based public review of the specification.
6. There should be reference implementations, competing implementations, and test methods to validate conformance as appropriate.

These attributes focus not on the SSO and the process of the SSO, but rather on the production of potentially interoperable specifications. The process (item 3) needs only to preclude the ability of the providers to gather to work mischief (apologies to Adam Smith). The key to this entire definition (and the public good component) lies in item 5, which requires that the output, not the

input, of the SSO be examined. If only one company (due to say, restrictive licensing or technological capability) can implement a standard, then the standard may not really be open, no matter how many people worked on creating it. Item 5 also begins to address the real danger of exceeding the carrying capacity for standards, since standardization output will be tempered by the capacity and willingness of organizations to produce competing implementations. It is hoped that this item will encourage SSOs to look at the results, or expected results, of a standardization activity—that is, how many implementations are there for a produced standard and whether or not these standards increase user choice or decrease use risk. Using a cartel to create a standard to capture a market is not too farfetched; however, IP restrictions are probably a lot safer to use.[20]

This type of activity would not be groundbreaking. ANSI currently runs a certification program for "legitimate SDOs," and there are numerous test and certification organizations that could be called upon to review and legitimize SSOs. The new criteria would not need to be mandatory; it would merely require a bill such as the *Standards Development Organization Advancement Act of 2003* (HR 1086), which limited antitrust penalties for SDOs to single, not treble, damages, to give limited immunity from antitrust (similar to that currently enjoyed by SDOs) to certified organizations. Those who wished to remain outside the pale could do so, depending on their assessment of the economic risk. It would be the market at work.

It would also be not too difficult to begin to create a mapping of those SSOs who register to examine their scope and extent of work. By making available a list of new SSOs that are created on a monthly basis, it would be possible for business people (and the consultants who service them) to begin to understand the activities of the SSOs. If the SSOs could be convinced—as part of the registration—to list their standards, the scope of work, and the potential audience,

[20] It is far easier to use cross-licensing of IP rights as an effective barrier. The cellular phone contains up to a 137 essential pieces of technology—each of them is owned by a large corporation, which usually has cross-licensing terms with its large competitors. A small company trying to enter the market would find that licensing the 137 patents would pose a formidable barrier to entry that would not be encountered by its larger competition.

the creation of a systems approach (with its attendant discipline) would be only that much closer. This list would potentially facilitate interoperation and cooperation among SSOs, since it would be easier to identify potential collaborative opportunities.

These criteria offer a more palatable and realistic solution than one requiring stronger government intervention to the tragedy of the commons situation now plaguing SSOs and standardization. Since market mechanisms have not been successful and standards are an impure public good, it is feasible that government may eventually see the need to limit standardization output. This could be accomplished by limiting the number of SSOs that are certified each year and requiring recertification on a regular basis. However, this solution presents several obstacles. First, since the carrying capacity for standardization is unknown, it would be difficult to determine the optimal number of SSOs. Second, the solution would only be effective if it were implemented internationally. Currently, there is no international standards body that would be trusted by all parties and nations with this task. Finally, private industry, especially in the United States, traditionally favors self-policing and market mechanisms over government intervention. While this type of government intervention is an impractical solution at this time, it would be wise for SSOs and their members to actively and cooperatively work towards an alternative solution to the problem rather than become subjected to government regulations such as those experienced by other industries that exceeded carrying capacity (e.g., limits to polluting emissions by oil refineries, manufacturers, etc.).

We believe these proposed changes would help manage—or at least provide insight into—the proliferation of competing, non-interoperable specifications that are limiting the public benefits of standardization and undermining the progression of the ICT industry. In doing so, the United States would facilitate the tightly coupled interoperation essential for the growth and prosperity of a society that relies on advanced technologies.

CONCLUSION

The reforms we have proposed would serve standardization well and are reasonably benign—all are being done now in various fora. What is needed is the belief that standards are important enough to U.S. industry (or to the European Union industry, or Chinese industry) for this approach to be initiated. We believe that objections to it will come from the SSOs that will have to change and cooperate, and from industry, which will see yet another "managerial freedom" being removed. The reforms are a very light set of guidelines that can be implemented in a largely voluntary fashion. Compliance is not mandatory; there is a risk associated with non-compliance (increased risk of antitrust), but that is a business decision left to the organizations and their sponsors.

We also believe that this approach, with its reasonably light touch, will be far preferable to a more draconian measure to which governments will be pushed if the current situation continues. If standards are an impure public good (as we believe they are), then the government has not only the right but also the duty to intervene when the private sector fails. We believe that the beginnings of this failure—as evinced by either chaos or monopoly—are already beginning to be seen. So the question really comes down to whether or not the private sector, with help from the government, can correct itself, or whether it is willing to risk that no one will notice until the entire system collapses. It is a bet that we will see played out over the next five years.

Appendix

The Evolution and History of Standards-Setting Organizations

Formal Standard-Developing Organizations and ANSI

A brief examination of the history of standardization within the United States is necessary to put an organization like ANSI into its proper perspective. Following the First World War, there was a national standardization initiative sponsored by Herbert Hoover to make sense of the chaotic state of standards in the United States. Voluntary cooperation between the organizations was a goal; it was initiated in the Twenties and then stopped as the Depression began. However, following the Second World War, the initiative took off again and eventually the organization that was to become ANSI came into prominence.[21] While not a governmental entity, ANSI was meant to regularize standardization in the United States. Several serendipitous legal incidents happened to strengthen ANSI's hand (an anti-trust case and a Congressional investigation), and eventually ANSI came out as the first among equals in U.S. formal standardization. It alone (of the myriad of standards organizations in the United States) has the right to publish standards that bear the appellation *American National Standard.* ANSI does itself not create standards; it acts as a publishing arm for the more than 175 organizations which have sought ANSI accreditation.[22] At

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[21] The following is a description of ANSI from its Web site:

> The American National Standards Institute (ANSI) has served in its capacity as administrator and coordinator of the United States private sector voluntary standardization system for more than 80 years. Founded in 1918 by five engineering societies and three government agencies, the Institute remains a private, nonprofit membership organization supported by a diverse constituency of private and public sector organizations (http://www.ansi.org/public/ansi_info/intro.html)

[22] ANSI ensures that its guiding principles—consensus, due process and openness—are followed by the more than 175 distinct entities currently accredited under one of the its three methods of accreditation (organization, committee or canvass). (see

the same time, other nations (especially Germany, France, the United Kingdom, and Japan) began to strengthen their nationally chartered bodies to pursue standards as a part of their national industrial policies.

A European-style national standards body makes sense in the context of the post-World War II industrial environment. Nations were trying to strengthen their individual industrial capacity; many were rebuilding after a devastating war. The creation of standards allowed an industrial policy that could be controlled (to varying degrees) by the nation. The United States, however, did not create a government-run standards organization. Instead, as was previously mentioned, it encouraged the private sector to enter into standards partnerships, which allowed trade associations and to act as standards organizations and encouraged the formation of new organizations. As national and regional economies became more interdependent, however, it was necessary to establish an international standardization authority. Following World War II, and with the growth of the internationalism, the ISO was established and the IEC and ITU had more credence given them, so that there could be truly international standards. There was a cultural sensitivity that was overlooked at times, however; the concept of "international" did not necessarily mean "good" to a country, unless it was that country's specification being carried forward. And since the basis of the international formal activity was the national body, the biases of the various national bodies were brought forward. Within the IT industry, the balance of power turned to the United States, because American-based IT companies were more successful than their counterparts worldwide. This was due in some part to the larger size and homogeneity of the U.S. market, which made economies of scale possible for U.S. firms. With the economies of scale came the ability to innovate more quickly, which in turn fed the need and use requirements of users, which led to more innovation, an increased market, and increased sales.

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http://public.ansi.org/ansionline/Documents/Standards%20Activities/American%20National%20Standards/Procedures,%20Guides,%20and%20Forms/ANS%20Procedures%20-%20Historical/ANSIPRO1987.pdf.)

By 1985, the U.S. dominance in IT—in market share, IP, research and development, and deployed base—was firmly established. Because of this market ascendancy, the dominance of the U.S. in formal standards was also established; a majority of IT standards were those proposed or initiated by U.S. companies, either through the U.S. standardization bodies (e.g., ASC X3 or the IEEE Computer Society) or through U.S. company representatives acting in foreign standards bodies (e.g., the Deutsches Institute for Normung [DIN], the German national body where U.S. subsidiaries exercised heavy influence).

In the early 1990s, the European Community began to coalesce. One of the favored methods of creating a single European market was to require the various nations to abandon unique national standards in favor of Pan-European (or regional) standards. By eliminating a multitude of competing and conflicting standards, a British manufacturer, for example, would not have to make multiple separate products or go through national conformance test regimes. By adhering to a single Pan-European standardization regime, it was felt that European providers could begin to realize economies of scale, similar to those of the U.S. manufacturers. To further this purpose, the European Union (EU) recognized (or created) three regional standards organizations —the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardization (CENELEC), and the European Telecommunications Standards Institute (ETSI).[23] The mission for all of these groups was to "promote voluntary technical harmonization in Europe in conjunction with worldwide bodies and its partners in Europe" (CEN http://www.cenorm.be/cenorm/idex.htm).[24] The key to understanding the activities

[23] Web sites for these organizations are www.cenorm.be, www.cenelec.org, and www.etsi.org, respectively.

[24] Between 1983 and 1989, the EU began to focus on its internal market and the plethora of standards available within Europe. As a result, the *Council Resolution of 7 May 1985 on a New Approach to Technical Harmonization and Standards* was passed establishing the principles of European standardization. The essential outcome of all of these activities was to gain a national commitment, where "formal adoption of European Standards is decided by a weighted majority vote of all CEN National Members and is binding on all of them" (see http://www.cenorm.be/cenorm/aboutus/generalities/how+we+work/index.asp).

of the EU is to remember that European National Body standardization activities were often a barrier to the unification of European economic activity. By requiring the unification of standards (and a common acceptance of a single standard), the EU was seeking to unify its markets and provide for economic growth as a unified Europe.

This was not, however, the way that the activity was seen in the United States. The unfortunate appearance of the ISO 9000 Quality Management series of standards in 1989 gave the impression that the Europeans were creating a "Fortress Europe" by using standards and certification schemes as non-tariff trade barriers.[25] The debate was exacerbated by the use of common standards phrases with substantially different meanings, depending upon which side of the Atlantic Ocean you lived.

At the behest of some of its members, ANSI began a long, torturous, and losing battle to stop the pan-European standardization activity. The requirement that the European national standardization bodies must accept a CEN standard, and that CEN has a "special" relationship with ISO[26] gave rise to U.S. concerns that the vote in ISO could be rigged in favor of the Europeans, since the Europeans might vote in concert with one another.

The accusations by ANSI that the Europeans were block voting became (and remains) shrill.[27] While this may be necessary for national positioning, it is not helpful to the IT industry,

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[25] ISO 9000 is an entirely problematic standard. It was originally started as a U.S. Air Force standard in the 1960s, adopted by the British in the 1970s, and then sent to ISO in the 1980s. It is a management standard, which means that it does not tell you how to do quality, but rather "how to manage a quality program, including the necessary paperwork and records retention." The appearance of this standard and its rapid acceptance and "mandatory use" (including third-party certification) in many European companies and government procurements left a bitter legacy with U.S. companies who were "forced" to comply with third-party testing.

[26] See http://www.cenorm.be/boss/production/production+processes+-+index/cen+enquiry/vaguidelines2004finalversion.pdf for the complete text, recognizing the Vienna Treaty and the common European norms.

[27] At a presentation at the American Academy for the Advancement of Science (February 17, 2001, San Francisco, CA), ANSI President and CEO Mark Hurwitz stated that he believed that the Europeans engaged in block voting to stop American SDO initiatives. From a national point of view, this has significance; from an international point of view (that normally taken by multinational companies), the

which has a substantial international market for its products. The appearance of ANSI's *National Standards Strategy for the United States* has placed IT companies with a significant presence in European standardization bodies in an awkward position—they must either accept the concept of an overriding U.S. national position or they must be willing to dismiss the statements of an organization in which many of them are members.

At the same time, the lack of clarity within the U.S. standardization regime has made many of its counterparts in ISO uneasy with ANSI.[28] ANSI has no absolute mandate as the sole international representative of the U.S. at ISO. ANSI sits at ISO and the IEC because it is the single "most representative" body on all standardization, and because it has the singular right to grant the title of an American National Standards to a specification. Ensuring that those who wish to publish an American National Standard follow the ANSI procedures for creating standards enforces this right. As noted above, ANSI's only contribution to standardization is the process and coordination between groups. Its mission statement reads "ANSI does not itself develop American National Standards (ANSs); rather it facilitates development by establishing consensus among qualified groups." The way that a group becomes "qualified" is to embrace ANSI's development rules—which are the "formal process rules."[29]

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existence of a standard that is meant to satisfy a large potential market (325 million people) is of substantial interest and is worth investigating and possibly implementing.

[28] See Global Standards (1992) prepared by U.S. Congress, Office of Technology for a view of the U.S. standardization process which haunts the United States to this day in Europe.

[29] It is interesting to note that both major international standardization organizations—the ISO and the IEC—have, within the last four years, adopted processes to recognize industry technical agreements (ITAs), which allow any organization as "open" to advance a common industry practice through a lightweight process to achieve the appellation of either an ISO or IEC ITA. The senior organizations have recognized the need within their primary markets for a quicker and faster way to gain widespread recognition of a specification that is widely accepted, but possibly does not need the rigor of their full process. For a description of the IEC program, see http://www.iec.ch/tctools/ita-e.htm; and for a description of the program at ISO, see http://www.iso.org/iso/en/stdsdevelopment/whowhenhow/proc/deliverables/iwa.html

It is this formal process which is the value of the "formal organization," whether a trade association doing standards, ANSI, any of the ANSI-accredited Committees, or the international organizations of ISO. The process is specified; variations are not allowed. The mantra of ANSI is:

- Decisions are reached through consensus among those affected.
- Participation is open to all affected interests.
- Balance is maintained among competing interests.
- The process is transparent — information on the process and progress is directly available.
- Due process ensures that all views will be considered and that appeals are possible.

Absent any of these conditions, an organization cannot become accredited. And because their fundamental rationale for existence may not meet the ANSI conditions, consortia have always been outside of the pale of formally accepted standards.

Consortia and Alliances

The legal basis of the organizational style known as consortia or alliance is found in the *National Cooperative Research and Production Act of 1993* (U.S. Code 15. §§4301, et seq. See http://caselaw.lp.findlaw.com/casecode/uscodes/15/chapters/69/sections/section_4301_notes.html), which has as its purpose "to promote innovation, facilitate trade, and strengthen the competitiveness of the United States in world markets by clarifying the applicability of the rule of reason standard and establishing a procedure under which businesses may notify the Department of Justice and Federal Trade Commission of their cooperative ventures and thereby qualify for a single-damages limitation on civil antitrust liability." The Act lists a lengthy series of activities that are prohibited if an organization wishes to take advantage of the Act; in many cases, the charter of an organization specifically writes these prohibitions into their charter to make sure that

participants understand the purpose of the organization is to encourage innovation and commercialization of technology (two purposes of the Act.).[30]

As was previously mentioned, although the speed at which consortia arrive at standards has been the focus of much attention, it is the process that consortia use to achieve this speed that is most integral to the way consortia differ from the formal standardization process. In most of the cases, the consortia modified the traditional standardization process in several ways. First, they formally imposed some limitation on participation. The limitation usually took the form of dues—that is, there is a requirement to "pay to play."[31] The payment could be modest or significant (from approximately $3,000 per year to the $50,000 that large corporations are often taxed.) Second, the consortia announced their intentions—when you have like-minded companies, you can announce and drive to a solution with a greater degree of freedom than can a formal SDO, which usually has no way of controlling where its efforts will lead. Third, the consortia do not need to be broad spectrum—that is, a consortium can focus on and solve only those problems that it wishes to solve. There is no requirement for it to create committees to solve all problems; rather it should (by definition) be working on problems that its members need to have solved in order to produce products.

Finally, and perhaps most damaging to the formal standardization process, consortia specifications are usually immediately turned into product offerings by the participating companies. The rationale for playing (and paying) within a consortium is to create and then market a technology. To participate in a consortium (paying both dues and committing scarce

[30] A typical statement, taken from the proposed sponsor agreement of one consortium, is "Nothing in this Agreement shall be construed to require or permit conduct that violates any applicable Antitrust Law. A Sponsoring Member consents to the disclosure of its name as a member of the Corporation, for the purpose of permitting the Corporation to invoke the protection of the National Cooperative Research and Production Act of 1993 (15 U.S.C. §§4301, et seq.), if the Corporation decides to invoke such protection." Private communication from unnamed consortium and Carl Cargill.

[31] It has been argued by several members of consortia that the travel and meeting requirements of formal organizations constitute a membership limitation, as very few private citizens have the ability to travel to all of the meetings of an international technical committee where the technology is decided. Some of the consortia with Internet-based processes claim that their consortia dues are less than a participant would pay in travel costs.

human resources) and then not to implement the specification when it appears is definitely foolish and possibly irresponsible, and is the exception more than the rule. Additionally, depending upon the cohesiveness of the consortia, the specification usually has one or more implementations that validate the specification.

There are two schools of thought on when and what to standardize. The "current practice school" believes that standardizing current practice—that is, abstracting an interface specification from existing products—is the preferred method. The other "future technology" school revolves around standardizing future technology in its predeployment phase. The current practice school rewards the innovator by allowing a time-to-market and market-share advantage, while embracing stability in the market and rapid deployment of technology. The future technology school of thought permits a group design, combining the best of the breed (at times), but is usually slower and can produce a specification that is filled with compromise. Both have been used successfully within consortia, but the first, in which the innovator opens a proprietary specification in return for a possibly transient market advantage, is usually the most preferred.[32]

On the one hand, the classic case used to argue for current practice standardization is the failure of OSI (Open Systems Interconnect), which involved standardizing technology that was not deployed and which was being created in committee. On the other hand, there is a reluctance to take a widely deployed but nonstandard technology to the formal organizations, since there have been instances when formal organizations have attempted to change the technology once it arrived in their committees. When this occurs, the worst case results—a standard emerges that does not reflect the installed base usage of the specification. As a result, either the original nonstandard technology or the new specification is declared invalid. With either outcome, both sides lose.

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[32] The business case behind this type of decision is usually very complex and filled with enough vagaries to make the prediction of success purely Brownian. Normally, it comes down to a senior executive being willing to take a chance and go forward with opening a technology to the market.

Consortia are also slightly more informal in the coordination of their efforts. Unlike the formal world, where all of the players are known to one another and tracked, the consortia/alliance arena has no central clearing house or authority to coordinate activities. There are efforts made to track consortia, but new consortia appear in the ICT arena at the rate of about one every other week.[33] There is nothing to prevent multiple organizations from tackling the same general topic (i.e., wireless internet communications). This is encouraged by the organizations that fund the consortia and alliances, since having multiple solutions sometimes mitigates the impact of catastrophic technical change. What the industry does not like is two SSOs solving the same problem using the same specifications (dueling specifications) or a specification being bifurcated and modified. This is where much of the concern about standardization comes in—and the old tired rubric of "the nice thing about standards is that there are so many of them" is brought up.[34] It is duplicative standards—not duplicative standardization efforts—that are the bane of the industry.

The consortia processes are rigorous, since they must comply with the provisions contained in the *National Cooperative Research and Production Act of 1993*, under which many of them are chartered. There is an area of expertise on the legal implications of the creation of consortia, and nearly every consortium that is created requires the services of at least one lawyer (for a discussion of the nature of the rules that apply when establishing a consortium, see Updegrove 1995). Consortia operate as strictly under their rules as formal SDOs operate under theirs. If they fail to keep their processes legitimate, they risk all of their members and their own existence. The emphasis that consortia place upon following their rules is illustrated by the fact

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[33] The IT sectorial organization under CEN (CEN/ISSS) undertakes to maintain a list and description of consortia. It currently lists/links to approximately 260 consortia working in the areas of IT, either publishing specifications or specifying requirements. It is available at http://www.cenorm.be/isss/Consortia/Surveyshort.htm.

[34] This statement amplifies the contention that there is a lack of education about standards and standardization.

that, as of this writing, there has never been a successful suit brought against a consortium for antitrust activities.[35]

Consortia and alliances (their more short-lived brethren) serve a need of the ICT industry as a way to stabilize the market in a time of shortened product life cycles and rapid market change. By providing processes that are open, and by providing the market with multiple implementations of the consortia specification, they have increased competition and ensured that the standardization of the high-technology industry can continue.

Open Source

The key to understanding the Open Source community is understanding the license. The licensing itself is complex; there are at least five variants (Hecker 1999):

1. No license at all (i.e., releasing software into the public domain)
2. Licenses like the BSD (Berkeley Software Distribution) License that place relatively few constraints on what a developer may do (including creating proprietary versions of Open Source products)
3. The GNU General Public License (GPL) and variants which attempt to constrain developers from hoarding code (i.e., making changes to open source products and then not contributing those changes back to the developer community, but rather attempting to keep them proprietary for commercial purposes or other reasons)
4. The Artistic License, which modifies several of the more controversial aspects of the GPL
5. The Mozilla Public License and variants (including the Netscape Public License), which go further than the BSD and similar licenses in

[35] The closest successful suit was *Addamax Corporation, v. Open Software Foundation, Inc., Digital Equipment Corporation, and Hewlett-Packard Company, Inc*. (888 F. Supp. 274; 1995-1 Trade Case, (CCH) P71,036), which lost and lost again on appeal.

discouraging software hoarding, but still allow developers to create proprietary add-ons if they wish.

The intent of these various forms of licenses is to ensure that the code remains open for all to use, validate, modify, and improve. These license forms, more than anything else, are the core of the Open Source standards movement. They encourage the community to act together, and they act as a re-enforcing mechanism for open source behavior (which is a larger good to which all standards organizations must subscribe). By tying their unique behavior to licensing activities, they are then freed to espouse rules that re-enforce the benefits of open source licensing—including rules on how to write, publish, and correct code, and so on.

The positive aspect of open source is that there are multiple implementations of the code—anyone who wishes may take the source code and write an implementation. The difficult aspect of open source is that there is never a stabilized standard set of source code to specify, since by its very nature, Open Source constantly and incrementally improves its code base. However, the creators and purveyors of Linux are working on this, and are attempting to create a Linux standard that will solve this problem. If this problem is solved (basically, a version control problem), then the Open Source organization will also be a viable candidate for procurement.

Conclusion

All of the various forms of standardization can and do serve a purpose in the ICT sector. There is the need for stability (provided by the formal arena), a need for defined and structured faster change (provided by consortia and alliances) and the need for complete community involvement (provided by open source.) The groups within each arena have not learned to work together for the good of open systems. Rather than considering proprietary and closed systems to be the force to be changed, they have dissipated their energies by arguing about which form of standardization is best, forgetting that the answer is that "Standardization is best, and non-standardization is less than optimal." ANSI is a necessary, but not sufficient, standardization component for the needs of

the IT sector. Consortia are central to ICT standardization success, but they need the stability that the formal process can offer. And for long-term change (to both the technical and legal fabric of IT and ICT sector standardization), open source provides an interesting direction—and may lead to an entirely different standardization environment in the future.

Standardization is a complex discipline that is constantly changing as the industry underneath it evolves. The last decade in the ICT industry has seen massive change as the very nature of information use and sharing by customers has changed. The state and changes in the ICT industry in the United States reflects the state and changes of its consumers—U.S. society, both commercial and private. The ICT sector has been credited with making the U.S. economy much more productive, and this has aroused admiration throughout the world.[36] Uniting the various forms of standardization by allowing equivalency —in legal as well as in economic settings—would only enhance the industry. It is a rare situation that has no negative consequences to the industry or society.

[36] As Vittet-Philippe (1999, p. 2) states, "Despite the relatively modest share of ICT [Information and Communication Technologies] manufacturing in total U.S. production—8% of total—the remarkable acceleration of productivity in that specific sector has contributed a disproportionately high 0.6% a year to total U.S. labour productivity growth."

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