The Role of Firms in Industrial Standards Setting: Participation, Process, and Balance

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Standards are created in great part to serve public interests, but most industrial standards are voluntary rather than mandatory and are created by private standard setting organizations that are neither government regulators nor firms and markets. The voluntary consensus standards setting (VCSS) process by which most industrial standards have long been set started in engineering societies at the end of the 19th century, and in the beginning of the 20th century it became the basis for national and international standard setting organizations such as the American National Standards Institute (ANSI) and the International Organization for Standardization (ISO). This process, which produces industrial standards that firms then adopt voluntarily, centers around technical committees that work towards consensus on proposed standards in various specific technical domains. The committees are composed primarily of engineers, many of whom work for firms with an interest in the outcome of standardization processes. To what extent does the role of firms in developing industrial standards support public interests? Firm interests? This paper addresses that question.

The VCSS process should be of great interest to scholars of political economy as well as of business history. Susan Strange, one of the social scientists who led the revival of the encompassing, historical approach to the study of society developed by the classical political economists, argued that political economy provided the only way to understand emergent global problems: financial crises, persistent inequality, threats of ecological collapse, and the like. She told the scholars in her own field, international relations, that they had to learn to look "beyond states to markets and market operators, and to non-state authorities," the latter functioning as

standard setters in every field of endeavor.[1] Strange was writing in the mid-1990s when VCSS had taken on new roles in the governance of the Internet, environmental management systems, and corporate social responsibility. Similarly, in the past decade or so business and economic historians have also begun to differentiate and study every part of the wide array of economic coordination mechanisms that exist along the dimension from "market" to "hierarchy,"[2] including VCSS, which can readily be understood as falling somewhere between the extremes.

To address the role of public versus firm interests in the VCSS process, we examine the historical development of its underlying principles and mechanisms. In the earliest days of VCSS institutions, the participation of engineers working for concerned firms was controversial, since some claimed that representatives of firms would serve the firm's own interests rather than the common good. Others argued that only the best engineers with the highest reputations could be involved in such work if it was to be voluntarily adopted by manufacturing concerns, and that those virtuous individuals could be trusted not to be biased, even if they worked for a concerned firm. Still others argued from the pragmatic view that industrial standards that were to be voluntarily adopted could not be set without representatives of the firms who produced or consumed industrial goods to which the standards applied.

This paper examines how voluntary consensus standard setting evolved to reflect the *participation* of interested parties, a *process* designed to transcend interests through respectful deliberation to reach a common consensus, and a *balance* of interests to safeguard against the

[1] Susan Strange, 'Political Economy and International Relations.' *International Relations Theory Today.* Ken Booth and Steve Smith, eds (Cambridge: Polity Press, 1995), pp. 154-74. The quoted words are from page 172.
[2] See, especially, Naomi R. Lamoreaux, Daniel M. G. Raff, and Peter Temin, "Beyond Markets and Hierarchies: Toward a New Synthesis of American Business History," *American Historical Review* 108(2, April 2003): 404-33. Some historians of business and technology who have considered standardization more closely include Steven W. Usselman, *Regulating Railroad Innovation: Business, Technology, and Politics in America, 1840-1920* (Cambridge, UK: Cambridge University Press, 2002); and Andrew Russell, *Open Standards and the Digital Age: History, Ideology, and Networks* (New York: Cambridge University Press, 2014)

interested behavior that was still possible and perhaps even likely. Having determined that participation of firms was necessary, voluntary consensus standard setting organizations established a process that promoted respectful and even disinterested behavior but also recognized and neutralized the possibility of interested behavior by developing committee membership rules that ensured a balance of potentially competing interests. In recent decades, however, a flood of new standard setting organizations and methods have emerged, still with participation of interested firms, but with different approaches to process and balance.

In this paper, we begin by tracing the early arguments of standardizers about participation and balance, showing how and when the principles emerged and using more recent documents to demonstrate how they are currently followed in the organizations. We then demonstrate how the process encouraged transcending interested behavior and promoted respectful deliberation and consensus, in a form of deliberative democracy, supplementing early discussions with records from standardizing efforts in the second half of the twentieth century. We end with a look at the new standards setting organizations that have emerged in recent decades and their potential implications for standard setting today.

Participation and balance: Establishing the principles

The nineteenth century saw the emergence of several predecessors of voluntary consensus standard setting organizations and processes for industry.[3] Scientists in Europe, the U.S., and beyond worked towards standardizing units and measures in various scientific areas, through correspondence and occasional meetings coordinated with world's fairs and

[3] This paragraph draws on JoAnne Yates and Craig Murphy, *Standards Bearers: Engineers and the Industrial Standardization Movement 1900-Present,* book manuscript in progress, Chapter 1.

expositions.[4] Diplomats, assisted by scientists and engineers, negotiated intergovernmental treaties and treaty organizations such as the International Telegraphic Union to set mandatory standards in certain realms that were seen as requiring the involvement of governments.[5] At the same time, national engineering societies were being established in the most advanced industrial nations, and some of them eventually established standards committees in response to demand for technical standards in related industrial arenas. Standards committees of engineering societies were the most direct predecessors to the national and international standards setting organizations that emerged around the turn of the 20th century. As early as the 1830s, for example, scientists and engineers of Philadelphia's Franklin Institute, a proto-engineering society, motivated by "the urge for useful service," launched an investigation into the causes of horrific steam boiler explosions on riverboats, publishing boiler standards in 1836.[6] The German *Verein Deutscher Ingenieure* (VDI), the German Association of Engineers, issued its first guideline on the same technical subject in 1884.[7] Screw threads were another subject of standardizing efforts on both sides of the Atlantic, by Joseph Whitworth in the UK's Institute of Civil Engineering in 1841 and by William Sellers in the US's Franklin Institute in 1863.[8] Work to standardize steel rails at the end of the 19th century, as discussed below, was an example of

[4] See, for example, Robert P. Crease, *World in the Balance: The Historic Quest for an Absolute System of Measurement* (NY: W.W. Norton, 2011).

[5] F. S. L. Lyons, *Internationalism in Europe, 1815-1914* (Netherlands: A. W. Sythoff-Leyden, 1963); Craig N. Murphy, *International Organization and Industrial Change: Global Governance since 1850* (Cambridge, UK: Polity Press, 1994).

[6] Bruce Sinclair, *Early Research at the Franklin Institute: The Investigation into the Causes of Steam Boiler Explosions, 1830-1837* (Philadelphia, PA: The Franklin Institute, 1966), p. 2 (quote), 6—7. The published guidelines were initially voluntary, but were, in 1852, adopted as legal regulations.

[7] On the VDI, see Kees Gispen, New Profession, Old Order: Engineers and German Society, 1815-1914 (Cambridge: Cambridge University Press, 1989), pp. 45-46, on the VDI. For the boiler plate standards, see VDI, "VDI Guidelines," http://www.vdi.eu/engineering/vdi-guidelines/.

[8] See A. E. Musson, "Joseph Whitworth and the Growth of Mass-production Engineering," *Business History* 17: 2, 109-149; and Bruce Sinclair, "At the Turn of a Screw: William Sellers, the Franklin Institute, and a Standard American Thread," *Technology and Culture* 10:1 (January 1969), pp. 20-34.

standardization across professional societies that would usher in new organizations and processes of standardization.

Around the turn of the 20th century, the participation of engineers representing interested firms (especially manufacturing firms) and methods for assuring balance of interests were major points of discussion around standardizing in engineering associations and in emerging national and international standard setting organizations. The International Association for Testing Materials (IATM), perhaps the first international association for standardization, would not survive as a standards setting organization past World War I, but it established some of the early norms for standard setting, as well as launching the still active American Society for Testing Materials (ASTM).[9] Both IATM and ASTM included engineers from multiple engineering disciplines, most prominently mechanical and chemical engineering. The IATM arose out of a series of meetings convened by the director of a government-supported materials testing lab at the Polytechnic Institute of Munich, Professor J. Bauschinger, during the 1880s and 1890s, initially among researchers at similar testing laboratories at engineering schools in Germany, Austria, and Switzerland.[10] As the conferences became more formal, engineers from other countries (e.g., Russia, France, America, Norway, Holland, Italy, Spain) attended, as well, voting on preferred testing methods. The resulting "resolutions," as they called them, were published in existing technical journals and as pamphlets, and attracted considerable attention from the engineering world.[11] During the 1880s committees were established to continue activities during

[9] One early scholar of standards classified them as clearing houses for standards in the area of testing rather than as standards organizations per se (Brady, *Industrial Standardization*, p. 71, note 3).

[10] Stephen P. Timoshenko, *History of Strength of Materials, with a brief account of the history of theory of elasticity and theory of structures* (New York: Dover Publications, 1983; reprint of original published by McGraw-Hill, 1953), pp. 279-281.

[11] For example, J. Bauschinger, "Resolutions of the Conventions Held at Munich, Dresden, Berlin and Vienna – For the Purpose of Adopting Uniform Methods for Testing Construction Materials with Regard to Their Mechanical Properties," translated by O.M. Carter and E.A. Gieseler for the U.S. War Department (Washington: Government Printing Office, 1896).

the two to three years between meetings, and in 1895, those involved officially declared it an ongoing association, the International Association for Testing Materials, with a stated purpose of "the development and unification of standard methods of testing for the determination of the properties of the materials of construction and other materials, and also the perfection of apparatus for that purpose."[12]

This organization, unlike typical engineering societies, did not admit individual members by technical qualifications, but included individuals, engineering societies, government departments, and even firms as members, as long as they embraced the organization's purpose and paid their dues.[13] Indeed, in his introduction to the "Resolutions of the Conventions Held at Munich, Dresden, Berlin and Vienna," written two years before the official formation of IATM in 1895, Bauschinger referred to the need for representatives of firms to participate, and for them to come from both the *manufacturers* and *consumers* of materials, to avoid one or the other set of interests dominating.[14] This broader membership profile along with a requirement for balance between producers and consumers, would come to be typical of voluntary consensus standard setting (VCSS) organizations. By 1898 the IATM had established a governing Council, which both established technical committees with representation from each participating country and urged that country representatives create national sections to organize their work. Professor Mansfield Merriman, the first president of the American Section of IATM (formed immediately

[12] Mansfield Merriman, "The Work of the International Association for Testing Materials," *Proceedings of the ASTM* Vol. 1:4, Sept., 1899, pp. 17-25 (quote of purpose from pp. 18-19); and American Section of the International Association for Testing Materials, *History, Laws, Committees and List of Members* (Philadelphia: Office of Secretary of American Section, January 1899), pp. 7-8.

[13] J. Bauschinger, in his introduction to "Resolutions of the Conventions Held at Munich, Dresden, Berlin and Vienna – For the Purpose of Adopting Uniform Methods for Testing Construction Materials with Regard to Their Mechanical Properties," translated by O.M. Carter and E.A. Gieseler for the U.S. War Department (Washington: Government Printing Office, 1896), p. 7.

[14] Bauschinger, "Resolutions of the Conventions…," p. 7. Although the translation into English is dated 1896, it must have been written in 1893, shortly after the Vienna conference, as Bauschinger died later in that same year (Timoshenko, *History of Strength of Materials,* p. 301).

after the Council's call) outlined in his opening speech what he saw as advantages of the IATM membership system for firms:

> Under this arrangement it is possible for a corporation to exert a greater influence than through the indirect individual membership of its president or superintendent, both manufacturers and consumers can make their wishes more directly known, and thus more quickly harmonized than under the usual plan of strict individual membership.[15]

Representation of firm producers and consumers of a material would allow direct discussion and negotiation to "harmonize" the interests of both, with balance safeguarding against an outcome biased toward one or the other.

Published records of an early conflict between the IATM and its American Section, as well as accounts of a controversy between the American Section and standardizing committees in several American engineering associations, centered on this principle of balance. Committee No. 1 of the IATM (the committee addressing Standard Specifications for Iron and Steel) had a stated policy of having its technical committees evenly balanced between representatives of producers, on the one hand, and representatives of consumers or unaffiliated engineers, on the other. Based in part on this principle, they challenged the American Section's addition of many more representatives of producers to their subcommittee of Committee No. 1.[16] Meanwhile, in the national rather than international arena, the American Section of the IATM was immediately involved in a controversy with railroads and steel manufacturers on committees in the American Society for Civil Engineering (ASCE), the American Institute for Mining Engineering (AIME), and (after 1900) the newly founded American Railroad Engineering and Maintenance of Way Association (AREMWA) over setting standards for testing iron and steel rails; in it the American Section of IATM was accused of being dominated by producers (steel companies), to the

[15] Merriman, "The Work of the IATM," p. 20.
[16] Minutes, meeting of the Executive Committee, American Section, IATM, *ASTM Proceedings* Vol. 1:7 (January, 1900), p. 76.

detriment of consumers (railroads).[17] American Subcommittee #1 chairman, consulting engineer William Webster, explained that he had added many steel manufacturers to the committee to help in getting the specifications implemented, and that they had attended meetings and contributed to the effort more assiduously than non-producer committee members. As a result, he argued, "This has all been misunderstood, and the proposed specifications have been referred to as 'Manufacturers' Specification,' and as being 'too lenient,' etc. This has come about by the [non-producer] engineers on this Committee being too busy to attend its meetings."[18] His arguments and subsequent invitation for more input from user associations were unlikely to have disarmed critics in the short term.

Meanwhile, conflicts with IATM led the American Section to break off and establish itself as the independent American Society for Testing Materials (ASTM) in 1902. In ASTM a principle of balanced representation was quickly solidified, in great part by its election of chemical engineer Charles B. Dudley as president.[19] Dudley represented a consumer (railroad) company, though he was also active in the producer-dominated American Institute for Mining Engineering. He had also, from the very first meeting of the Executive Committee of the newly formed American Section of IATM in June of 1898, advocated the importance of balancing producers and consumers in the association, having suggested a discussion for this inaugural

[17] For a discussion of this controversy see Usselman, *Regulating Railroad Innovation*, *pp. 235-239*.

[18] Minutes, meeting of the Executive Committee, American Section, IATM, *ASTM Proceedings* Vol. 1:7 (January, 1900), p. 76. The report on Committee No. 1 notes that five producer companies had requested to be added to it, and that request was granted, with the further resolution that "as it is policy of the Association that its Technical Committees should be nearly equally divided between producers and consumers, that Committee No. 1 be requested to name five engineers not directly associated with manufacturing, to balance the five firms above mentioned." Webster responded to criticisms of bias towards steel makers during his Progress Report of Committee No. 1 at the October, 1900 meeting of the American Section of the IATM (*ASTM Proceedings* Vol. 1: 20, p. 177), and went on to invite more input from members of other involved associations on their draft recommendations, to help respond to accusations of being a producer committee.

[19] Even Usselman (*Regulating Railroad Innovation, pp. 235-239)*, who saw the American subcommittee of IATM's Committee NO. 1 as being slanted towards steel manufacturers, admits that once Charles B. Dudley, head of the Pennsylvania Railroad's Chemical Dept., becomes President of the newly independent ASTM in 1902, any such bias was gone.

meeting on "The Relation of the International Association to Producers and Consumers."[20] ASTM established rules that required that producer firm representatives could never outnumber consumer firm representatives plus independent authorities, and added other checks and balances as well.[21] In his "Personal Tribute" to Dudley upon his unexpected death in 1909, another member of ASTM would note the importance of Dudley's belief in balancing consumer and producer to the success of ASTM:

> When the Society was first formed, it was generally feared that it would become a manufacturers' organization, and therefore it was with hesitancy that others gave to its deliberations and recommendations unprejudiced consideration. I doubt if there was another man under whose leadership the Society could have so quickly been made successful. Dr. Dudley's whole business career has been as representative of the consumer, yet he had always made manifest his endeavor to be fair to the maker. Hence the confidence that both sides had in him. There might be, and often were, differences of opinion, but never doubt of intelligence or honesty of purpose.[22]

The principle of balancing producers and consumers was held by the relatively short-lived IATM, and continued with reinforcement by the rules of ASTM and the added moral force of Dudley.

Debate about representation of commercial interests, not just technical expertise, also appeared within engineering societies around the same period. In the US, for example, the American Institute for Electrical Engineers (AIEE) was formed in 1884 to address both theoretical and practical interests in telegraphy, light, and power. Officers and members included inventors who ran commercial organizations (e.g., Alexander Graham Bell and Thomas Edison), professors, telegraphic electricians, and managers from electrical industries (e.g., the

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[20] Minutes of the Executive Committee meeting, June 25, 1898, published in ASTM Proceedings 1:1 (April, 1899, p. 5. Dudley was not able to attend the meeting, so someone else opened the discussion.

[21] See "ASTM 1898-1998: A Century of Progress," p. 32, at http://www1.astm.org/IMAGES03/Century_of_Progress.pdf and http://www.astm.org/ABOUT/history_book.html (accessed 1/3/2014); and C. L. Warwick, "The Work in the Field of Standardization of the American Society for Testing Materials," *Annals of the American Academy of Political and Social Science*, Vol. 137 (May 1928), p. 50.

[22] Robert W. Hunt, "Charles B. Dudley—A Personal Tribute," in ASTM's *Memorial Volume Commemorative of the Life and Lifework of Charles Benjamin Dudley,* pp. 79-80.

president of Western Union, Norvin Green).[23] From its founding, the AIEE declared that it would "settle 'disputed electrical questions' within the industry—a sign of the importance given to uniform industrial standards from the beginning."[24] Nevertheless, despite widespread internal support for the association's successful work in standardizing electrical units, some members resisted the standardization of industrial goods. After an early 1890s attempt at standardizing wire gauge failed due to lack of agreement about what role the organization should play in product standardization, AIEE president Francis Crocker—a Columbia professor and co-founder of Crocker-Wheeler Company, a manufacturer of dynamos and other electrical apparatus—approached with care an 1898 meeting he chaired on "The Standardizing of Generators, Motors, and Transformers (A Topical Discussion.)."[25]

This time the point of greatest contention, as revealed by the detailed proceedings of the meeting, was not *whether* AIEE should become involved in industrial standardization (initially, standardization of methods for testing apparatus), but *how* it should constitute the standardizing committee. In particular, the issue most discussed was whether manufacturers of such apparatus should serve on the standardizing committee. An MIT professor, Cary Hutchinson, argued that such individuals would naturally favor their own firms, and thus should not be included on the committee, though the committee should consider their views.[26] Referring to a paper by E.W. Rice, Jr. (the founding technical director of General Electric and at that time vice president in charge of manufacturing and engineering) that had opened the meeting, Crocker noted that "There are three sides to the question, as Mr. Rice has pointed out in his paper--the

[23] M. Michal McMahon, *The Making of a Profession: A Century of Electrical Engineering in America* (New York: IEEE Press, 1984), Chapter 1.
[24] McMahon, *The Making of a Profession,* p. 29.
[25] Ibid., pp. 83-84; "The Standardization of Generators, Motors and Transformers (A Topical Discussion)"; *AIEE Transactions* 15 (1898), pp. 3-22.
[26] *AIEE Transactions* 15 (1898), pp. 12-13; for Rice's affiliation, see McMahon, *The Making of a Profession,* p. 85.

manufacturer, the purchaser and the consulting engineer, and leaving out any one of them you do not necessarily produce any better result."[27] The third category included engineers unaligned with either manufacturers or purchasers, who could be professors or consultants or both. Further discussion exposed a variety of opinions on the question, with some sharing Hutchinson's negative view of including representatives of manufacturers and others questioning how it was possible, pragmatically, not to include them. A consulting engineer, Arthur Kennelly, argued that "having a committee to recommend how manufacturers should make apparatus, without having any manufacturers on that committee, was something like playing Hamlet with Hamlet left out."[28] Charles P. Steinmetz, the famous GE engineer, argued in favor of having manufacturers represented based on the positive reputation of those who would be on it:

> If the INSTITUTE [AIEE] intends to produce something of lasting value, which will be accepted and adopted by the whole continent, then the committee doing the work must be composed of men of such standing and reputation that, regardless of whether they are connected with manufacturing concerns or not, there can be no question that they will be impartial and not influenced by the fact that they are connected with this or that company.[29]

After extensive discussion, AIEE appointed a Committee on Standardization composed of men from all three of the constituencies mentioned by Crocker: two professors (Hutchinson and Crocker, the latter of whom was also the owner of a manufacturing company), two famous GE (manufacturing firm) engineers and managers (Steinmetz and Elihu Thomson), and two engineers from power companies (purchasers) that used the equipment (John Lieb and Lewis B.

[27] *AIEE Transactions* 15 (1898), p. 14. For Rice's affiliation, see IEEE Global History Network, article on Edwin W. Rice, Jr., at http://www.ieeeghn.org/wiki/index.php/Edwin_W._Rice,_Jr., consulted 12/30/2013.
[28] Ibid., p. 15. For Kennelly's affiliation, see McMahon, *The Making of a Profession,* p. 85.
[29] *AIEE Transactions* 15 (1898), p. 20.

Stillwell).[30] Committee members were men of high standing and reputation, but the committee also embodied a safeguard against interested behavior by its balance of the three constituencies.

Similar balancing of producer and consumer interests occurred in Great Britain in the formation of the first of the national standards setting organization just three years later, though in this case government departments, rather than firms, were initially the largest purchasers.[31] In 1901, British engineers in the venerable Institute for Civil Engineering (ICE) observed with admiration the coordination among American engineering societies that had led to standardizing steel rails in the US (as mentioned above). Driven by the industrial demands of the British Empire, they established a more formal mechanism for ongoing coordination—the Engineering Standards Committee (ESC) convened by ICE in conjunction with the Institution of Mechanical Engineers, the Institution of Naval Architects, and the Iron and Steel Institute. When the organizer of the initial effort to standardize steel sections for railroads and construction, Sir John Wolfe-Barry, approached the War Office, Admiralty, and India Office, those government departments (and largest purchasers) responded enthusiastically, providing funding as well as suggesting additional areas for standardization (e.g., locomotives). Soon the Institution of Electrical Engineers was added to the other four societies to constitute the five founding societies of the new committee.

ESC quickly established a system of sectional committees to establish standards in such areas as Bridges and Building Construction, and Railway and Tramway Rails.[32] The sectional committees included representatives from other associations, industrial trade organizations, and

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[30] McMahon, *The Making of a Profession,* p. 85.

[31] The founding of the Engineering Standards Committee, as described in this paragraph, is based on the thoroughly documented Robert C. McWilliam, "The Evolution of British Standards," PhD thesis, University of Reading Dept. of Management, School of Business, 2002; and in McWilliam, *BSI: The First Hundred Years, 1901-2001: A Century of Achievement* (London: The Institute of Civil Engineers, 2001).

[32] Ibid. See also Robert C. McWilliam, "The First British Standards: Specifications and Tests Published by the Engineering Standards Committee, 1903-18," *Transactions of the Newcomen Society* 75(2005).

government departments, as well as individuals from firms, to get broad and balanced input from what were seen as all interested groups. These sectional committees were further broken down into subcommittees to deal with specific standards. For example, one of the initial sub-committees of the Sectional Committee on Locomotives included 5 consultants to the government (representing purchasers) and 7 manufacturers.[33] At this point no exact rules for balance had yet been set, but both sides were strongly represented.[34] In 1917 Sir Wolfe-Barry, who had led the organization since its 1901 beginnings, outlined in an address what he had established as ESC's fundamental principles; the first of these was "That the different interests of producers and purchasers should be thoroughly represented."[35] In 1918, ESC would become independent of ICE, a freestanding organization called the British Engineering Standards Association, or BESA. In that year Charles Le Maistre, Secretary of BESA, reinforced the importance of this principle in a paper about BESA (and its predecessor ESC):

> From its inception, certain definite principles have governed the work of the committee, amongst which may be placed in the forefront the community of interest of producer and consumer, which is, in fact, the corner stone of the organization.
> …
> Thus for many years past, the British Engineering Standards association, as it is now called, has provided the neutral ground upon which the producer and the consumer, including the technical officers of the large spending departments of the government and the great classification societies [e.g., Lloyd's Register of shipping], have met and considered this subject of such vital interest to the well-being of the engineering industry of the country.[36]

[33] McWilliam, "The Evolution of British Standards," p. 75.
[34] Indeed, although representatives of manufacturers outnumbered those of purchasers, the fact that the purchasers were government departments may have given their 5 consultants enough weight to offset the higher number of manufacturers represented.
[35] Sir John Wolfe Barry, "The Standardization of Engineering Materials and its influence on the prosperity of the country," the 'James Forrest' Lecture, 1917, p. 10, in the archives of the Institute for Civil Engineering [ICE BSI 3.1-33 (1)].
[36] Charles LeMaistre, "Summary of the Work of the British Engineering Standards Association," *Annals of the American Academy of Political and Social Science,* Vol. 82 (Mar., 1919), pp. 247-248. A footnote indicates that the paper is "Reprinted from paper read before the Annual Meeting of The American Society of Mechanical Engineers, …December 3 to 6, 1918."

Balancing the interests of producers and consumers was clearly a central principle of the organization.

BESA remained the only such national body until World War I, which created additional demand for standards. Countries on all sides of the conflict, including Germany, the US, and neutral Switzerland, also created national standardizing bodies, following the ESC (now BESA) model, including in the matter of participation and balance. For example, in 1918 the first constitution of the American Engineering Standards Committee, drawing on the British model, created Sectional Committees which "shall be made up of representatives of producers, consumers and general interests, no one of these interests to form a majority."[37] In 1921 Charles Le Maistre, secretary of BESA and institutional entrepreneur encouraging the creation of national standards bodies in many parts of the world, convened the first "Unofficial Conference of the Secretaries of the National Standardising Bodies" under BESA's auspices.[38] Seven national organizations were represented at it: the U.S., Belgium, Great Britain, Canada, Holland, Norway, and Switzerland.[39] The minutes of the meeting indicate that in a discussion of principles followed by the various bodies, "[t]he fact was emphasized that the greatest care was taken in all countries to ensure that every interest, including that of both manufacturer and consumer, was consulted, though possibly not in exactly the same manner, in the setting up of the Standards, and that it was considered that this was the best means of ensuring that the

[37] 4 May 1918, Minutes, American Engineering Standards Committee (AESC), obtained from the American National Standards Institute.

[38] "Unofficial Conference of the Secretaries of the National Standardising Bodies convened under the instructions of the Main Committee of the British Engineering Standards Association"/"Report of Meetings of Secretaries at the Offices of the Association," London (28 Victoria St.): BESA, September, 1921. Marked Private and Confidential. in the archives of the Institute for Civil Engineering [ICE BSI 3.1-33 (1)]. For more on Le Maistre's role in standards setting in BESA, the International Electrotechnical Commission, etc., see JoAnne Yates and Craig N. Murphy, "Charles Le Maistre: Entrepreneur in International Standardization," *Entreprise et Histoires*, 51(2008), pp. 10-27.

[39] "Unofficial Conference," p. 5. France, Italy, and Sweden were unable to attend, Czechoslovakia was in the process of forming such an organization, and the German body was apparently not invited. For discussion of Germany's national standards body, see Robert A. Brady, *Industrial Standardization*.

Standards when issued should be adopted as widely as possible."[40] Thus on the national level, balancing the interests of manufacturer and consumer was considered very important, though the different methods of doing so might include consultation with some interests, rather than their inclusion on committees. This balance, to the extent that it was shared by national organizations, would extend to the failed interwar International Standards Association (ISA) and the post-World War II International Organization for Standardization (ISO).

The first still-surviving international standards setting organization, the International Electrotechnical Commission, was proposed in 1904 at the International Electrical Congress at the St. Louis World's Fair, established by a vote of those present at a preliminary meeting in London in 1906, and ratified by national members in 1908.[41] It brought together representatives of national electrotechnical societies into an international body "to consider the question of the standardization of the Nomenclature and Ratings of Electrical Apparatus and Machinery."[42] In the 1906 meeting delegations from national electrotechnical societies discussed and voted on a set of proposed rules. According to the detailed report of that meeting, they accepted without debate the principle that each national delegation would get one vote, but they discussed in some detail who should appoint the national delegations and what their composition should be. They ultimately agreed that the technical society of any country that had had such a society for at least three years would name the local committee, but in those countries not meeting that condition, the government should appoint the national committee.[43] On national committee composition, the main discussion point was the importance of having manufacturing interests represented.

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[40] "Unofficial Conference," p. 19.

[41] For an account of its formation, see Mark Frary, "The founding of the IEC," IEC History website, http://www.iec.ch/about/history/beginning/founding_iec.htm, accessed 11/5/2012.

[42] The International Electrotechnical Committee, "Report of Preliminary Meeting Held at the Hotel Cecil, London, on Tuesday and Wednesday, June 26th and 27th 1906," London, IEC, 1906, p. 44, available on IEC History website, http://www.iec.ch/about/history/documents/pdf/IEC_Founding_Meeting_Report_1906.pdf, accessed 1/3/2014.

[43] IEC, "Report of Preliminary Meeting…," pp. 10, 20

Some countries wanted the rules to state explicitly that the committees should include manufacturers, while others pointed out that most established technical societies already had manufacturers as members. As the report noted, "In the old countries the Manufacturers were probably Members of the Electrotechnical Societies, but this was not the case in the younger countries."[44] The Canadian delegate argued that in countries whose technical societies didn't include manufacturers, lack of that representation "might militate against ultimate success," and the Belgian delegate agreed and wanted to make their inclusion explicit. After much discussion, the following compromise sentence was added to the rule: "The persons appointed on the committees need not be Members of Technical Societies," allowing representatives of manufacturing companies to be on committees even if the technical society of a particular country did not allow their inclusion.[45] At the end of the conference, meeting convener and British representative Colonel Crompton said that he and Acting IEC Secretary (as well as Asst. Secretary of ESC and member of the British Institute for Electrical Engineering or IEE) Charles Le Maistre could show other delegates how IEE incorporated manufacturers into its standardization work, saying, "The work in England had been carried on with very great difficulty, and it had been absolutely necessary to have the Manufacturers on their side[;] in fact it had been found by experience that no standardization could be successful which did not have the co-operation of the Manufacturers."[46] So even in international standards setting organizations such as IEC, where representation was by country, the need for participation of those most interested—producers and purchasers of products—was recognized and articulated from the start.

[44] Ibid., p. 20.
[45] Ibid., pp. 28, 30; both quotes from p. 30. Thus they did not need to provide rules to the technical societies to allow for inclusion of manufacturers
[46] Ibid., p. 52.

This principle of including representatives of industry and of establishing balance among producer, consumer, and unaffiliated engineers, more or less strictly defined and enforced depending on the standards setting organization, was established around the turn of the twentieth century and has continued to dominate the traditional VCSS organizations for over a century. For example, according to the 2011 version of "Procedures for [ANSI-]Accredited Standards Committee C63® ElectroMagnetic Compatibility (EMC)," the C63 committee as a whole is a consensus group, and it creates a (smaller) consensus body called a Balloting Group to approve a specific proposed American National Standard.[47] The C63 Committee itself was required to classify its members by their interests, and "be sufficiently diverse to ensure reasonable balance without dominance by a single interest category," in accordance with the *ANSI Essential Requirements.* These ANSI requirements included lack of dominance and balance:

> **1.2 Lack of dominance**
> The standards development process shall not be dominated by any single interest category, individual or organization. Dominance means a position or exercise of dominant authority, leadership, or influence by reason of superior leverage, strength, or representation to the exclusion of fair and equitable consideration of other viewpoints.
>
> **1.3 Balance**
> The standards development process should have a balance of interests. Participants from diverse interest categories shall be sought with the objective of achieving balance.[48]

The nature of balance is further spelled out in a subsequent section, as follows:

> **2.3 Balance**
> Historically the criteria for balance are that a) no single interest category constitutes more than one-third of the membership of a consensus body dealing with safety-related standards or b) no single interest category constitutes a majority of the membership of a consensus body dealing with other than safety-related standards.

[47] "Procedures for Accredited Standards Committee C63®/ ElectroMagnetic Compatibility (EMC)/Revision 9 December 2011," Leonard Thomas papers (acquired from Dan Hoolihan, President of Hoolihan EMC Consulting and Past President and current board member of the Electromagnetic Compatibility Society (EMCS) of the IEEE, who is creating a digital archive of the history of EMCS). The subsequent quote is from p. 1.
[48] "ANSI Essential Requirements: Due process requirements for American National Standards," Edition January 2010 (which would have been in effect in 2011), p. 4.

> The interest categories appropriate to the development of consensus in any given standards activity are a function of the nature of the standards being developed. Interest categories shall be discretely defined, cover all materially affected parties and differentiate each category from the other categories. Such definitions shall be available upon request. In defining the interest categories appropriate to a standards activity, consideration shall be given to at least the following:
>
> a) producer;
> b) user;
> c) general interest.
>
> Where appropriate, additional interest categories should be considered.[49]

The C63 committee further spelled out this balance on the next level—that of the Balloting Group for any particular standard—saying that all ASC C63 committee members had to be invited to serve on a Balloting Group, but that in responding they had to specify their interest category with respect to the particular standard, listing as the normal categories "manufacturer, government, professional society, trade association, test laboratory, or general interest."[50] Users might be in any of the categories other than manufacturer in this list. According to the Procedures,

> Those responding affirmatively shall comprise the balloting group, subject to review by the Secretariat to ensure balance among the interest groups. No single group of common interest shall comprise more than 50% of the balloting group. If necessary, the Secretariat will invite additional specific parties to join the balloting group, in order to provide satisfactory balance.

In practice, a category explicitly designated as "users" was not always present, but manufacturers could never dominate over the other categories, and many of the other categories could also include users.[51] To approve a standard, the ballot must be approved by at least a majority of the balloting group and at least two-thirds of those voting.

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[49] Ibid., p. 5.
[50] "Procedures for Accredited Standards Committee C63®," p. 10. Subsequent quote is from same page.
[51] In one example, the members of the balloting group who voted on C63.4 Draft 11 (in the revision of the C63.4 standard, "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz") were classified as follows: 11 producers, 2 consumers, 12 university, 14 government, 9 general interest, and 9 test lab. Here, the producers are not balanced by an equal number of

Within at least some national representative committees to traditional international standard setting bodies, balance between producers and purchasers has also been sought, though this may be more uneven across countries. For example, the International Special Committee on Radio Interference (CISPR) is a still-active standardizing committee, created in 1933, which deals with the measurement of, and setting limits to avoid, radio interference. Initially a collaboration of IEC, the International Sound Broadcasting Union, and a few other international organizations, CISPR was designated a special committee of IEC in 1950.[52] In 1979, the head of one advisory committee to the U.S. National Committee for CISPR described his committee's make-up as follows:

> In setting up this committee, I have endeavored to bring together all groups who have an equity in ignition interference from spark ignited internal combustion engines. Such groups include automotive, marine, regulatory, governmental research, after-market suppliers, OEM suppliers, Canadian Standards Association, independent laboratories, farm equipment, off-road equipment, instrumentation, land mobile radio service, Small Engine Manufacturers Association, trucking, the Motor Vehicle Manufacturers Association, military, and Aerospace AE-4."[53]

He went on to say, "You will notice that many of the representatives are inherently hostile," a factor that "leads to tempestuous meetings sometimes." But he claims that very good results come out of this committee.

So in the long-lived VCSS associations, national and even international (within many national delegations), the principles of firm participation and balance of interests are in place to include interested parties while preventing one interest (e.g., manufacturing firms) from railroading its proposals through the process without gaining the support of other interests. In conjunction with this safeguard against dominance of one set of interests, the process of

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consumers, but they are clearly outnumbered by all of the other constituencies (9 April 1990, Results of Ballot C63.4/D11 closed on 4/9/90, in Binder on C63.4/D11 balloting, papers of Ralph Showers).

[52] Donald Heirman and Manfred Stecher, "History of CISPR," *InCompliance* (June 2010), pp. 36-41.

[53] Fred Bauer to Ralph Showers, 9 February 1979, in Ralph Showers papers.

standards setting developed in VCSS organizations also encouraged all participants to broaden their viewpoint beyond their obvious economic interests, as the next section demonstrates.

Process: Deliberation and Consensus

The principles of participation and balance were part of a broader ideology around the standard setting process and what came to be called the *standardization* or *standards movement*. This movement saw standard setting as having broad social goals intended to forward national and international efficiency, but also to foster world peace and to benefit humanity. In 1919, in the wake of World War I, the head of the American Engineering Standards Committee made the connection of standard setting to world peace:

> In a broad sense, international standardization means a common industrial language and the removal of one of those barriers which tend to separate nations and give rise to misunderstandings. The more of these barriers we can remove and the more we come to realize that our interests are after all in common, the more likely we are to attain that lasting peace for which the world longs.[54]

Despite the failure of lasting peace, as demonstrated by World War II, standardizers continued to see standardization as having an almost diplomatic role in fostering peace, as evidenced by their extensive and ultimately successful efforts to include the USSR in the new post-war organization, ISO.[55]

More importantly for the subject of this paper, the movement was built around a *process* as well as goals. This process, as Le Maistre noted,

> …may necessitate the sinking of much personal opinion, but if its goal, through wideness of outlook and unity of thought and action, is the benefit of the community as a

[54] Comfort A. Adams, [source? AESC minutes?], 1919.
[55] JoAnne Yates and Craig N. Murphy, "From Setting National Standards to Coordinating International Standards: The Formation of the International Organization for Standardization (ISO)," Business and Economic History On-Line, Vol. 4 (2006). (Proceedings of 2006 annual meeting of the Business History Conference).

> whole, standardization as a coordinated endeavor is bound increasingly to benefit humanity at large.[56]

In the technical committees in which all standard setting occurs (higher level councils or committees typically only judge the process, not the standards themselves), members arrive at standards by *deliberating* until they reach *consensus*, defined as a very high level of agreement accompanied by respectful consideration of all disagreement; this deliberative consensus process encouraged Le Maistre's "sinking of much personal opinion." Standardizers have commented that deliberation led to discovery of both better technical solutions and deeper understandings of their common mission in the course of committee debates. Ivar Herlitz, an eminent Swedish electrical engineer, summarized his view of the international standardization process in a 1962 lecture honoring le Maistre:

> If we strike too high a tone of idealism, it would probably be easy for a critic to find cases where narrow-minded national points of view have been dominating and so forth. No, let us accept the fact that most of us are here to take care of our own interests. But let us hope that everyone in so doing is broadminded enough to realize that, in the long run, his own interests are best served by a spirit of give and take, by a desire to find what is common rather than that which is conflicting. Then our work will be constructive in tearing down barriers between nations … Politicians may sometimes like to burn bridges and build barriers; engineers should not lend themselves to such tendencies but devote their efforts to the more constructive work of building bridges and opening doors.[57]

The "give and take" he referred to was deliberation, and "what is common" is consensus.

Ian Stewart, who began a long career with the Standards Association of Australia in 1935,[58] described the process that the early standardization movement invented as more than a means to achieve optimal standards; it was also a form of democratic civic education:

> The dialogues associated with standardization are a liberal education for all who participate in them. They involve an exchange of experience and of expertise of people

[56] LeMaistre, "Summary of the Work of BESA," *Annals,* p. 252.
[57] Ivar Herlitz, "The I.E.C., Yesterday, Today, and Tomorrow, 8th Le Maistre Lecture (Geneva: IEC, 1962), p. 17.
[58] Winton Higgins, *Engine of Change: Standards Australia since 1922* (Blackheath, Australia: Brandl & Schlesinger, 2005), p. 126.

> who may not otherwise get together. They involve possibly conflicting interests who otherwise would stand in isolation from one another. All who emerge from such dialogues are wiser because mutual understanding has been strengthened. Participation in the preparation of standards is not a chore to be endured but an opportunity to be used, to benefit from the process of mutual education and to influence the content of standards that will determine future practice, both national and international.[59]

Stewart saw that the deliberation of the voluntary consensus process allowed participants to pursue their interests but also offered them the opportunity to see beyond the narrow interests of their firm allegiances and even their disciplinary expertise. Winton Higgins, historian of Australia's national standards organization, notes that Stewart's argument about the "legitimacy and superiority of decisions hammered out in uninhibited discussions between equals who represent a variety of interests" is often associated with Jürgen Habermas.[60] In fact,

> … Habermas has revealed one of the secret strengths of the kind of deliberative decision-making that these standard bodies deploy. "Communicative rationality"-- the outcome of open discussion between equal individuals with different backgrounds -- represents a superior rationality compared to the conclusions reached by experts and senior administrators in isolation, ones untested in debate. The standards produced by the typical standards body crystallise the communicative rationality that Habermas has in mind.[61]

This process is consistent with theories of deliberative democracy.[62] Political science scholar Jane Mansbridge explains the deliberation required in deliberative democracy as follows:

> In the ideal, democratic deliberation eschews coercive power in the process of coming to decision. Its central task is mutual justification. Ideally, participants in deliberation are engaged, with mutual respect, as free and equal citizens in a search for fair terms of cooperation.[63]

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[59] Ian Stewart, *Standardization Association of Australia Monthly Information Sheet,* April 1977, p. 4, quoted in Higgins, *Engine of Change*, p. 144.
[60] Higgins, *Engine of Change*, p. 141.
[61] Higgins, *Engine of Change*, pp. 28-29.
[62] Jurgen Habermas, *The Inclusion of the Other: Studies in Political Theory* (Cambridge, MA: MIT Press, 1998); Jane Mansbridge with James Bohman, Simone Chambers, David Estlund, Andreas Follesdal, Archon Fung, Christina Lafont, Bernard Manin, and José Luis Marti, "The Place of Self-Interest and the Role of Power in Deliberative Democracy," *Journal of Political Philosophy* 18 (2010), pp. 64-100.
[63] Mansbridge et al., p. 94, as quoted in Jürg Steiner, *The Foundations of Deliberative Democracy: Empirical Research and Normative Implications* (NY: Cambridge University Press, 2012), p. 4.

Of course, the members of standards committees are not just any citizens, but engineers—technical experts—and in that respect standardizing differs from deliberative democracy. Indeed, we might call this process *deliberative technocracy*. But in other respects, this description captures much of the idea behind the technical committee process. Deliberation with mutual (non-coercive) justification and respect are crucial to reaching consensus (or "fair terms of cooperation"), and the standard setting process followed by these organizations attempted to create such deliberation among the committee members. Examples for which thorough documentation of the process is available illustrate how it encouraged deliberative democracy or technocracy.

Mutual and non-coercive justification is encouraged in VCCS organizations first by a strong focus on technical data as the source for arguments. The engineering identity of committee members is invoked to encourage technical contributions of data and analysis, which become the basis for the arguments. For example, in the process of trying to resolve some negative votes, one committee member of the ANSI C63 Committee suggested, "Regarding volumetric site attenuation on sites other than anechoic chambers, I recommend indicating that such techniques are under study, but not requiring volumetric site attenuation at the present time *until more data regarding that technique has been assembled*" [emphasis added].[64] In another example related to the same standards, a representative of a testing laboratory noted,

> It has been brought to my attention that an in-process C63 document related to the FCC testing of Computing Devices proposes 20 site attenuation measurements per year for enclosed test sites. Such a requirement would be a clear economic burden on use [by] small laboratories and *more importantly is questionable from a technical standpoint*. A test site is a piece of test equipment and accordingly should be treated as one from a calibration standpoint. Why should the frequency of calibration (site attenuation measurements) be increased arbitrarily for all sites *when their historic calibration data does not warrant it*?[65] [emphasis added]

[64] Glen Dash to Ralph Shopwers, 1 May, 1990 (in Binder on C63.4/D11 balloting, papers of Ralph Showers).
[65] Walter Poggi to Ralph Showers, 7 May 1990 (in Binder on C63.4/D11 balloting, papers of Ralph Showers).

Although the economic burden worried the writer, he presented the technical argument as the stronger one.

Records of the International Special Committee on Radio Interference (CISPR) also illustrate the focus on data. The "Report of the Meeting held in Paris on 3rd-4th July, 1939," its last meeting before World War II, provided two appendices: the first is a very detailed, 10-page technical report specifying the "Model C.I. S.P.R. Measuring Set," and the second is a 2-page program of tests to be performed by various country delegations using this measuring set.[66] When CISPR began meeting again after the war, the appendix for the 1947 meeting included a long list of reports with titles such as "A Measurement of Fluctuation Noise by means of a Diode Voltmeter," and "Report of Tests carried out by the B.B.C. and the E.R.A. in connection with Discontinuous Interference."[67] Subsequent meetings saw ever increasing numbers of technical reports that served as the basis of discussion. Indeed, the various subcommittees of CISPR created and voted on study questions, which provided a framework for the short and long technical reports then created by members of national delegations and distributed to all subcommittee members.[68]

Extensive technical reports were created in CISPR to focus the discussion in the committee on technical, rather than political or economic interests. The same was true for the *Comité consultatif international pour la radio*, or CCIR, a standardizing committee of the

[66] "IEC, International Special Committee on Radio Interference (C.I. S.P.R.), Report of the Meeting of the Group of Experts held in Paris on 3rd-4th July, 1939," from Leonard Thomas Papers.
[67] "IEC, International Special Committee on Radio Interference (C.I. S.P.R.), Report of the Meeting of the Group of Experts held in Lucerne on 22th-25th October 1947," Leonard Thomas Papers.
[68] Based on extensive records of CISPR meetings in the Donald N. Heirman Papers, obtained from Don Heirman and courtesy of the Purdue University Libraries, Virginia Kelly Karnes Archives and Special Collections Research Center. For example, "IEC, International Special Committee on Radio Interference (C.I. S.P.R.), Sub-committee A: Radio Interference Measurements and Statistical Methods, Draft Study Questions: Antenna for nearfield measurement of interference caused by vehicles and their electrical equipment," Document CISPR/A/(Secretariat) III, July 1991. The draft study question starts by listing reasons for posing these study questions, then lists specific questions about the topic.

International Telecommunications Union or ITU (the predecessor of today's ITU Radiocommunication Sector or ITU-R) operating in a technical area related to that of CISPR. Although ITU is a treaty organization, the CCIR, established in 1925, used voluntary consensus standard setting methods to the extent possible, given that national representatives on these committees are determined by governments rather than by technical societies.[69] Records of subcommittees of the CCIR before meetings include numerous technical reports from various delegations. For example, leading into and coming out of a week-long March 1962 meeting of CCIR Study Group IV, 107 numbered documents were issued by the secretariat, including many reports, study programs, draft resolutions, and other items.[70] Many of these documents were quite lengthy, requiring considerable time on the part of participants to read and study in order to discuss them. The "Summary Records" of the several meetings of this Study Group during the week suggested that members had closely studied these documents in preparation for the meeting, as they approved drafts with detailed lists of changes, set up working groups to work out conflicts raised by particular delegations, and so on.[71]

The VCSS focus on technical evidence and argumentation encourages mutual and non-coercive justification. The VCSS process also encourages mutual respect, the other key element Mansbridge highlights as defining deliberative democracy. In particular, to reach a consensus,

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[69] Ernest K. Smith, "The history of the ITU, with particular attention to the CCITT and the CCIR, and the latter's relations with URSI," *Radio Science*, 11:6 (June 1976), pp. 497-507. CCITT, or Comité Consultatif International Téléphonique et Télégraphique, is a second standardizing committee ITU established in 1925, predecessor of the ITU-T.

[70] These items are listed in three documents: Box 6, W-IV/50E, List of Documents Issued (Docs. Nos. IV/1 to IV/50), 21 February 1962; Box 7, W-IV/100E, Documents/CCIR Study Groups/Period 1960-1962, Doc. IV/100-E, List of Documents Issued (Doc. Nos. IV/51 to IV/100); and Box 7, W-IV/107E, Documents/CCIR Study Groups/Period 1960-1962, Doc. IV/107-E, 19 July 1962, List of Documents Issued (Doc. Nos. IV/101 to IV/107). All are in the Donald MacQuivey papers, Silicon Valley Archives, Courtesy of Department of Special Collections and University Archives, Stanford University Libraries.

[71] See, for example, W/IV/78E, Documents/CCIR Study Groups/Period 1960-1962, Doc. IV/78-E, 17 March 1962, "Study Group IV/Summary Record of the Second Meeting"; and W/IV/94E, Documents/CCIR Study Groups/Period 1960-1962, Doc. IV/94-E, 21 March 1962, Study Group IV/"Summary Record of the Third Meeting." Both are in MacQuivey paper, Box 7.

the process rules typically required committees to address the reasons provided for every negative ballot on a proposed standard as well as every comment or suggestion accompanying a positive vote—a form of due process. Thus for each ballot, VCSS organizations carefully tabulated all comments and votes, along with the response to each (e.g., accept, reject with reason, address as indicated, etc.). Although 100% of committee members did not have to vote yes to establish consensus, these organizations did not finalize standards until every possible attempt had been made to secure the agreement of all committee members. This due process requirement created time-consuming and elaborate negotiation. For example, the ANSI C63 committee began updating its 1981 version of the C63.4 standard for "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" in 1987 and continued into 1991.[72] Members voted on 11 different drafts, and at least one of those drafts, draft 11, went through 4 different versions, on each of which they also voted. After each vote, an ad hoc committee (consisting of the C63 chair and two other members) compiled and considered the reasons given for each negative ballot as well any comments included with positive ballots. Each member of the ad hoc committee commented on each comment, and only by an agonizingly extended process was a draft "approved" by the committee. Even after that, the proposed standard was opened for public comment, and again the ad hoc committee answered all such comments respectfully. A new revision cycle started immediately after the 1991 standard was published, as the committee had to consider some late comments that missed the deadline for that version. A 1992 version was published to deal with

[72] Based on several boxes of documents in Ralph Showers papers. See, for example, 4 Sept. 1987, Edwin L. Bronaugh (Vice Chair of C63) to "Members Ad Hoc Committee to Work MP-4, MP-4"A" and CBEMA Proposed MP-4 into C64.3"; Binder on C63.4/D11 balloting (about 1.5 inches of paper); 21 May 1990, "Actions taken with regard to Negative Ballots on C63.4D11, 5/21/90"; etc. The standard had gone through previous revisions and would go through additional ones after the revision discussed here.

some of these issues, but editorial notes indicated that achieving that publication required leaving out one issue on which agreement had still not been reached:

> Two out of 28 ballots on Revision No. 1 were negative (from the FCC and AT&T) due to expressed concern that insufficient data was available to support the 40 cm high table alternative for conducted emission testing. In order to satisfy these concerns without delaying the publication of this revision, this matter has been returned to the task group for reconsideration and the 40 cm option has been removed in this version.[73]

At each stage, then, the consensus principle required the committee to respond to all comments seriously and respectfully, especially those that concerned data.

Similarly, international VCSS organizations also required committee members to record and respectfully consider all comments. The 1994 ISO/IEC Directives Part 1, Procedures for the Technical Work, explained the consensus process as follows:

> Consensus, which requires the resolution of substantial objections, is an essential procedural principle and a necessary condition for the preparation of International Standards that will be accepted and widely used. Although it is necessary for the technical work to progress speedily, sufficient time must be allowed before the approval stage for the discussion, negotiation and resolution of significant technical disagreements.[74]

The Procedures spelled out that after every round of balloting on a proposed standard—working draft, committee draft, enquiry draft (called draft international standard by ISO or committee draft for vote by IEC), and final draft international standard—the secretariat or international headquarters must circulate a compilation of comments to all members with "the observations of the secretariat of the technical committee or sub-committee on each of the comments submitted."[75] The Procedures further noted that "Every attempt shall be made to resolve

[73] Revision no. 2 to ANSI C63.4—1992. Editorial Notes. Ralph Showers papers.
[74] ISO/IEC Directives Part 1, Procedures for the Technical Work, Draft Third Edition, August 1994, Revision 1994-09-90, in Ralph Showers papers; passage is unchanged in the 2013 version of the document, which may be found at http://www.iec.ch/members_experts/refdocs/iec/isoiecdir-1%7Bed10.0%7Den.pdf, accessed 2/24/2014.
[75] Ibid., section 2.6.5 (identical in 1994 and 2013 version)

negative votes." Working documents indicated that such compilations were carefully produced after each ballot.[76]

The VCSS process itself, then, encourage mutual and non-coercive justification around data, extensive deliberation, and respect for the views of others. This process is intended to encourage the participants, whether firms or representatives of other bodies, to see beyond their own interests. The voluntary consensus standardization process constituted what we might term a deliberative technocracy of engineers.

Recent challenges to the balance principle in voluntary standards setting

At the beginning of the 20th century, the emerging industrial standard setting organizations debated whether to include firms (both producing and consuming firms), how to encourage technically-focused, fair and respectful (if not truly disinterested) behavior by firm representatives on standardizing committees, and how to balance types of firms to prevent one set of interests from unduly influencing the process, developing the principles of voluntary consensus standard setting. In the late 20th and early 21st centuries, new developments have endangered some of these principles, including balanced participation and the consensus deliberative process. Starting in the later 1980s, new organizations for developing information and communication technology (ICT) standards began appearing, organizations that did not necessarily incorporate the rules of participation and balance found in traditional VCSS organizations, nor, in some cases, the deliberative process to reach a consensus. The proliferation of standards setting bodies emerged in great part in reaction to the slowness and

[76] See, for example, May 1987, CISPR/A (Copenhagen/Secretariat), CISPR Sub-Committee A: Radio Interference Measurements and Statistical Methods, Collation of comments on document CISPR/A (Secretariat)) 96: Draft Recommendation…," Heirman papers.

perceived bureaucratic nature of VCSS processes in the new world of computers and digital communication.

One of the earliest and most influential of these new organizations is the Internet Engineering Task Force (IETF), which oversees standards related to the Internet. The computer scientists and U.S. Defense Department managers who built the ARPAnet created IETF in 1986, after they had developed the TCP/IP protocol and implemented it on that first computer network, to stabilize and continue to develop the network protocols in the context of the emerging and broader Internet.[77] It is an unusual body. According to *The Tao of IETF*, its online guide for new participants,

> The IETF is a loosely self-organized group of people who contribute to the engineering and evolution of Internet technologies. It is the principal body engaged in the development of new Internet standard specifications. The IETF is unusual in that it exists as a collection of happenings, but is not a corporation and has no board of directors, no members, and no dues….
> […]
> The IETF is not a traditional standards organization, although many specifications that are produced become standards. […]
>
> There is no membership in the IETF. Anyone may register for a meeting and then attend. The closest thing there is to being an IETF member is being on the IETF or Working Group mailing lists (see Section 2.3).[78]

From the start, this loosely organized group of technically knowledgeable individuals has sought to govern the Internet with minimal hierarchy. They view their openness to anyone with the

[77] For the story of the Internet's origin, see Janet Abbate, *Inventing the Internet* (Cambridge, MA: MIT Press, 1999). For a treatment of the standards war around TCP/IP and the ISO's Open Systems Interconnection standard, see Andrew L. Russell, "'Rough Consensus and Running Code' and the Internet-OSI Standards War," *IEEE Annals of the History of Computing*, 28:3, pp. 48-61.

[78] Paul Hoffman, editor, The Tao of IETF: A Novice's Guide to the Internet Engineering Task Force (copyright 2012 IETF Trust, http://www.ietf.org/tao, accessed 2/16/2014. For a fuller explanation of the process of IETF standardization, see Natalie Nelson Marsh, "Reconsidering the Conceptual Relationship between Organizations and Technology: A Study of the Internet Engineering Task Force as a Virtual Organization," PhD dissertation, Dept. of Comm., University of Colorado at Boulder, 2006.

technical knowledge to participate as essentially democratic.[79] Moreover, they see themselves as better protectors of the Internet from commercial interests than are traditional VCSS organizations, which they view as hierarchical, rule-bound, and slow.[80] They believe in "rough consensus," rather than the more deliberative, respectful consensus of traditional VCSS organizations, and their processes do not require full consideration of every negative opinion before reaching a decision.[81] Because IETF has no membership, and, in fact, no real voting, the chair of a working group is empowered to judge when adequate "rough consensus" has been achieved in the group (sometimes by asking attendees at meetings to hum for their preferred alternative!).[82] In addition to embracing the "rougher" version of consensus, without due process to provide respectful consideration of every opinion, the IETF has a decision-making process that does not require the balance between producers, consumers, and unaffiliated engineers required in the traditional VCSS organizations, thus removing the safeguard against having one set of interests dominate the standardizing system.[83]

In addition to the IETF, company consortia (e.g., X/OPEN, originally created to standardize the UNIX operating system and later merged into the Open Group), have become increasingly common venues for standards setting since the mid-1980s. Andrew Updegrove, a

[79] They certainly strive to be democratic. In recent years they have struggled with the fact that participation is dominated by older males from Western countries, sometimes referred to as grey beards, and are seeking ways to broaden individual participation on gender, age, and geographical dimensions. Because it has also become very vendor-driven, they have also sought to bring more researchers back in. (Phone interview with Karen O'Donoghue, Research Analyst, Internet Society and participant in IETF, 5/7/2013).
[80] Marsh, "Reconsidering the Conceptual Relationship…," and Russell, , "'Rough Consensus and Running Code.'"
[81] For an excellent explanation of the concept of "rough consensus" that has become central to the group's identity, see Russell, "'Rough Consensus and Running Code' …."
[82] The deliberative democracy literature might refer to the chair's decision on consensus as "decision by interpretation" (Jürg Steiner and Robert H. Dorff, "Decision by Interpretation: A New Concept for an Often Overlooked Decision Mode," British Journal of Political Science, 10:1 (January 1980), pp. 1-13).
[83] Since any interested and technically competent individual can join a committee email list or attend a meeting, a large firm could, in theory, pack a particular committee with its employees, thus potentially dominating committee decision making.

lawyer who specializes in setting up these bodies, described the reasons for their emergence as follows:

> Rightly or wrongly, a feeling arose in the late 1980s that the SDOs [standards developing organizations] acted too slowly to provide useful standards in the fast-paced world of technology. Further, their dedication to permitting all parties to participate in standard setting led some companies wishing to create products based on standards to feel that their needs were not being directly enough met.
>
> The result was the explosive formation, beginning in about 1987, of a myriad of unofficial groups of companies, each usually formed to create a standard to address a single commercial need. [84]

Firms launching consortia have not typically sought balance; on the contrary, they have sought a few other firms and organizations that shared their interests.[85] Moreover, companies and non-profit organizations usually pay significant dues to become members of a consortium and thus to be able to participate in its standardizing process, a practice sometimes referred to as "pay to play," which favors large companies over small new ones.[86] The companies that founded X/OPEN in 1984, for example, were all large European manufacturers of computer systems (Bull, ICL, Siemans, Olivetti, and Nixdorf). Such consortia generally started out to solve a specific standards problem, sometimes broadening their mandates and membership later, and sometimes closing down after the standard was developed and achieved broad uptake. In 2002, Carl Cargill, standards guru at Sun Microsystems and a prolific writer on standardization, lamented that "consortia, rather than SDOs, have won the lead position for creation of standards for the IT industry."[87]

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[84] Andrew Updegrove, ConsortiumInfo.org, *The Essential Guide to Standards,* published online at *http://www.consortiuminfo.org/essentialguide/*, accessed 2/17/2014.
[85] Carl Cargill, "Uncommon Commonality: A Quest for Unity in Standardization," in Sherry Bolin, ed., *The Standards Edge* (Ann Arbor, MI: Bolin Communications, 2002), pp. 29-39.
[86] See, for example, Maureen A. Breitenberg , "The ABCs of Standards Setting," NISTIR 7614 report, August 2009, http://gsi.nist.gov/global/docs/pubs/NISTIR_7614.pdf, accessed 2/17/2014.
[87] Cargill, "Uncommon Commonality: A Quest for Unity in Standardization," p. 36.

Cargill and a co-author have argued that some consortia are created to avoid the traditional standards setting (VCSS) process:

> Application consortia are usually the creation of a group of vendors who want to use collective action to accomplish a result that cannot be agreed to in an SDO, due to conflicts, options, or basic disagreements on the nature or intent of the technology being standardized. On occasion, a consortium is formed by a group that is trying to avoid the standards process and go directly to market with a product.[88]

The standards developed in consortia are sometimes later introduced as proposals into a traditional standards setting organization such as IEEE or ANSI at the national level or to IEC or ISO at the international level, in order to gain legitimacy not provided by the consortium process. Some of the traditional standards setting organizations have set up abbreviated processes to accommodate consortia standards setting, creating what ISO and IEC refer to as Publically Available Specifications (PAS), which fall short of International Standards and require a much less extensive process. The PAS offers traditional VCSS organizations a way to stay relevant in areas where consortia are dominating standards setting. IEC describes the PAS as follows:

> A Publicly Available Specification is a publication responding to an urgent market need, representing either:
>
> - a consensus in an organization (e.g. manufacturers or commercial associations, industrial consortia, user group and professional and scientific societies) external to the IEC or
> - a consensus of experts within a working group.
>
> A Publicly Available Specification does not conflict with an International Standard however competing Publicly Available Specifications on the same subject are permitted.
>
> The objective of a Publicly Available Specification is to speed up standardization in areas of rapidly evolving technology.[89]

[88] Martin Weiss and Carl Cargill, "Consortia in the Standards Development Process," *Journal of the American Society for Information Science*, 43:8 (September 1992), p. 561. Weiss and Cargill say this about what they term "implementation consortia," which "take a completed standard and try to make it usable" (p. 561).
[89] http://www.iec.ch/standardsdev/publications/pas.htm, accessed 2/17/2014

Of course, even though a consortium standard may gain PAS status, it has not gone through the balanced and time-consuming process followed by the IEC or ISO in setting normal international standards, with the benefit of the balance and due process used to assure respectful consideration of all viewpoints. If a consortium standard is moved into a Fast Track process towards becoming a real standard (not a PAS) in professional organizations such as IEEE, national bodies such as ANSI, or international bodies such as IEC and ISO, the shortened traditional process would be subject to some requirements for balance and consensus. But even in that case, the consortium itself has acquired a special agenda-setting power not given to an "unbalanced" body in the traditional process.

One important consortium that emerged in 1994 differed from typical consortia in many, though not all, ways. The World Wide Web Consortium (W3C), founded by the inventor of the Web, Tim Berners-Lee, has the stated mission "to lead the World Wide Web to its full potential by developing protocols and guidelines that ensure the long-term growth of the Web."[90] Like other consortia, its membership consists of firms and organizations that pay significant dues (though W3C offers a much lower rate for non-profits and very small firms).[91] Unlike many consortia, it was initiated by an individual who was not working for any firm and who saw its mission as being in the public interest. Today, its website states its first design principle as follows:

> **Web for All**
> The social value of the Web is that it enables human communication, commerce, and opportunities to share knowledge. One of W3C's primary goals is to make these benefits available to all people, whatever their hardware, software, network infrastructure, native language, culture, geographical location, or physical or mental ability.[92]

[90] http://www.w3.org/Consortium/mission.html, accessed 2/15/2014.
[91] Tim Berners-Lee with Mark Fischetti, *Weaving the Web: The Original Design and Ultimate destiny of the World wide Web by Its Inventor* (San Francisco, CA: HarperCollins, 1999), p. 94.
[92] http://www.w3.org/Consortium/mission.html, accessed 2/15/2014. Its patent policy may be found at http://www.w3.org/Consortium/Patent-Policy-20040205/, accessed 2/15/2014.

Broad use, not efficiency or firm profitability, is its most basic value. It also has an established royalty-free policy for its standards, which is more in line with practice in the traditional VCSS organizations in the early- and mid-20th century than with other consortia or even with many traditional VCSS organizations today.[93] Its processes share many aspects of VCSS processes, such as requirements for a high level of consensus. Indeed, an extensive W3C Process Document makes its goals clear up front:

> The Process Document promotes the goals of quality and fairness in technical decisions by encouraging consensus, requiring reviews (by both Members and public) as part of the technical report development process, and through an appeal process for the Advisory Committee.[94] [underlining indicates links in original]

Although the document spells out many rules, including rules around consensus and the appeals process (its equivalent of due process), it includes no explicit rules about balance in membership of its standard-setting committees, called working groups. There are only four web browser companies (the equivalent to the manufacturers in this realm) and currently 400 members, including firms, non-profits, and individuals, making it natural that they are not the majority in any W3C technical group. Nevertheless, many other members consider them to have greater power than other firms and individuals in the process, since if they do not implement a standard, the standard becomes irrelevant to the working of the web and thus to the other members.[95]

Even with this potential power asymmetry, some representatives from web browser companies feel that the W3C consensus process gives too much power to the many non-browser

[93] Most consortia and many traditional VCSS organizations allow patents as part of standards today, as long as they are disclosed in advance and made available for licensing on [fair,] reasonable and non-discriminatory terms ([F]RAND). For a discussion of the issues around defining RAND and FRAND, see Andrew Updegrove, "Case Watch: Judge Robart's Opinion in Motorola vs. Microsoft and the Future of FRAND," in *Standards Today,* 12:1 (July 2013), http://www.consortiuminfo.org/bulletins/#testimony, accessed 2/17/2014.

[94] World Wide Web Consortium Process Document, 1 August 2014, found at http://www.w3.org/2014/Process-20140801/, accessed 11/9/2014.

[95] Based on participation in and confidential interviews with members of a W3C working group in 2013 and 2014.

companies over the small number of browser companies. Indeed, WHATWG (Web Hypertext Application Technology Working Group), another standards group (though decidedly not a VCSS organization), was established to represent the interests of the browser manufacturers more directly and to eliminate the slow and painstaking aspects of deliberation and consensus.[96] Although anyone can contribute to its mailing list discussions free of charge, and there are no meetings that require attendance, the editor of a specification, typically from a browser company, has complete control over deciding which suggestions to accept and which not to accept. As the organization explains on its website, "This is not a consensus-based approach-- there's no guarantee that everyone will be happy! There is also no voting." The results are not fixed specifications, as at W3C, but what they refer to as "living standards" that are maintained and changed as needed. The process is more rapid and keeps up with what browser manufacturers offer, but it is not consensus based at all. One member of a browser manufacturer who has served on committees in IETF, W3C, and WHATWG explained to me that he objected to what he saw as W3C's excessive focus on process and consensus, arguing that it allowed non-web-browser companies to override browser companies, often leading the browser companies to ignore the standards.[97] Indeed, he asserted that WHATWG was created by browser companies that felt their concerns were being ignored in the name of consensus.

One recent development suggests some continuing (or possibly resurgent) appreciation of the VCSS process. In the summer of 2012, five organizations involved in the Internet and considered the more "open," and thus the more fair, of such organizations—IEEE, IAB (the Internet Architecture Board), IETF, the Internet Society, and W3C—joined together to establish

[96] WHATWG FAQ, on the WHATWG website, https://wiki.whatwg.org/wiki/FAQ#What_is_the_WHATWG.3F (accessed11/7/2014). This paragraph, including the quote, is based on this page. See also the main WHATWG page (https://whatwg.org/) and the Wikepedia entry for WHATWG (http://en.wikipedia.org/wiki/WHATWG), both accessed 11/7/2014.

[97] Interview by JoAnne Yates on 10/30/2014.

an alliance called OpenStand. Three of the five organizations (IEEE, IETF, and W3C) are standards setting organizations (with IEEE going back to the 19th century and IETF and W3C being more recent), while the other two (IAB and the Internet Society) are governance organizations, and they apparently initiated this alliance in opposition to proposals from the ITU for it to develop mandatory standards for the Internet.[98] OpenStand stated its principles as follows:

> "OpenStand: The modern paradigm for standards," 2012
>
> - cooperation among standards organizations;
> - adherence to due process, broad consensus, transparency, balance and openness in standards development;
> - commitment to technical merit, interoperability, competition, innovation and benefit to humanity;
> - availability of standards to all; and
> - voluntary adoption.[99]

The listed principles, especially those in the second bullet, are very much in keeping with VCSS principles, including due process, consensus, and balance. IEEE and W3C are both consensus-based and follow due process with its respect for other opinions, while IETF espouses only rough consensus and has norms that are less respectful of other opinions. Only the much older IEEE, with its traditional VCSS process, has explicit rules of balance.[100] IETF and W3C espouse the principle of balance in OpenStand, but lack explicit rules to guarantee balance. Openness and transparency seem to be newer additions that were not articulated in that way during most of the 20th century, when VCSS organizations were more comfortable with being technocratic and

[98] Alissa Cooper, "'OpenStand' Underscores Commitment to Voluntary Internet Standards," website of Center for Democracy and Technology, https://www.cdt.org/blogs/alissa-cooper/2908openstand-underscores-commitment-voluntary-internet-standards-process, accessed 2/27/2014.
[99] OpenStand website: http://open-stand.org/about-us, accessed 2/15/2013.
[100] The OpenStand site defines balance very much in keeping with VCSS principles: "Standards activities are not exclusively dominated by any particular person, company or interest group" (from http://open-stand.org/principles/, accessed on 2/17/2014).

including only those with technical expertise and from established firms and organizations.[101] To the extent that OpenStand affects standardization in this arena going forward, it may reinforce traditional VCSS principles. How much effect it will have, however, is still unclear.

Conclusion

The original VCSS organizations welcomed participation of interested players, created processes designed to transcend interests through respectful deliberation to reach a consensus, and adopted rules to safeguard against allowing one set of interests to dominate the process, all with a goal to serving the public interest. All these measures supported the goal of serving a broader public interest rather than simply specific firm interests. The ascendancy of consortia and other new types of standards setting bodies (e.g., IETF, W3C, WHATWG) in standard setting in the ICT arena, with the continued participation of interested firms but with processes that differ in the extent and nature of deliberation and in the nature (or even presence) of consensus, along with the absence of rules assuring balance, have implications for voluntary standards. Voluntary consensus standards have long been viewed by policy makers as serving public interests and as desirable alternatives to regulation in many realms, but with the changes of recent decades, this issue may need to be revisited. Altering the combination of participation, process, and balance may reduce the value of standards to the public in the long term.

[101] For a different view of openness in ICT standards, see Russell, *Open Standards and the Digital Age.* .