

CONSORTIA AND THE EVOLUTION OF INFORMATION TECHNOLOGY STANDARDIZATION

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Abstract: This paper examines – from the viewpoint of an empowered, embedded, and usually neutral observer – the struggle between consortia and Standards Developing Organizations (SDOs) for hegemony in the standardization arena. The paper traces the events that framed the conflict and the roots of the claims that both sides have made. The key elements that are brought out are the activities of the major funding sources for the Information Technology (IT) industry’s participation in standardization – and how this participation has mutated over the past decade. The paper posits that the struggle has been overtaken by events – and that basically, the market no longer really cares where a standard comes from as long as there is a standard.

In 1989, when the U.S. Accredited Standards Committee X3 was at its height, it contained approximately 40 members, representing the leading providers, the large and small users, and major government agencies. It had a significant presence in – and impact upon - the U.S. Information Technology (IT) market. In 1998, less than 10 years later, the committee (having changed its name to the “National Committee for Information Technology Standardization”) has only 19 members, few significant new work items, and a minimal presence in the U.S.

market. (I believe that similar statements can be made for other national body programs, many of which are also experiencing financial and/or membership problems.) The International Organization for Standardization/International Electrotechnical Commission Joint Technical Committee 1 (ISO/IEC JTC1) has suffered a

decline as well – not necessarily of members, although that is down – but of participants (down from well over 5000 in 1993 to approximately 2100 today) as well as suffering from a dearth of new and interesting standardization programs.

The decline in participation (and, it should be admitted, interest) cannot be attributed to a lessening of the *need* for standards. The IT industry has become a major force in the world’s economic arena; the IT industry has even been awarded its own “Schumpeter’s wave” by the Economist newspaper.¹ The Internet and the World Wide Web, object oriented programming and object oriented languages, complex hardware and LANs - all are based on standards and are growing geometrically. The Information technology revolution has succeeded in becoming a significant economic and social force – one that is driven by the ability to interoperate and interconnect, which are the

children of standardization. And yet we see the participation in and the importance of the formal standardization arenas declining throughout the world, while consortia continue to thrive and grow. (The point is not that the consortia, as individual entities survive, but that the sponsors of these groups consider them a more viable investment for standardization than the formal standardization entities and continue to pour money and people into them.)

The first question which must be asked is “What happened that placed the formal IT standards groups into an ‘also ran’ position and replaced them in the eyes of much of the industry with consortia such as The Object Management Group (OMG) and the World Wide Web Consortia (W3C) and the Internet Engineering Task Force (IETF)?” The answer to the first question drives the second question – “What are the implications of this change and is it irreversible?”

In 1989, when I was trying to make a prediction about the future of the Information Technology (IT) standardization arena, I made the comment that “Certain principles cannot or should not be compromised, but, all too often, a position is defended because it is easier to be dogmatic than to understand what is really going on.”² At the time that I wrote this line, I was applying it to the groups who were engaged in making standards into a marketing arena – the consortia. In retrospect, I believe that the comment is more applicable to the participants of the formal standardization organizations than those at whom the comment was aimed.

Also in 1989 – in what was later called the “Year of the Consortia” in some areas – two battles began to appear on the formal standards scene in the U.S. that had tremendous impact on the IT arena. The first was a conflict between the various Standards Developing Organizations (SDOs) for an increased position of hegemony in U.S. standards activities; the second was the growth of consortia in the IT arena. The two were difficult enough to deal with individually; together, they initiated the bankruptcy of the formal process.

The first of these battles was started by a proposal for a “Standards Committee, USA” (SCUSA) put forth by members of the U.S. Department of Commerce in the late 1980’s. The proposal was to provide an alternative to the multiplicity of standards organizations claiming to be the “natural leader” of U.S. standardization by creating an overarching government backed leadership committee. The traditional “first among equals” of U.S. standardization is the American National Standards Institute (ANSI), which alone has the right to grant the appellation “American National Standard”. In an effort to rally support for its cause as the leader (and to preclude “governmental interference”), ANSI was obliged to seek help from U.S. SDOs which operated under the aegis of “ANSI rules”.³ In return for the help of these organizations, ANSI had to agree to limit some of its claims to their royalty stream – and possibly other concessions. While the deals were concluded, and the harmony restored in the U.S. arena, there were lessons learned by both the U.S. SDOs and by the Europeans. For the U.S. SDOs, the lesson

was that ANSI was no longer as strong a leader as it had been previously, and that there were vulnerabilities that they could exploit. For the companies in the IT arena, who were involved either as supporters or were sideline observers, the message was substantially different – it indicated that the formal process was in disarray and that it was no longer to be feared. For the Europeans, there was a message that the U.S. process was convoluted and could be dealt with in a piecemeal fashion if necessary. The European Telecommunications Standards Institute (ETSI) Intellectual Property Right (IPR) Undertaking in 1991-1994 time frame was symptomatic of the approach of dealing with the U.S. standards body from a regulatory/governmental fashion, where the burden of defense and defense by the U.S. was left to the U.S. Trade Representative (USTR) and to the industry lobbying association of The Computer and Business Equipment Manufacturer's Association (CBEMA, now the Information Technology Industry Council, [ITIC]). Although it concerned a standardization matter (the rights to IPR in standardization), ANSI played only a minor role in the defense. With the lion's share of credit going to the organizations mentioned above⁴, the message was delivered to both the Europeans and to major US firms that ANSI – and the members of the “federated system” were not necessarily the solid bulwarks that they had imagined. In a second, and far more effective approach to managing around the U.S. standardization system, ISO Technical Committee 176 (Quality Management and Quality Assurance) realized that standardizing the use (management) of

technology, and not the technology itself, was much more successful. From an U.S. standardization point of view, it was more invidious, because it was much more difficult to argue with principles than it was with technical facts.⁵

This idea – the use of management standards – bears significantly upon the increasing abandonment of standards in the IT arena. The idea behind ISO 9000 (Quality Management Standardization) was to provide a standard – not for quality – but for the management of quality systems generally. On the face it was a good idea – among other things, it allowed a small island nation that had quality problems to propagate its solution to those problems around the world. This propagation was especially significant in the U.S., where quality consultants who would help a company achieve “ISO 9000 Certification” multiplied like rabbits. An ISO 9000 certification program was even sold as a shrink-wrapped piece of software for \$99.00. Unfortunately, many in the U.S. opposed the growth of ISO 9000, seeing it as a program that was intended to enrich consultants without adding anything to the value chain of their products.⁶ Even worse, however, the derogation of the concept of “ISO 9000” required that ISO be derogated as well. It became very difficult for many practitioners in the standardization arena to gain “mind share” in their companies for standardization activities that were related to ISO, since there was the immediate attachment of the term “ISO” to both the failure of “OSI” and to “ISO 9000”. The negative publicity was hard to counter – especially since JTC1 was

lacking any notable successes at this time (~1989-1995).

For the major multi-nationals that made up the standardization arena, however, there was another lesson gained from this activity. There came the realization that the major drivers of IT standardization were the major U.S. corporations (Digital, IBM, HP, AT&T, UNISYS, NCR, XEROX, and so on) and they each had only a small fraction of the U.S. vote, while major players in the European IT sphere (ICL or Siemens or Olivetti) had substantially more clout in their native country than did an individual U.S. company. As a result, U.S. based multinationals became involved in the standardization activities of other national bodies – usually trying to ensure that one of their employees was the Head of Delegation (HoD) or head of a technical committee in the national bodies of these various other countries. Being a HoD, of course, gave undue influence to the positions of the U.S. company that employed the HoD. While it must be granted that a HoD does not control the voting of the country, the HoD is a powerful position that can help craft and manage the creation of the national body position. At the same time, the officers of newly formed Working Groups or technical committees were also positions of power that could be used by multinationals to gain influence in these various countries – all of which had a vote equivalent to that of the U.S. It did not take long for U.S. multinationals to realize that playing at standardization in national bodies of other countries sometimes paid higher rewards than playing at standards in the U.S.

At some point, based on this model, these multinationals realized that they could “standardize better and faster” if they were to join in their own groups – groups that formed the basis of consortia. The first major consortium of which I am aware was the Corporation for Open Systems (COS), which was created to work hand in glove with the standards committees creating the Open Systems Interconnect (OSI) standards. COS’s mission was to test the interoperability of the various standards to ensure that “conformance to OSI” meant interoperability.⁷ It was an unsuccessful consortium – as were “Industrial Combine” activities such as the Manufacturing Automation Protocol (MAP) driven by General Motors and the Technical Office Protocol (TOP) driven by Boeing. These failures didn’t discourage continued efforts to craft a “real consortium – and the appearance of X/Open (to open UNIX to all the world) marked the initiation of the first major industrial consortia. This was followed (in no specific order) by the Object Management Group, The Open Software Foundation, UNIX International, Open 88, SPARC International, Plug and Play Consortium, the Desktop Management Forum, the ATM Forum, and so on and so on.

The initial response to these consortia was one of hostility by the participants in the formal standards arena.⁸ The attempts to reach out to one another were patently insincere – both groups believed that they were in a “do or die” situation, in which their specific survival depended upon their ability to diminish (but not destroy) the other side whilst retaining hegemony for their set of beliefs. While the

groups were not capable of stating the position directly, the actions by the supporters of the two camps were reasonably derogatory. Consortia were accused of “not being open” – a charge that continues to haunt them to these day – and formal standards were charged with being too slow – a charge that the SDOs have been trying to refute for five years. After several years of this type of conflict, the corporations that funded the lion’s share of the IT activity began to lose interest in both the formal and informal process. Lumping them all together in a bucket best described as “arcane marketing activity”, the IT industry began to move into the “de facto standardization phase” that characterized the IT industry until the Internet and the World Wide Web (WWW) began to flash into the public consciousness. This retro-transition to “standards awareness” driven by the Web began to occur in 1996-1997.

In this reemergence of a role for standards, however, things were “jumbled”. There were no longer clean lines separating the telecommunications standards from IT standards from Application standards from language standards. The formal bodies and the “main line consortia” were at a substantial disadvantage in this new environment. The appearance of the Web (with Web time) drove many standardization activities to adopt new models of standardizing. The World Wide Web Consortium (W3C) is the most significant of the Web focused consortia, and it deserves a bit of inspection.

The twin foundations of the WWW are the Hypertext Markup Language (HTML) and the Hypertext Transmission Protocol (HTTP). These two innovations provided the ability to easily transmit pictures, drawings, and variant types of text over the Internet (everything did not have to be flat ASCII anymore) to be read and enjoyed by the users. With the ability to transmit more than a singular type of text, the Internet began to appear to be of interest to all sorts of other activities and a fundamental change occurred in the IT industry – from the user perspective. The Web, fulfilling Tim Berners-Lee’s original goal, provided for an explosion of information, the likes of which had not been seen for several hundred years. On the other hand, the WWW is a visual display medium, and it is the transition to visually attractive (albeit sometimes content and context free) display of information that the Web is having one of its biggest impacts.

The management of the standards that drove the WWW was supposed to be the province of the W3C. However, the HTTP – being a protocol – was given to the IETF, which is responsible for Internet protocols. And the Internet is the infrastructure upon which the Web depends. Once W3C gave up HTTP, it was left with “display” standardization – that is, how do you make the display of information universally acceptable. And, even better, how do you get everyone to agree upon the standards?

W3C solved this last question in a somewhat unique way. W3C, as an entity, does not really exist. Contracts are written between the sponsoring organizations (since only organizations can belong) and the three

sponsoring entities (MIT, Keio University, and INRIA). The Director of W3C is an employee of MIT, and is responsible to no one for his decisions. The model, is of course, based on MIT's successful X Consortium, in which Bob Schieffler was the "benevolent dictator" of X Windows. The difference between X Windows and the World Wide Web apparently escaped MIT when they designated Tim Berners-Lee the Director, as most people tend to believe that the Web is too big for a single person or organization to control. But MIT, in its attempt to reassert its technological leadership, opted for the current W3C structure. It was a decision that will come back to haunt the Web.⁹

However, while all of the new consortia were gearing up to get their piece of the "web action", the SDOs were stuck in a complete morass. The Web defies traditional classification – it is neither pure IT nor is it pure telecommunications. As a result, it bridges both technologies and cultures. The formal groups were largely ignored by the providers as the Web surged ahead. It is significant that no major provider seriously suggested giving JTC1 any portion of the WWW technology during the time that the Web was in its phenomenal growth stage. Of the consortia, the IETF received a significant boost, and the W3C has been discussed. The Open Group (the amalgam of the OSF and X/Open) initiated "IT Dial tone" to make itself germane, and every other consortia picked up a piece of the Web to incorporate into its mission. The formal process in the U.S. tried to respond with an ANSI inspired initiative on what standards would be necessary to the

National Information Infrastructure, but accomplished very little other than to identify several dozen standards which were widely ignored in the drive for the Web. The French national body (AFNOR) suggested standardizing HTML, and HTML is now in JTC1 – but only after it was developed in W3C. XML has been suggested as a candidate for JTC1 standardization – but it has already been accepted as a W3C Recommendation and is an industry practice. In the meantime, the JTC1 Sub Committee (SC) for SGML (the ever-evolving predecessor to HTML) has been disbanded and has been reconstituted as a new SC, which hopes to be able to have XML brought to it for work. The Netscape language JavaScript was inserted into a consortium and emerged as ECMAScript (which provides a subtle tip-off as to where it was taken for standardization) and was then fast-tracked through JTC1.

And this is where the current situation rests. The formal groups do not have a significant voice in the development of the Web and Internet based technologies in the formal IT arena. The Publicly Available Specification (PAS) submission experiment has been hailed as a success by JTC1, despite the fact that only eight consortium/companies have applied for PAS status, and despite the fact that, after nearly three years, only three DIS have been submitted for standardization. In a recent study¹⁰ done for the Information Society Standardization System (ISSS), a working group of the European Committee for Standardization (CEN)¹¹, lists all of the fora of the standardization arena. The

study is lengthy, and makes compelling reading to those who believe that there is no money in standardization. The list of standardization organizations runs nearly 190 pages, with usually a single page (or less) describing the consortium. Looking through this list, it is easy to see why there is no new work coming into the SDOs – the consortia are receiving all of the work items, from imaging to Internet printing to scripting languages to chip design, because they are created to specialize in a single subject and are probably more tightly under the control of their members.

And this preponderance of consortia brings up a central question to the future of standardization within the IT community. With the replacement of the formal SDOs with consortia as the preferred mechanism for the market to standardize technology, what are the social and technical implications? In a major Congressional Office of Technology Assessment (OTA) study completed early in the decade, the following comment commands attention:

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.*¹²

[Emphasis mine]

The reason for this emphasis is very simple – the societal choice that faces the IT world is how to move to a new standardization paradigm in which the various consortia seem to be the preferred form of standards making bodies. There is not really a contest any longer; the amounts of money spent on consortia by most major IT companies far exceeds the amount of resources dedicated to formal standardization. And since standardization is recognized as a business activity (not marketing, as some would have it), resources tend to flow to the arena that promises the best return on investment. And consortia, rather than SDOs, have won the lead position for creation of standards for the IT industry.

The first question is whether or not the change is irreversible, and if the SDOs can reassert their power. I believe that, in the immediate future, there will be no capability of returning to the halcyon days of JTC1. The formal SDOs have lost the major power base with the acceptance (by governmental procurement officers) of consortia – specifically IETF and W3C – specifications. The private sector long ago gave up demanding formal standards as a precondition of successful bids¹³. While there are many bids that go out demanding standards, there is no insistence that they be only formal standards; de facto standards and publicly available specifications are cited more often than not. And it is the user demand that drives the use of – and participation in – standardization. The demand test – the most crucial one for economic survival – is passed equally well by both formal and consortia standards. The users do not, in

general, differentiate by source of the specification. The measurement criteria is whether or not the specification meets a business need, and consortia specifications (usually more than SDO standards) are developed for that purpose.

The acid test – that of utility by and for the users – being examined, all types of specifications (from SDO documents to Publicly Available Specifications to consortia specifications) appear to be equally useful. Given that the outcomes of the standardization work are equivalent (for utility in achieving standardization), the question now becomes one of finding the organizational structure and process which best suits the needs of the IT market - as it is currently structured. And it is here that the disadvantages of the formal SDO process, with its interminable formalized steps and structure, become clear – given the IT market as we currently know it. The formal structure used by ANSI was heavily influenced by hearings in the 1970 that threatened the private sector with governmental oversight¹⁴; it should be remembered that the U.S. industry resents – and vociferously opposes – any attempt by the government to “interfere” in the standards process except as a participant. The only way to preclude governmental participation as a regulator, however, was to ensure that “Jacksonian democracy” was observed in the standardization process. The particular manifestation of this phenomena was to place safeguards for “openness” at every level, which, in the ideal world, would allow everyone to participate. In reality, the cure opened up as many abuses by the participants as it precluded,

since the process was arcane and highly ritualized. This ritualization has been carried over into the rules that JTC1 – and even ISO, generally – use to conduct their activities. It has produced a class of “standards people” who are specialists in creating and interpreting the rules of the organizations.¹⁵ Most standards bodies do not end with action on a positive note; discord is seen as a reason to cease the current activity causing contention and seek a compromise.

In a consortia, however, there is a precondition that SDOs do not enjoy – basically, the members of the consortium are usually like minded and usually wish for action to occur. In the main, they represent a significant segment of the market who have come together to create or cause a specification to be created – a specification that the members of the consortium can accept and implement. And the implementation is the key to the concept of the consortia – while specifications are the product of a consortium, the success of the consortium is measured more by the success of the members in productizing the specification, not in producing the specification. Member organizations which produce products embodying the technology of the consortium are the indicator of a consortium’s success. And this, more than anything else, is the reason for the success of the consortia and their associated types of activities, such as alliances. Members can see a correlation between activity and market share and market activity.

This can, of course, be dismissed as “marketing”. And in the broadest sense of the term “marketing”, it is valid. By understanding that

the providers want demonstrable results from their resources, consortia have tapped into a fundamental wellspring of cooperation that exists in many companies. The SDOs have forgotten why people value standards. As an example, there was a new ANSI constitution (composed of 10 items) that was promulgated in 1995. Approximately 50% of the text in the constitution was devoted to making sure that ANSI was regarded as the leader in standardization, nationally and internationally. About four percent of the words were devoted to teaching people about standards, and about six percent were focused on the public good¹⁶. The focus is not on satisfying a user need or responding to a requirement as an “impure public good”. Rather, it is about the continuation of a power structure that the users are abandoning because it no longer fills a need in the IT arena.

The entire debate has been focused on “open” and “due process” and “speed” and other such buzzwords. The users – in the main – are looking for a solution to business problems that permit them to get on with the business of business. The appeal of standards to the users was – and continues to be – the idea of “second sourcing”, described as the ability to have multiple sources to obtain a common technology. The interest is in the “common” technology, not in that the common technology came about by a arcane and specialized method. From the vendor point of view, the guiding idea is “return on investment” for contributed resources. If a consortium can return the same results as an SDO in half the time (but with greater expenditure of resources), what the organization

has is a simple business question to solve - time versus resources. If the outcome of the consortia is superior – in the eyes of the companies – to the outcome of the SDO, the choice is even simpler. And because the SDOs have never focused on providing education on why their product is qualitatively superior to the product of the consortia, they have failed.

And it is this failure that has led to the societal change in the perception of standardization. The majority of IT corporations – both providers and users – accept the consortia and SDO as equal partners in standardization.

In conclusion, the fundamental nature of standardization has not changed. The public still wishes for multiple sources for core technologies, and believes that standards which make things interoperable are good things. What has changed is the acceptance of the methods by which these standards are created. The structure of the creation is no longer important – alternatives have been tried and several have survived. Within the IT industry (producers and others), there is no longer a substantive differentiation (generally) between a “specification” and a “Standard (the product of an SDO)”. They are lumped under the generic heading of “standard” – and the results of the standard (products) are the metric by which the success of the standard is judged. The message from the market is clear – IT standards developing organizations are no longer just the preserve of the ISO/National Body regime. The challenge that faces the discipline of standardization is healing the divide, not

accentuating it. The only losers in this process will be those who, through fear or pride, refuse to evolve and condemn themselves to slow, but inevitable, obsolescence.

¹ *The Economist Newspaper Limited*, London, Volume 350, Number 8107, “A Survey of Innovation in Industry”, p. 6

² Cargill, Carl F. Information Technology Standardization: Theory, Process, and Organizations Digital Press, Bedford, MA 1989, p. 234

³ It is necessary to describe the U.S. system here, since it is one of the few, if not only, “federated standards system”. ANSI does not write or create standards; it has no technical capabilities in any of the normal standardization arenas. However, it does write the rules for standardization in the U.S. that permit SDOs (such as the American Society of Mechanical Engineers, the IEEE, and the American Society for Testing and Materials) to operate with limited immunity from certain anti-trust legislation. However, in order to publish American National Standards (with the ANSI imprimatur), royalties had to be paid to ANSI. The subordinate SDOs (who never saw themselves as subordinate), resented this, since they made substantial revenue from publishing and selling their copyrighted standards. See the OTA study (op.cit.) for more details.

⁴ Shurmer, Mark and Lea, Gary “Telecommunications Standardization and Intellectual Property Rights: A fundamental Dilemma?” *StandardView*, Volume 3, Number 2, June 1995 contains a complete discussion of the entire IPR Undertaking.

⁵ The earlier battles between pragmatists and theorists had usually been won by the pragmatists – as shown by the standardization

battles between ODA and SGML (SGML has survived), between EDI and EDIFACT (EDI is deployed), and between OSI and TCP/IP. The use of management principles in a standard (which talk about proper deployment of some technology) removes the discussion from a carefully defined set of issues to one that is more and more process focused – one that does not empower innovation, but rather one that imposes structure and rules. The use of standards to impose structure is not new - but it is one of those things that bears watching to ensure that it does not inhibit innovation through foolish rules.

⁶ In 1996, the U.K. Advertising Standards Agency upheld a complaint that the BSI was untruthfully claiming that ISO 9000 improves quality, forcing BSI to cease making claims in the printed advertising that ISO 9000 increases productivity.

⁷ Unfortunately, over time, conformance to OSI came not to mean “interoperability” – which is what the intent of the OSI standards was - but rather, conformance to a standard. This was another one of those instances where this made perfect sense to providers working in standards but left the majority of users (and a goodly number of IT executives and technologists) wondering about the general wisdom of standards.

⁸ While on the outside there were commitments to goodness and cooperation, the participants on both sides were looking for the ability to co-opt one another. Possibly the most noticeable moment was the presentation by Mike Lambert (CTO of X/Open) at JTC 1 in the early 1990's, in which the hostility bubbled to the surface. As a participant on both sides, I was aware of the

hostility and the ways that it was being exploited to advance the causes of the various organizations.

⁹ The irony of course, is exquisite. The most open of all IT phenomena being controlled by the most closed organizational structure.

¹⁰ Available at <http://www.cenorm.be/iss/Survey.htm>

¹¹ CEN is not a formal SDO in the normal sense of the word, being a creature of the European Commission. However, it does have the power, under the Vienna agreement, to “compel” European nations to accept CEN norms in lieu of national body standards. This has been a sore subject with many in the U.S. who see this as “bloc voting”.

¹² U.S. Congress, Office of Technology Assessment (D. Linda Garcia, lead researcher), Global Standards: Building Blocks for the Future, TCT-512 (Washington DC: U.S. Government Printing Office, March 1992), p. 14, footnote 23.

¹³ Informal discussions with sales representatives and systems engineers at major IT companies show that a preponderance of commercial request for proposals or requests for bid make no distinction between formal, consortia based , or de facto standards. The same is true – but to a lesser extent – of governmental bids, where items such as UNIX™ and POSIX , RFCs and GOSIP, and CORBA™ and Java™ appear with a high degree of constancy.

¹⁴ See the description of these activities in Cerni, Dorothy, Standards in Process: Foundations and Profiles of ISDN and OSI Studies, NTIA Report 84-170, (Washington DC: U.S. Government Printing Office, December 1984), pp. 49-61 for

an excellent review of responses to “due process” which were initiated by the 1969 standards suits that charged anti-competitive behavior in the plywood industry. Once the chronology is traced, it becomes apparent why the U.S. voluntary system is the way that it is, with all of the “due process” features that make it very cumbersome to the IT industry.

¹⁵ A parallel can be found in the Norse Saga of Burnt Njal, which contains a compelling scene at the Icelandic Thing (the annual gathering of all of the Vikings on Iceland). In the scene at the trial of Njal’s killers at the Thing, the minutia of the rules is invoked again and again (wrong court, right court, wrong type of witness, subcondition on the witness, and so on). Unlike a standards meeting, however, the scene in Njal’s Saga ends in action being taken.

¹⁶ Cargill, Carl F. Open Systems Standardization: A Business Approach Prentice Hall PTR, Upper Saddle River, NJ, 1997. Pp. 243-244