WORKING PAPERS

EAST-WEST CENTER WORKING PAPERS

Economics Series

No. 128, February 2012

America's Voluntary Standards System—A "Best Practice" Model for Innovation Policy?

Dieter Ernst

EAST-WEST CENTER
COLLABORATION • EXPERTISE • LEADERSHIP

EAST-WEST CENTER WORKING PAPERS

Economics Series

No. 128, February 2012

America's Voluntary Standards System—A "Best Practice" Model for Innovation Policy?

Dieter Ernst

Dr. Dieter Ernst, East-West Center senior fellow, is an authority on global production networks and R&D internationalization in high-tech industries and on industrial and innovation policies in China, the US, and emerging economies, with a focus on standards and intellectual property rights. He serves as a member of the US National Academies' Committee on Global Approaches to Advanced Computing.

Related publications include: *Indigenous Innovation and Globalization: The Challenge for China's Standardization Strategy (2011)* [Chinese publication in production]; *China's Innovation Policy Is a Wake-Up Call for America (2011), A New Geography of Knowledge in the Electronics Industry? Asia's Role in Global Innovation Networks (2009), Can Chinese IT Firms Develop Innovative Capabilities within Global Knowledge Networks?, 2008; China's Emerging Industrial Economy-Insights from the IT Industry* (with Barry Naughton), *2007; Innovation Offshoring-Asia's Emerging Role in Global Innovation Networks (2006).*

This paper is a first draft of a book chapter in Ernst, D., forthcoming, *Innovation Policy in the Global Knowledge Economy – Comparing the US, China, Taiwan and Europe.*

EastWestCenter.org/publications

Publication Sales Office| East-West Center
1601 East-West Road | Honolulu, Hawai'i 96848-1601

Tel: 808.944.7145 | Fax: 808.944.7376
EWCBooks@EastWestCenter.org

EAST-WEST CENTER
COLLABORATION • EXPERTISE • LEADERSHIP

America's Voluntary Standards System – A "Best Practice" Model for Innovation Policy?[1]

by

Dieter Ernst, East-West Center

Abstract

For its proponents, America's voluntary standards system is a 'best practice' model for innovation policy. Foreign observers however are concerned about possible drawbacks of a standards system that is largely driven by the private sector. There are doubts, especially in Europe and China, whether the American system can balance public and private interests in times of extraordinary national and global challenges to innovation.

To assess the merits of these conflicting perceptions, the paper reviews the historical roots of the American voluntary standards system, examines its current defining characteristics, and highlights its strengths and weaknesses. On the positive side, a tradition of decentralized local self-government, has given voice to diverse stakeholders in innovation, avoiding the pitfalls of top-down government-centered standards systems. However, a lack of effective coordination of multiple stakeholder strategies tends to constrain effective and open standardization processes, especially in the management of essential patents and in the timely provision of interoperability standards.

To correct these drawbacks of the American standards system, the government has an important role to play as an enabler, coordinator, and, if necessary, an enforcer of the rules of the game in order to prevent abuse of market power by companies with large accumulated patent portfolios. The paper documents the ups and downs of the Federal Government's role in standardization, and examines current efforts to establish robust public-private standards development partnerships, focusing on the *Smart Grid Interoperability* project coordinated by the National Institute of Standards and Technology (NIST).

In short, countries that seek to improve their standards systems should study the strengths and weaknesses of the American system. However, persistent differences in economic institutions, levels of development and growth models are bound to limit convergence to a US-Style market-led voluntary standards system.

[1] This paper is a first draft of a book chapter in Ernst, D., forthcoming, *Innovation Policy in the Global Knowledge Economy – Comparing the US, China, Taiwan and Europe*.

About the author

Dr. Dieter Ernst, East-West Center senior fellow, is an authority on global production networks and R&D internationalization in high-tech industries and on industrial and innovation policies in China, the US and emerging economies, with a focus on standards and intellectual property rights. He serves as a member of the US National Academies' Committee on Global Approaches to Advanced Computing. Dr. Ernst was a senior advisor to the OECD, Paris; research director of the Berkeley Roundtable on the International Economy (BRIE) at the University of California at Berkeley; professor of international business at the Copenhagen Business School; and scientific advisor to governments, private companies and international institutions, among them the World Bank, the U.N. Conference on Trade and Development, and the U.N. Industrial Development Organization. He was invited to provide expert advice and testimony by the US National Research Council, the US National Science Foundation, the US-China Economic and Security Review Commission, the Council on Foreign Relations, the US Council of Scientific Society Presidents, the US-China Cooperative Dialogue on Science & Technology, US-China Strategic and Economic Dialogue, the US Science and Technology Policy Institute (STPI) that assists the US government, the US Department of Commerce, the US Social Science Research Council, the Deloitte Center for the Edge**,** the Frontier Strategy Group.

Relevant publications include *Indigenous Innovation and Globalization: The Challenge for China's Standardization Strategy* (2011) [now published in Chinese]; *China's Innovation Policy Is a Wake-Up Call for America* (2011), *A New Geography of Knowledge in the Electronics Industry? Asia's Role in Global Innovation Networks* (2009), *Can Chinese IT Firms Develop Innovative Capabilities within Global Knowledge Networks?*, 2008; *China's Emerging Industrial Economy-Insights from the IT Industry* (with Barry Naughton), 2007; *Innovation Offshoring-Asia's Emerging Role in Global Innovation Networks* (2006): "Complexity and Internationalization of Innovation: Why is Chip Design Moving to Asia?", *International Journal of Innovation Management*, 2005; "Limits to Modularity - Reflections on Recent Developments in Chip Design", *Industry and Innovation*, 2005; *International Production Networks in Asia: Rivalry or Riches?* (2000), and *Technological Capabilities and Export Success - Lessons from East Asia* (1998).

Conflicting Perceptions

The American standards system is focused on voluntary consensus standards that are created by private-sector standard development organizations. For its proponents, the American system is an effective response to the new challenges that innovation policy faces in the global knowledge economy and hence it can serve as a 'best practice' model for other countries. In this view, the key to success is an informal, flexible bottom-up approach that provides "open" access and responds quickly to the accelerating pace of technical change and the sometimes disruptive shifts in markets.

The view from outside the US is different. Interviews with standardization experts from the US, Europe, Japan, China, Taiwan, Korea and India show that these foreign observers are well aware of the extraordinary achievements of the US market-led system of voluntary standards in generating innovation[2]. There is a keen interest to learn more about the potential advantages of a US-style voluntary standards system and how this system really works in practice.

But these foreign observers also expressed serious concerns about possible draw-backs of a standards system that is largely driven by the private sector. Foreign observers are particularly concerned about the capacity of the American system to balance public and private interests in times of extraordinary national and global challenges, and they doubt whether this system qualifies as a "best practice model" for other countries.

To assess the merits of these conflicting perceptions, this paper examines defining characteristics of the American standards system. The chapter is structured by two basic propositions.

First, it is well-documented in the literature that the deeply rooted US tradition of bottom-up, decentralized market-led standardization has been extraordinarily successful in generating innovation - not just for industrial products but also for software, services and business processes[3]. There is also ample evidence that the predominance of the private sector has clearly fostered entrepreneurship and risk-taking. However, after the recent global economic crisis, new questions have been raised whether the incentives for (sometimes excessive) risk-taking built into the US market-led standards system need to be countered by countervailing forces (including stricter regulations) that emphasize a careful assessment of the broader risks and social costs of innovation[4].

A second basic proposition is that the American system of standardization is a microcosm of US-style capitalism. As the literature on varieties of capitalism

---

[2] These interviews are part of the East-West Center's research on innovation policy in the Global Knowledge Economy. For research findings on China, see Ernst, 2011a, *Indigenous Innovation and Globalization: The Challenge for China's Standardization Strategy***,** UC Institute on Global Conflict and Cooperation; La Jolla, CA and East-West Center, Honolulu, HI., 123 pages http://www.EastWestCenter.org/pubs/3904

[3] National Science Board, 2010, *Science and Engineering Indicators* 2010, Arlington, VA: National Science Foundation; Lester, R.K and M. J. Piore, 2004, *Innovation – the Missing* Dimension, Harvard University Press, Cambridge, Mass; Mowery, D.C. and R.R. Nelson, eds, 1999, *Sources of Industrial Leadership*, Cambridge University Press; Rosenberg, N, 1972, *Technology and American Economic Growth*, Harper & Row, New York etc

[4] See for instance, proceedings of the international workshop "States of Innovation. Where Are We After 10 years of Nanotechnology Policy: The Case of Renewable Energy", organized by the Center for Nanotechnology in Society, University of California at Santa Barbara, in Lyon, France, April 29-May 1, 2010, http://www.cns.ucsb.edu/index.php?option=com_content&task=view&id=1184&Itemid=154, accessed May 21, 2010.

convincingly demonstrates, convergence among different varieties of capitalism is limited[5] – partial convergence often goes hand in hand with persistent diversity[6]. Hence, it may not be easy at all to transplant the American standards system to other countries. In fact, the decentralized voluntary American standards system is deeply embedded in "American political culture and the manner in which industrialization took place in the United States." [7]

The private sector has been developing *de facto* voluntary consensus standards, either within the firm or through inter-firm standardization in formal and informal committees. However, we will also see in this paper that the US federal government has played an important role, both directly and behind the scenes, in shaping the evolution and the defining characteristics of the US standards system. This has given rise to a unique form of public-private interaction which, for many foreign observers, is the less well-known side of the American standards system. Of particular interest is to understand how the boundaries set for the role of the government in standardization have moved over time, in line with shifts away from the welfare and warfare state to the deregulation of markets.

To understand the defining characteristics of the current US standards system and its strengths and weaknesses, I will proceed as follows. Section 1 reviews widely shared expectations in the US that the American System can serve as a "best practice model" for fostering innovation, and that this model can be replicated in other countries. Section 2 introduces a framework for analyzing the governance of the American standards system. Section 3 reviews the historical roots of that system, while section 4 describes potential strengths of the consensus voluntary standards system that is grounded in a tradition of local self-government.

Section 5 reviews what the literature has to say about drawbacks of the US voluntary standards system. Specifically, I will explore why America's voluntary standards system is prone to intense conflicts and lacks effective coordination that is needed for an integrated national innovation policy.

In section 6, we will then turn our attention to the missing link of the American standards system – the important role that the Federal government has played, distinguishing between direct and indirect government action[8].In particular, section 6 will document the ups and downs of the government's efforts to establish robust public-private standards development partnerships. In addition, I will address two important questions for observers of the American standards system: What forms of public-private standards development partnerships can help to coordinate and channel the tremendous

---

[5] Boyer, R., 1996, "The Convergence Hypothesis Revisited: Globalization but Still the Century of Nations?", in: S. Berger and R.Dore, eds, *National Diversity and Global Capitalism*, Cornell University Press Paperback, Ithaca and London. See also P. A. Hall and D. Soskice, eds., 2001, *Varieties of Capitalism. The Institutional Foundations of Comparative Advantage*, Oxford University Press, London

[6] For an empirical case study, see Ernst, D. and J. Ravenhill, 2000, "Convergence and Diversity - How Globalization Reshapes Asian Production Networks" in M. Borrus, D. Ernst and S.Haggard (eds), *International Production Networks in Asia: Rivalry or Riches?* (London: Routledge) pp. 226-56

[7] OTA, 1992, *Global Standards: Building Blocks for the Future*, chapter 2, "Standards Setting in the United States", page 39, Office of Technology Assessment, Congress of the United States, Washington, DC

[8] This is in line with Russell's observation that "there is no clear and concise definition of "the government role" in standardization; instead, there exists a multitude of direct and indirect influences to consider." (Russell, A., 2007, "The American System: A Schumpeterian History of Standardization. Part II", in *Progress on Point*, Release 14, The Progress Freedom Foundation, Washington, D.C., 4 March, p.16)

entrepreneurial and innovative energies that are set free in the pluralistic regime of creating voluntary consensus standards? And what changes would that require in the role played by the federal government?

These questions are addressed empirically in section 7 which examines current attempts to reestablish such public-private standardization partnerships, focusing on the Smart Grid Interoperability project coordinated by the National Institute of Standards and Technology (NIST).

The paper concludes with a summary of main findings and highlights generic policy implications.

1. Expectations

Proponents of the American system believe that a "voluntary standards system" is capable of accomplishing innovation policy objectives better than any other standards system, especially systems that are heavily reliant on the government. Hence, the American standards system should serve as a "best practice model" and other countries should strive to replicate the voluntary standards system.

Take the response of the American National Standards Institute (ANSI) to a national survey on the impact of globalization on US standards policies[9]. According to ANSI, "…[n]o change to the current private sector-led and public sector-supported standardization system is warranted,… [a]s … the current system works **well** [bolded in original, DE]." (ANSI, 2009: page 1). And the Commerce Department's International Trade Association argues that "the voluntary standards system has been a key to driving technical innovation and maintaining the United States' position as a global leader in technology… in today's global economy."[10]

For the proponents, the main asset of the American standards system is its informal, flexible bottom-up approach that provides "open" access. In a recent paper, Chuck Powers - a Motorola engineer who is a highly respected participant in US and international standards bodies - defines "open" access as follows: *"anyone can participate, can work to achieve results, can bring perspectives, and can work to achieve consensus. And it is not just big IP holders, as there are also a lot of small companies represented, individuals, universities, etc…"*[11]

Our interviews show that non-American observers find it difficult to accept such optimistic claims. Some interviewees acknowledge that this concept of open and equal access may well exist within informal peer-group networks of dedicated engineers whose overriding interest is to create something new and to get this job done as quickly as possible and without much fuss. Most foreign observers however remain skeptical that

---

[9] ANSI, 2009, *ANSI RESPONSE TO NATIONAL SURVEY QUESTIONS ON U.S. STANDARDS POLICIES, NPC 016-2009*, May 27,2009 http://publicaa.ansi.org/sites/apdl/Documents/Standards%20Activities/Critical%20Issues/Survey-US%20Standards%20Policies/ANSI-response-05-27-09.pdf, accessed May 20, 2010

[10] International Trade Administration [ITA], Department of Commerce, 2009, *The Voluntary Standards System: A Dynamic Tool for U.S. Economic Growth and Innovation*, seminar program, July 24, Washington, DC, page 2

[11] Powers, Chuck, 2009, "Public-Private Interaction in the US Standards System – New Challenges in the Global Knowledge Economy", in: NBR/EWC October 14, 2009 Beijing conference "Standards and Innovation Policy in the Global Knowledge Economy – Core Issues for China and the US" : http://cdn.nbr.org/announcements/Email/NBR_200910_ChinaStand.papers.html

really open access can be realized in industries that are shaped by intensive technology-based competition.

In fact, competition in the ICT industry is shaped by brutal rivalries and battles among leading players[12]. Under such conditions, the proposition of equal access may sound a bit too good to be true. In the rapidly moving ICT industry, success or failure is defined by return-on-investment and speed-to-market, and every business function, including R&D and standard development, is measured by these criteria.

As observed by the *Economist*, "…[i]n the computer industry, new standards can be the source of enormous wealth, or the death of corporate empires. With so much at stake, standards arouse violent passions. Much of the propaganda pumped out by individual firms is aimed at convincing customers and other firms that their product has become a 'standard' " [13]. As a result, companies have very little room for compromise on sharing the potentially significant economic rents to be reaped by those who shape and control the process of standardization.

A second broadly shared expectation in the US is that the American standards system should serve as a "best practice model" and that it can be replicated in other countries. In the management literature, a "best practice model" is defined as "the most effective and efficient method of achieving any objective or task"[14]. What constitutes best practice can be determined through a process of benchmarking. For standardization, the" best practice model" would imply that a standard development organization in another country is supposed to benefit from a process of progressive compliance ('convergence') with key elements of the American voluntary standards system.

That expectation can be found for instance in ANSI's "*United States Standards Strategy"*, approved by the ANSI Board of Directors on December 8, 2005 [15]. This document proposes the "universal application of the globally accepted principles for development of global standards" that are based on the US voluntary standards system. The document culminates in the following statement:

> *" Open and accessible, the U.S. standardization system has contributed its technology, in gigantic proportions, to other standardization models and to other societies. It is committed, not only to interests within its own territory, but to international standardization, and to a global trading system that is balanced and without obstacles. This strategy is designed to strengthen the standards system of the United States and all who benefit from it."* (ibid: p.VI)

---

[12] Ernst, D., 2002, "Electronics Industry", in: *The International Encyclopedia of Business and Management (IEBM), Handbook of Economics*, editor: William Lazonick, International Thomson Business Press, London.

[13] "Do it my way", *The Economist*, February 27, 1993, Vol. 326, Issue 7800, pages 11-12.

[14] *BNET Business Dictionary*, http://dictionary.bnet.com/definition/Best+Practice.html, accessed May 20, 2010

[15] ANSI, 2005, *United States Standards* Strategy, New York, p.IV. It is noteworthy that, after 2005, no attempt has been made to update ANSI's standards strategy doctrine so that it can address new challenges in the dramatically altered post-crisis global economy.

A similar optimism was expressed by two speakers from US industry at the EWC-NBR China standards conference in October 2009 in Beijing[16]. Both speakers emphasized that the US market-led system of standardization should inform China's policies to develop and implement its standardization strategy. According to Chuck Powers,

> *"the U.S. standards system is healthy and robust because there is a careful balance of competing interest; the open process ensures the system is appealing to all stakeholders, without unnecessary requirements; the U.S. government plays a limited role and simply ensures a level playing field; and there are numerous examples of successful U.S. standards deployed around the globe. It is also scalable because it can balance competing interests globally, not just in the US."* (Powers, 2009)

But is it realistic to assume that other countries, including China, will over time converge to the US-style market-led standardization system as the "best practice" model?

In fact, in our interviews we found that the proposition of natural convergence to the US system was met with considerable skepticism by standards experts in China and in other emerging economies[17].

Unfortunately, an important weakness of the standardization literature is that we still lack systematic research that compares different national standards systems and their divergent development trajectories[18]. Existing comparative studies are focused on a comparison of the American and the European systems, neglecting important developments in Japan[19], India, Brazil, Russia, and, most importantly, China. An example of this outdated view of the global map of national standards systems can be found in an article published in the Journal *World Politics* that argues:

> *"What emerges from the study of the formal institutions and organizational practices is that there are, broadly speaking, two types of institutional systems at the national level: an American (U.S.) system of standardization, which is fragmented,*

---

[16] Amy Marasco, General Manager, Standards Strategy at Microsoft, and Chuck Powers, General Manager, Corporate Standards Office, Motorola

[17] For an analysis of what explains this skepticism and whether there is scope of system convergence, see Ernst, 2011a

[18] There are of course many specialized data bases for engineers that compare technical standards for particular technologies. But very little research exists that compares institutional arrangements and strategies that shape different national standards systems. On data bases for engineers, see for instance http://www.engineeringtoolbox.com/pipes-codes-standards-t_17.html. Accessed, April 30, 2010

[19] On Japan's standardization strategy, see the interesting presentation by Toru Yamauchi, (Former Director of Industrial Standards Research, Japan International Cooperation Agency (JICA), on "Comprehensive strategy for international standardization activities for Japan", October 8, 2004. http://www.cicc.or.jp/japanese/hyoujyunka/pdf_ppt/04SEJapanese%20Standardization%20Polocy.pdf , accessed 30 April 2010. An interesting comparison of Japanese and US standards systems can be found in Leiponen, A., 2001," National styles in the setting of global standards: The relationship between firms standardization strategies and national origin", in: Newman, A. and J. Zysman (eds), *How Revolutionary was the Revolution? National Responses, Market Transitions, and Global Technology in the Digital Era* by A. Newman and J. Zysman (eds.). Stanford University Press, Stanford, Ca. See also John R. McIntyre, 1997, *Japan's Technical Standards - Implications for Global Trade and Competitiveness*, Praeger Publishers

market driven, and characterized by a high degree of internal competition, and a markedly more hierarchical and highly coordinated system in Europe, which is also publicly regulated and subsidized."[20]

It is time to move beyond this geographically restricted research agenda, and to take note of important developments in the national standards systems of emerging economies. A detailed comparison between the US and Chinese standards systems is beyond the scope of this paper. But, "even a cursory comparison shows how national approaches to standardization embody a great variety of choices and tradeoffs that are time and place specific." (Russell, 2005: p. 3)

In the remainder of chapter two and in chapter three on China, I will explore whether there is scope for system convergence, and highlight important differences in the historical trajectory of the US and the Chinese standards systems. The analysis reviews differences in the historic development of both systems, examines how the role of government and industry differs, reviews strengths and weaknesses of both systems, and examines how both standards systems differ in their approaches to international institutions.

The findings of this paper on the American standards system will lead to an important proposition for future research: While standards everywhere are confronted with similar tasks, there are significant differences in the organization and governance of standardization processes. These differences reflect peculiar characteristics of a country's economic institutions, its level of development, its economic growth model, as well as its culture and history.

2. Governance

What do we know about the governance of the American standards system? How do we define and measure the ingredients of governance in standardization? Who are important stakeholders and what is their role in standards development? And what does this tell us about the efficiency and distributive justice of the American standards system?

Bell (2002) provides a general definition of "governance" that we can use as a starting-point - the use of institutions, structures of authority and collaboration to allocate resources and coordinate or control activity in society or the economy.[21] What is an appropriate definition of "governance" that allows us to capture critical challenges for standards development?

2.1. Evolving tasks of standardization

There is an almost infinite number of standards that differ in their form and purpose. To shed light on the evolving tasks of standardization, we first need to open the black box of standards and introduce an operational definition. A state-of-the-art definition that serves our purpose well is provided by the National Institute of Standards

[20] Mattli, W. and T. Buethe, 2003, Setting International Standards. Technological Rationality or Primacy of Power?, *World Politics*, 56, October, pages 1 -42.
[21] Bell, Stephen, 2002. *Economic Governance and Institutional Dynamics*, Oxford University Press, Oxford.

and Technology (NIST) as part of its Smart Grid Interoperability Standards project[22]: Standards are

> *"…[s]pecifications that establish the fitness of a product for a particular use or that define the function and performance of a device or system. Standards are key facilitators of compatibility and interoperability. …* Interoperability…[is].. *the capability of two or more networks, systems, devices, applications, or components to exchange and readily use … meaningful, actionable information - securely, effectively, and with little or no inconvenience to the user.…* [Specifically, standards] *define specifications for languages, communication protocols, data formats, linkages within and across systems, interfaces between software applications and between hardware devices, and much more. Standards must be robust so that they can be extended to accommodate future applications and technologies."*

In the literature, standards are normally categorized as 'proprietary' versus 'open', and as '*de facto* versus' '*de jure*'[23]. Proprietary standards are owned by a company that may license them to others, while open standards "are available to all potential users, usually without fee"[24]. *De facto* standards achieve adoption through standards competition among rival standards consortia. Finally, *de jure* standards are adopted through consensus, which is sometimes formally expressed through industry committees or formal standards organizations[25].

At the most fundamental level, standards are necessary to ensure the quality and safety of products, services and production processes, and to prevent negative impacts on health and the environment. Hence, an important function of standards is to reduce "risks for makers of compliant products and users of these products." [26]

In addition, standards are necessary to reap the growth and productivity benefits of increasing specialization, analyzed long ago in chapter III ("That the Division of Labor is Limited by the Extent of the Market") of Adam Smith's "The Wealth of Nations"[27]. According to economic historian Charles Kindleberger (1983: p.378, 379), "… [f]or the most part, standardization was originally undertaken by merchants" to facilitate a progressive specialization through trade."

Today however, specialization extends well beyond trade into manufacturing and services, including engineering, product development and research. Equally important is the international dimension. As globalization has been extended beyond markets for goods and finance into markets for technology and knowledge workers, standards are no longer restricted to national boundaries. Standards have become a critical enabler of

---

[22] NIST, 2010, Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0 , Office of the National Coordinator for Smart Grid Interoperability, NIST Special Publication 1108, National Institute of Standards and Technology, US Department of Commerce, Washington, D.C., January, pages 19 and 20

[23] Stango, V., 2004, "The economics of standards wars", *Review of Network Economics* 3: pages 1-19

[24] Steinfield, C.W. et al, 2007, "Promoting e-business through vertical IS stnadrads: lessons from the US home mortgage industry", in: Greenstein, S. and V. Stango, eds., *Standards and Public Policy*, Cambridge University Press, page 163

[25] See discussion under 2.3.1. Different standardization processes

[26] Alderman, R., 2009, "Market Inefficiencies, Open Standards, and Patents", manuscript, VITA, pages 2 and 3.

[27] Smith, A., 1776/1970, Book One, chapter III, Penguin Books, Harmondsworth, Middlesex, England

international trade and investment – they facilitate data exchange as well as knowledge sharing among geographically dispersed participants within global corporate networks of production and innovation[28]. As network sociologists emphasize, the "creation and diffusion of standards underlying new technologies is a driving element of contemporary globalization."[29]

In short, standards are the lifeblood of innovation in the global knowledge economy. Today, standards are necessary not only to reap economies of scale and scope, but also to reduce transaction costs and to prevent a duplication of efforts. In addition, standards are required to enable data transfer and knowledge exchange and to facilitate interoperability of components and software within increasingly complex technology systems (e.g., a laptop, a hand set or a switching system). Without interoperability standards, it would be impossible to achieve 'network externalities' which shape competition in markets for products and services that use information and communication technologies (ICT)[30]. In these markets, "…[a]s the set of users expands, each user benefits from being able to communicate with more persons (who have become users of the product or service)."[31] 'Network externalities' imply that a company succeeds "when customers expect that the installed base of … [the company's] … technology [will] become larger than any other," with the result that the customers "adopt that technology to the virtual exclusion of others"[32].

To cope with these critical challenges, standardization has become a complex and multi-layered activity that involves multiple stakeholders who differ in their objectives, strategies, resources and capabilities. In the US, stakeholders are primarily from the private for-profit sector; but they also involve government agencies, and non-profit organizations like universities, research labs, and NGOs.

Most importantly, standardization is a highly knowledge-intensive activity that requires well educated and experienced engineers and other professionals. While engineers originally created this discipline, key concepts are now shaped by legal counselors as well as corporate executives and government officials[33]. Equally important is that considerable financial resources are required to develop and implement effective standards. Our interviews with leading standards experts show that the cost of standardization involves, but is not restricted to, the following tasks[34]:

- Develop the technology to support the standard

---

[28] Ernst, D., 2005, "The New Mobility of Knowledge: Digital Information Systems and Global Flagship Networks", in: Latham, R. and S. Sassen (eds.), *Digital Formations. IT and New Architectures in the Global Realm*, Princeton University Press; and Ernst, D. 2005, "Limits to Modularity - Reflections on Recent Developments in Chip Design", *Industry and Innovation*, 2005; Vol. 12, No. 3, 303–335, September

[29] Grewal, D.S., 2008, *Network Power. The Social Dynamics of Globalization*, Yale University Press, page 194

[30] Katz, M. and C. Shapiro, (1985), "Network Externalities, Competition and Compatibility," *American Economic Review*, vol. 75 (3), pp. 424-440.

[31] Rohlfs, J.H., 2001, *Bandwagon Effects in High-Tech Industries*, MIT Press, Cambridge, Mass.,: p.8

[32] Sheremata, W.A. , 2004, "Competing through innovation in network markets: strategies for challengers". *Academy of Management Review*, 29:3: page 359

[33] Spring, M.B., 2009, "What have we Learned About Standards and Standardization?", manuscript, School of Information Sciences, University of Pittsburgh, 14 pages

[34] This is based on discussions with Chuck Powers at Motorola, WANG Ping at CNIS, Alan Fan Zhiyong at Huawei, Zhang Yang at IBM China, and Klaus Ziegler, European Standardization Expert for China.

- Cost-benefit analysis of whether to adopt existing international standard or to create a new standard
- Licensing fees for essential patents (both for existing standards and for newly created standards)
- pass testing, conformity assessment and certification
- membership fees for formal and informal standard development organizations
- Logistics (travel etc)
- Cost/risk of including IP into a standard
- Patent pool management
- Back-end support
- Legal (litigation)
- Lobbying

It follows that effective governance of standardization requires decisions on how to organize the allocation of productive resources (especially human and financial resources) that are necessary to achieve the above tasks. As standardization involves multiple stakeholders, the governance of standardization really boils down to the question: who controls strategic resources and who shapes the underlying standardization strategy and the resultant distribution of costs and benefits?

2.2. Corporate governance concepts

As private industry is a central player in the American standards system, the next step is to ask: What can we learn from the study of corporate governance? Corporate governance theory comes in three flavors: shareholder theories; stakeholder theories; and theories that link corporate governance with broader performance measures of the economy, including innovation, employment generation and productivity.

For the *shareholder* theory of corporate governance, the key issue is that shareholders (the 'principals') who bear the residual risk, have no assurance that the corporate managers or 'agents' who make decisions that affect shareholder wealth will act in the shareholder interests. In that view, the main task of corporate governance is to develop pragmatic organizational solutions that allow mitigating the agency problem between shareholders and managers[35].

The *stakeholder* theory of corporate governance extends this discussion to include other stakeholders, such as employees, suppliers, customers, as well as governmental bodies, political groups, trade associations, trade unions, communities, associated corporations, prospective employees, prospective customers, and the public at large. Much of that theory is normative and focuses on business ethics and corporate social responsibility[36]. The Brookings Institution's Margaret Blair however focuses on the long-term employees who "over the years, build up firm-specific skills that are an important part of the firm's valuable assets, but which the employees cannot market elsewhere, precisely because they are specific to the firm…. These employees…[thus bear some of the residual risk. They]…have contributed capital to the firm, and that capital is at risk to

[35] See for instance Fama, E. and Jensen, M., 1983, "Separation of Ownership and Control", *Journal of Law and* Economics, 26:301-25

[36] Phillips, R. R. and E Freeman, 2003, Stakeholder *Theory and Organizational Ethics*. Berrett-Koehler Publishers

the extent that the employees' productivity and the wages they could command at other firms are significantly lower than what they earn in that specific firm."[37]

Finally, the definition of corporate governance proposed by Bill Lazonick and Mary O'Sullivan is much broader than definitions that focus on the distribution of profits among shareholders, managers, workers and other stakeholders. In a study for the European Commission, Lazonick and O'Sullivan define "corporate governance" as the social process that determines the corporate allocation of resources and returns that shape a country's innovation and competitiveness[38]. That broader concept of corporate governance is the most relevant one for our discussion of the governance of the American standards system.

2.3. Key questions

Drawing on these three theoretical approaches, I suggest to use two questions to study the governance of the American standards system:

- What processes are used to organize the development and implementation of standards? And how do these processes differ for the main types of standards (proprietary, open, *de facto*, *de jure*), and across industries and countries, in terms of the incentives and mechanisms used to allocate strategic resources and to distribute returns?
- Who are the main stakeholders that shape strategy and organization? And how do these stakeholders differ in their business models and in their capacity to shape standards?

2.3.1. Different standardization processes

There are significant differences in the organization and governance of standardization processes. These differences reflect peculiar characteristics of a country's economic institutions, its level of development, its economic growth model, as well as its culture and history (Kindleberger, 1983: p.383). Differences in standardization processes also reflect diversity in the "underlying conditions of population, technology, resources, products and tastes." Finally, and most importantly, standardization processes differ across industrial sectors, reflecting differences in technology, demand patterns and competitive dynamics.

Michael Spring emphasizes that "the processes used to develop standards are different and have changed over time." (Spring: 2009a; p.7). He argues that, while standardization theory has developed fairly robust typologies of standards, little progress has been made in developing a taxonomy of standardization processes that examines the impact of different determinants. In practice, "standards development is sometimes as much serendipity and/or chaos as plan." (ibid; p.6)[39]

---

[37] Blair, M., 1995, *Ownership and Control: Rethinking Corporate Governance for the Twenty-First Century*, Brookings Institution, Washington, D.C., page 15

[38] Lazonick, W. and M. O'Sullivan, 2000, *Perspectives on Corporate Governance, Innovation, and Economic Performance*, report prepared for the European Commission (Contract no.: SOE1-CT98-1114; Project no: 053), pages 2-5

[39] Serendipity is the effect by which one accidentally discovers something fortunate, *especially* while looking for something entirely unrelated.

I suggest to distinguish seven types of standardization bodies, proceeding from 'formal' to more 'informal' organizations[40]:

- government agencies, like the German DIN Standards Institute, and the U.S. National Institute of Standards and Technology (NIST), in its role as coordinator of the Smart Grid Interoperability Standards project[41];
- national private non-profit organizations that are officially accredited to represent national interests, such as the American National Standards Institute (ANSI);
- officially accredited international organizations, such as the International Standards Organization (ISO), the International Telecommunications Union (ITU), or the European Telecommunications Standardization Institute (ETSI);
- trade or professional associations to which quasi-official authority has been delegated (IEEE);
- trade or professional associations broadly open to all comers, like the Consumer Electronics Association;
- private sector associations where membership is at the corporate level, such as the National Electrical Manufacturers Association (NEMA);
- and, most importantly, multiple layers of rapidly evolving informal standard-setting consortia with diverse business models. Common to all of these consortia is that they seek to produce *de facto* industry standards through processes with 'by-invitation-only' membership.

In theory, all of these formal standard bodies and consortia are supposed to share the following objectives: foster the unhindered application of standards; prevent blocking of standards; early disclosure of essential patents; and FRAND licensing conditions. In reality, however, there are many conflicting interests and diverse strategies and organizational approaches, as we will see below.

The above taxonomy presents a static snapshot. Yet, all of the above standardization processes are constantly evolving, seeking to adjust to the rapid pace of technical change and ubiquitous globalization. Since the 1980s, the combined impact of liberalization, deregulation and privatization has increased the importance of intellectual property rights (especially patents) for standardization in the information and communications technology (ICT) industries. This has forced formal standardization bodies to become more active. At the same time, many of these organizations are under intense pressure to redefine their role and to reform their rules and governance approaches.

But the most remarkable change in the dynamics of standardization processes is the rise of informal standardization processes. Especially in the ICT industries, private consortia, clubs and alliances have gained in importance relative to formal standardization processes[42]. The rapid growth of consortia has resulted in substantial

[40] This taxonomy is adapted from a taxonomy proposed in West, J., 2007, "The economic realities of open standards: black, white and many shades of gray", in: Greenstein, S. and V. Stango, eds., *Standards and Public Policy*, Cambridge University Press, page 94

[41] See below section 7. The Smart Grid Interoperability project – A new approach to public-private standardization partnerships?

[42] Blind, K. and Gauch, S. 2005. Trends in ICT Standards in European Standardisation Bodies and Standards Consortia, IEEE SIIT2005 Proceedings pp. 29-39. See also Cargill, C. and S. Bolin, 2007,

changes in governance arrangements for standard-setting. To start with, consortia membership typically is restricted. Membership conditions vary, depending on the importance of the standard, and can range from 'fixed group' arrangements where no new members are allowed, to 'country club' arrangements that may accept new members with qualifications. Some consortia apparently allow for more openness, by using the 'fitness club' model that allows for nondiscretionary membership[43].

Second, it is now much more difficult to distinguish between open and proprietary standards [44]. Not all self-declared 'open' standards are really open. In fact, industry leaders with strong IPR portfolios prefer to use consortia to push their platform leadership strategies, i.e. to establish *nominally open,* but *de facto proprietary industry standards*[45].

Third, a somewhat surprising characteristic of ICT standardization consortia is that they are less flexible and open than is widely assumed. Initially these consortia were meant to foster greater openness and to drive non-formal standards at a faster pace. However, many ICT consortia "are now as established and 'procedural' as the organizations they were meant to supplant…. (In many cases,) …they actually prove less effective than traditional standard-setting organizations."[46] In fact, by focusing on the input to the process, not the outcome, standards consortia fail to provide a guarantee that products can be easily built from these standards.

Furthermore, there is an issue of unequal control over resources and decision-making. Empirical research shows that standard-setting is prone to 'collective action' problems between diverse players that have vastly different bargaining power[47]. In many ICT standards consortia, standards are highly "impure public goods" that are used by incumbent industry leaders to block competitors and to deter new entrants[48].

A survey conducted in 2007 of the 250 major standard consortia in the ICT industry shows that about 500-100 major players, plus governments in the US, the EU and Japan determine what these consortiado, and more importantly, how they do it." (79brinkburn, 2007). The major players included the usual suspects, with the top ten

---

"Standardization: A Failing Paradigm", in: S. Greenstein and V. Stango, 2007, eds., *Standards and Public Policy*, Cambridge University Press, Cambridge

[43] West, Joel, 2007, "The Economic Realities of Open Standards: Black, White and Many Shades of Gray," in Shane Greenstein and Victor Stango, eds., *Standards and Public Policy,* Cambridge: Cambridge University Press, 2006, page 100

[44] Blind, K. and N. Thumm, 2004," Intellectual Property Protection and Standardisation". Int. J. IT Standards and Standardization Res. 2(2): 61-75 (2004)

[45] For a detailed study of the shift to nominally open, but *de facto* proprietary computer systems in the mid-1980s, see Ernst, D. and D. O'Connor, 1992, *Competing in the Electronics Industry. The Experience of Newly Industrialising Economies,* OECD Development Centre Studies, OECD, chapter 5.

[46] 79Brinkburn, 2008, *The Brinkburn Analysis Examines China*, Gateshead, Tyne and Wear, UK p.4

[47] For case studies, see: Garcia, D.L., B.L. Leickly, and S. Willey, 2005, "Public and Private Interests in Standard Setting: Conflict or Convergence, in: *The Standards Edge: Future Generations*, The Bolin Group, Ann Arbor/Michigan; and Bekkers, R.N.A. & West, J. (2009). Standards, patents and mobile phones : lessons from ETSI's handling of UMTS. *Journal of IT standards and standardization research, 7*(1), 13-34.

[48] As P.A. Samuelson observes, most of the real economy operates in the messy world of 'impure public goods', i.e. they are provided through some form of exclusion through clubs or consortia (Samuelson, P.A., 1969. "Pure Theory of Public Expenditure and Taxation", in: Margolis, J./Guitton, H. (Eds.): Public Economics, London. Reprinted in: Stiglitz, J. E. (Ed.), The Collected Scientific Papers of P.A. Samuelson, 6. ed., 1986.)

leaders being IBM, Microsoft, Fujitsu, Intel, Hewlett Packard, Hitachi, Sun Microsystems (since then acquired by Oracle), Nokia, Ericsson and Texas Instruments.

Of the 50 major players in ICT standardization organizations, 25 were from the US, 12 from the EU, and 8 from Japan. Only 5 companies from emerging countries (all from Asia) were consortia members, i.e. Samsung, Huawei, LG, Lenovo and ZTE. In addition, the study shows that, of the 753 corporate memberships in major ICT standard consortia, these five companies from China and Korea accounted for 51 memberships, less than seven percent of all memberships. But this has started to change, with large Chinese organizations (both companies and research institutes) playing a much more active role in international standards consortia[49].

2.3.2. Multiple stakeholders in standardization – A taxonomy

To determine who the main stakeholders in standardization are, I suggest distinguishing three groups – IPR owners, standard implementers, and standard users. It is useful to further disaggregate this group by size, capabilities, and business model. Of particular interest are three types of IPR owners:

- Large platform leaders who cooperate on standards (to enhance the markets for their technology platforms (e.g. Intel or Microsoft), but who compete on implementations.
- Large and diversified global corporations (such as IBM) who have a large enough portfolio of resources to compete both on implementations and on standards, depending on the competitive requirements of specific sectors[50].
- Smaller specialized technology and component suppliers (e.g. Nvidia, Broadcom or Tensilica[51]) who compete on standards by accumulating a large stock of patents for defensive cross-licensing.

There are multiple layers of *standard implementers* who depend on standards to design and/or produce components, platforms, final products, and services. This is a highly diverse group of stakeholders that encompass system integrators (like telecom service providers), producers of core components (like IC design companies) or producers of final products. Among standards implementers, the diversity is even greater than for IPR owners, in terms of size, capabilities, and business model. What matters however is that standard implementers are gaining in importance relative IPR owners in shaping the outcomes of standardization battles. According to Ken Krechmer, this may

[49] For a detailed analysis of Huawei's successful penetration of international standard development organizations, see Ernst, 2011, chapter III.

[50] IBM's primary interest has shifted from hardware to software and services. IBM promotes open standards to gain market share in the latter two industries. At the same time however, IBM competes fiercely on standards for mainframe computers where it continues to reap substantial profits.

[51] Nvidia is a global leader is the design of high-performance graphics processors (GPUs). Broadcom is one of the world's largest fabless communications semiconductor companies with 2009 revenue of $4.49 billion, and holds over 4,050 U.S. and 1,650 foreign patents, more than 7,900 additional pending patent applications, and intellectual property portfolios addressing both wired and wireless transmission of voice, video and data. Tensilica designs customizable processors for multiple applications in computers, communication devices and consumer devices.

well explain the increasing intensity of debates about what really constitutes "open standards"[52].

As for *users,* their primary interest is *network externalities*, as well as improvements in performance, quality and price. All users would like to avoid being locked into closed proprietary technology platforms. But users also differ. I suggest distinguishing between intermediate and final users. Intermediate users are typically sophisticated enough to understand and shape standardization processes. This is not the case for final users. Their representation tends to be weak, "since …[they]… tend to be diffuse and not technically sophisticated. In addition, large firms …[DE: both IPR owners and implementers]… often have an advantage in volunteering resources that influence the outcome, such as trained engineers to serve in the organization – engineers who may write standards in their employers' interests." [53]

An important concept for research on stakeholders in standards and innovation policy is the 'platform paradox'[54]. This concept reflects conflicting interests between, on the one hand, large platform leaders (who cooperate on standards, but compete on implementations) and smaller specialized technology and component suppliers (who lack a broad portfolio of complementary assets and hence compete on standards by accumulating a large stock of patents for defensive cross-licensing).

The 'platform paradox' describes a fundamental trade-off of 'open standards'. By facilitating component-level innovation ('modular design'), open standards promote an increased division of innovative labor and hence create favorable conditions for innovation by smaller specialized technology suppliers. At the same time, however, open standards provide the specialized technology suppliers with incentives for opportunistic behavior that can undermine the openness of the standards. These small firms lack a broad portfolio of complementary assets (e.g. scale or time-to-market advantages; superior design; marketing and distribution networks; etc), and cannot compete on applications. This is why they will seek to use their IPR to delay or withhold important technical information and/or to increase their licensing fees.

In short, the diversity of stakeholders in standardization indicates the tremendous challenge that the American standards system is facing to implement forms of governance that combine speed and efficiency with a reasonably fair distribution of the costs and benefits of standardization.

3. Historical roots

To understand the strengths and weakness of America's current standards system, we need to go back to the 18th century, when the nation entered the industrial stage[55]. In

---

[52] Krechmer, K, 2005, "Open standards requirements", *The International Journal of IT Standards and Standardization Research*, Vol. 4 No. 1, January - June 2006

[53] Greenstein, S. and V. Stango, 2007, Introduction, in: S. Greenstein and V. Stango, eds., *Standards and Public Policy,* Cambridge: Cambridge University Press, 2006, page 11

[54] Simcoe, T., S. Graham, and M. Feldman (2007). "Competing on Standards? Entrepreneurship, Intellectual Property and the Platform Paradox." NBER Working Paper 13632, http://www.nber.org/papers/w13632. accessed May 23, 2010.

[55] Fortunately, the recent surge in academic interest in standardization is no longer limited to research on business, economics and engineering. There is now a substantial body of research on the historical development of standardization. See for instance Anh, V.Y., 2006, "An introduction – The history of standardization", in: Hesser, W., A. Feilzer, and H. de Vries (eds.), *Standardization in Companies and*

contrast to many other countries, where unified national standards bodies were established in conjunction with the State, "standards development organizations in the US first emerged in the private sector, in response to specific needs and concerns." (OTA, 1992: p.39)

3.1. Early pioneers

Early pioneers in US standardization were scientific and technical societies (like the American Society of Civil Engineers, established in 1852, the American Society for Mechanical Engineers, established in 1880, and the American Society for Testing and Materials, established in 1898) and trade associations (like the American Iron and Steel Institute, established in 1855). Right from the beginning, these societies and associations had the right to make their own standards.

Take the American Society for Mechanical Engineers which has a tradition and solid record of supporting historical publications that trace the evolution of that society[56]. The ASME was founded in 1880 by prominent engineers. In the US, that was a time when engineering schools and institutions grew rapidly. As engineering was still a new profession, "engineers of the day moved easily among the concerns of civil, industrial, mechanical and mining engineering."[57] Steam power was the dominant technology, driving locomotives, ships, factory, machinery and mine equipment. As boiler explosions multiplied, spectacular accidents aroused public outcries for improving the safety of boilers and related equipment. "A Boiler Code Committee was formed in 1911 that led to the Boiler Code being published in 1914-15 and later incorporated in laws of most US states and territories and Canadian provinces." (ASME 2010:p.1)

These and other early US standards (such as standards for building codes and fire equipment) "…were driven by public pressure and the ethical concerns of the engineering profession. Standardization was a solution demanded by public concern and professional responsibility. "(Spring, 2009: p.6). In my interviews with US engineers who are involved in standardization, I found that there is still a very strong sense of these original motivations. This arguably explains why US engineers remain deeply attached to the US voluntary standards system with its long tradition of decentralized decision-making. As Chuck Powers puts it – the American standards system "…is a highly successful system because it is driven from the bottom-up." (Powers, 2009). The flipside of course is a deep distrust of government-centered standards systems.

3.2. Railways standardization

The main catalyst for the emerging US standards system was the massive standardization effort required to interconnect America's railways. According to

---

Markets; and Russell, A.L., 2005b, "Standardization in History: A Review Essay with an Eye to the Future," in Sherrie Bolin, ed., *The Standards Edge: Future Generations* (Ann Arbor, Michigan: Sheridan Books, 247-260.

[56] Ferguson, E.S., 1974, "A Sense of the Past: Historical Publications of the American Society of Mechanical Engineers", downloaded April 22, 2010 from http://www.asme.org/Communities/History/ASMEHistory/Sense_Past_Historical.cfm. See also Sinclair, B., 1980, *A Centennial History of the American Society of Mechanical Engineers 1880-1980*, Toronto University Press, Toronto.

[57] ASME, *A Brief History of ASME*, page 1, downloaded April 22, 2010 from http://www.asme.org/Communities/History/ASMEHistory/Brief_History.cfm

economic historian Alfred D. Chandler, cooperation between business enterprises "was essential for the creation of an integrated national transportation network. Without such cooperation the standardization of equipment and operating procedures required to move through passengers and freight quickly and efficiently from one line to another would have been much slower in coming." [58] By 1897, 1,158 independent railroad companies had laid and interconnected over 240,000 miles of track with little assistance from government. This required not only the standardization of gauges but also of cars and their equipment, uniform procedures and freight classifications as well as standardized time.

This achievement has left a powerful legacy for US economic philosophy – it explains why a defining characteristic of the US standardization system until today is "a strong political and cultural bias in favor of the marketplace." (OTA, 1992: p.39)[59]. As Carl Cargill puts it in his important 1989 study, the US standardization system is built on voluntary standards, developed by engineers, "… to make the industry grow or to make it profitable and/or less complex."[60]. In this view, the role of government is to provide a limited set of regulations to guarantee the safety and welfare of its citizens and to prevent the abuse of market power.

4. Potential strengths

A defining characteristic of the American standards system is that it has been shaped by the fundamental political traditions of the American Revolution[61]. According to Linda Garcia, a unique mix of voluntarism, local control, meritocracy, and individualism have given rise to a deeply entrenched preference for the private coordination of economic activity[62].

4.1. Decentralized self-government

An important institutional innovation dates back to 1916. By then the proliferation of engineering societies had led to considerable confusion among users of standards on acceptability and concerns about inconsistent quality. To cope with these problems of uncoordinated competition among engineering societies, the American Institute of Electrical Engineers (now IEEE) invited the American Society of Mechanical Engineers (ASME), the American Society of Civil Engineers (ASCE), the American Institute of Mining and Metallurgical Engineers (AIME) and the American Society for Testing Materials (now ASTM International) to join in establishing an impartial national body to coordinate standards development, approve national consensus standards, and halt user

---

[58] Chandler, A. D, 1977, *The Visible Hand. The Managerial Revolution in American Business*, The Belkap Press of Harvard University Press, Cambridge,Mass., p.143

[59] According to a contemporary New York journalist, the successful standardization of the nation's railways demonstrate beyond doubt that "…[t]he laws of trade and the instinct of self preservation effect reforms and improvements that all legislative bodies combined could not achieve." (quoted in Kirkland, 1961: p.50).

[60] Cargill, C.F., 1989, *Information Technology Standardization. Theory, Process, And Organizations*, Digital Press, Digital Equipment Corporation, Bedford Mass., p.21

[61] For a review of these traditions, see Bailyn, Bernard, 1967, *The Ideological Origins of the American Revolution*. Harvard University Press, Cambridge, Mass..

[62] Garcia, D.L., 1992, "Standard Setting in the United States: Public and Private Sector Roles", *Journal of the American Society for Information Science*, Vol.,43, No.8, September: pages 531-537.

confusion on acceptability. These five organizations subsequently invited the U.S. Departments of War, Navy and Commerce to join them as founders[63].

To transform industry standards into national standards, the AESC develop a federation of "industrial legislatures" that was meant to manifest a political philosophy in support of the directness and vitality of elementary local self-government (Russell, 2006: pages 74-76). That philosophy is nicely captured in an article by the AESC's first full-time secretary, Paul Agnew:

> *"We do not leave to Congress … the decision whether a bridge shall be built in the city of Oshkosh. We leave it to the people of Oshkosh, who will walk over it and ride over it, and who will have to pay for it. Why should not the very limited groups directly interested in each of the innumerable industrial problems with which they are faced, themselves solve these problems through cooperative effort?"*[64]

4.2. Resistance against regulatory standards

That fundamental orientation towards decentralized self-government explains why, in contrast to countries like Germany, France, Japan, and now China, the U.S. "has never established a centralized, overarching authority responsible for creating and enforcing standards." (Russell, 2006: page 77)

There is a widespread consensus in the US that regulatory standards are a "poor substitute" for voluntary, market-driven standards, and that regulatory standards are apt to stifle entrepreneurship and innovation. To quote again Carl Cargill, regulatory standards "are ponderous, like a juggernaut, they are hard to start and steer, require vast throngs of people to keep them moving, and seem to acquire a life of their own once they get going – once rolling, they are usually difficult to stop." (Cargill, 1989: p.18).

The resistance against more active government interference through regulatory standards is deeply entrenched. Leading industry representatives testifying at a 1990 hearing held by NIST on the role of the federal government in standardization were emphatic in their resistance against a more active role (Mattli and Buethe, 2003: p.24). And a study on *The US Software Industry's Perspective on US Government Engagement in the Process of Standard Setting* finds that key players in that industry believe that the existing governance mechanisms for standards development are adequate; doubt that US software industry can agree on a consensus strategy on the role of US government, due to conflicting strategic interests; and are not interested in developing a more structured approach to the governance of standards development[65].

---

[63] ANSI, *A Historical Overview: 1918 -2008*, http://publicaa.ansi.org/sites/apdl/Documents/News%20and%20Publications/Links%20Within%20Stories/ANSI%20-%20A%20Historical%20Overview.pdf, accessed, May 1, 2010

[64] Agnew, P.G., 1926, "A Step Toward Industrial Self-Government" *The New Republic*, March 17, page 95, quoted in Russell, 2006: p.75

[65] Lord, P.E., , 2007, *Risky Business: The US Software Industry's Perspective on US Government Engagement in the Process of Standard Setting,* M.A. thesis, Graduate School of Arts and Sciences, Georgetown University, Washington, D.C.. The author is a former standards manager at Oracle. His interview sample included key players of the Standard Policy Committee of the influential Information Technology Industry Council (ITI).

For non-American observers, the resultant institutional heterogeneity and fragmentation may look like chaos. But for Americans, the principles of consensus and pluralistic governance through local self-government are deeply familiar concepts and are part of their cultural heritage.

4.3. Advantages of decentralized self-government

The potential advantages of decentralized self-government are well-established in theories of innovation and organization.

Take modern complexity theory that is now an integral part of economic innovation theory. For complexity theorists, decentralized and flexible institutions, developed by participants who are "… intimately knowledgeable about details of their activities, are likely to be more workable than blueprints developed by policy analysts and imposed by politicians and bureaucrats."[66]

Modern innovation theory in turn emphasizes that innovation results from interactions of multiple and very diverse stakeholders through geographically dispersed innovation networks. Hence, innovation requires "…complex *systems that are characterized by the heterogeneity of agents with different functions, different endowments, different learning capabilities and different perspectives, and most important different locations in the multidimensional spaces of geography, knowledge, technology and reputation."*[67]

According to social network theory, decisions on standards can derive from relations of *sovereignty*, i.e. "decision-making follows a procedure … [set by the government]…which the entire group accepts as producing decisions that are valid for everyone." This represents the top-down governance model centered on the government. Alternatively, decisions on standards can originate from *uncoordinated* strategies of private and public actors, i.e. "through the accumulation of decentralized, individual decisions that, taken together, nonetheless conduce to a circumstance that affects the entire group." (Grewal, 2008: pages 9 and 10)

The second messy and uncoordinated mode of governance describes key features of the decentralized self-governance model of the American standards system. For Grewal (2008: pages 173 and 176), the effectiveness of a network (Grewal talks about 'network power') is greater, the greater "the ease with which a network accepts new entrants desiring to adopt its standard'"; the greater "the acceptance of parallel or simultaneous standards to gain access to a given network"; and the greater the extent to which a standard underlying a given network is open to (piecemeal) revision. In principle at least, the American voluntary standards system promises to fulfill these criteria better than the first model of top-down, government-centered governance.

Finally, and equally important, the vision of local self-government finds ample support in the "collective action" governance theory, developed by Elinor Ostrom, the 2009 Nobel laureate in economic sciences. In her path-breaking study *Governing the Commons. The evolution of institutions for collective action*, Ostrom argues that "… all

---

[66] Axelrod, R. and Michael D. Cohen, 1999, "Harnessing Complexity. Organizational Implications of a Scientific Frontier", The Free Press, page 22

[67] Antonelli, C., 2011, "The systemic dynamic of technological change: an introductory frame", introductory chapter for *Elgar Handbook on the System Dynamics of Technological Change,* Edward Elgar

organizational arrangements are subject to stress, weakness and failure. "[68] However, external regulatory agencies are even more subject to stress, weakness and failure: "A regulatory agency … always needs to hire its own monitors. The regulatory agency then faces the principal-agent problem of how to ensure that the monitors do their own job….It is difficult for a central authority to have sufficient time-and-place information to estimate accurately both the carrying capacity of a … [public good, like standards]… and the appropriate … [incentives and fines] … to induce cooperative behavior." (Ostrom, 1990: p.17)

To illustrate the potential benefits of the American voluntary standards system, let us briefly review two examples of decentralized self-governance, the IETF model of system-level standards development for the Internet, and the outsourcing of detailed component specification to informal peer group networks in the ICT industry.

4.4. Example 1: The IETF model of system-level standardization for the Internet

The history of the Internet provides important insights into the potential strengths of the American system of decentralized governance of technology development and standardization. It also highlights nicely the sometimes messy and often unpredictable evolution of public-private interaction.

Janet Abbate, in her path-breaking study *Inventing the Internet* examines the forces that have made it possible to transform the ARPANET, as it was initially implemented under the auspices of the US military, into the heterogeneous and decentralized 'network of networks" that we know today as the Internet. Abbate documents that

> *"… the Internet's origins departs from explanations of technical innovation that center on individual inventors or on the pull of markets… [Initially]…the Internet … reflected the command economy of military procurement, where specialized performance is everything and money is no object, and the research ethos of the university, where experimental interest and technical elegance take precedence over commercial application…Perhaps the key to the Internet's later commercial success was that the project internalized the competitive forces of the market by bringing representatives of diverse interest groups together and allowing them to argue through design issues. Ironically, this unconventional approach produced a system that proved to have more appeal for potential customers – people building networks – than did the overly commercial alternatives that appeared soon after."*[69]

In short, key elements of decentralized self-governance were reflected in a commitment to flexibility and diversity, not only in the technical design of the Internet's architecture, but also in its implementation and in the organization of the process of developing the fundamental standards. According to Abbate, flexibility and diversity

---

[68] Ostrom, E., 1990, *Governing the Commons. The evolution of institutions for collective action*, Cambrige University Press, page 25

[69] Abbate, J., 1999, *Inventing the Internet*, MIT Press, Cambridge, Mass. Page 145. See also Libicki's devastating critique of the competing Open System Interconnection Protocols (OSI), advanced by the ISO, NIST and prominent network computing vendors of the time, such as Digital Equipment Corporation (Libicki, M.C., 1995, "Standards: The Rough Road to the Common Byte", in: Kahin, B. and J. Abbate, eds, 1995, *Standards Policy for information Infrastructure*, page 35, MIT Press, Cambridge, Mass.)

were both critical in order to cope with the inherently unpredictable "changes that would revolutionize the computing and communications industries. …A network architecture designed to accommodate a variety of computing technologies, combined with an informal and inclusive management style, gave the Internet system the ability to adapt to an unpredictable environment." (Abbate, 1999, page 6)

The *Internet Engineering Task Force* (IETF) was an important battleground for many of these decisions on how to balance flexibility and diversity with the initial philosophy of "mission-oriented research" that had shaped the ARPANET. [70] The history of IETF, and its unique approach to strategy and organization of standards development provides us with a microscopic view of the potential strengths of a decentralized model of self-governance.

While IETF is an international standards organization, it is imbued right from its beginning with the values of the American pioneers of the Internet, i.e. a focus on flexibility and a basic presumption that diversity of opinions and approaches is preferable to top-down command-style "mission-oriented research" governance.

IETF develops and promotes Internet standards[71], cooperating closely with the W3C and ISO/IEC standards bodies[72] and dealing in particular with standards of the TCP/IP protocol suite.[73] IETF defines itself is an open standards organization, with no

---

[70] Mission-orient research focuses on large, complex prestige projects, as promoted by the Defense Department. The main aim is to push out the technological frontier and to develop leading-edge industries See Henry Ergas, "Does Technology Policy Matter?" in Bruce R. Guile and Harvey Brooks, eds., *Technology and Global Industry* (Washington, D.C.: National Academy Press, 1987), pp. 191-245. For the evolution of DARPA, see Fuchs, E., 2011, "DARPA Does Moore's Law. The case of DARPA and Optoelectronic Interconnects", chapter 7 in Block, F. and M.R. Keller, eds., 2011, *State of Innovation. The U.S. Government's Role in Technology Development*, Paradigm Publishers, Boulder, London.

[71] In computer network engineering, an Internet Standard is a normative specification of a technology or methodology applicable to the Internet.

[72] The **World Wide Web Consortium** (**W3C**) is the main international standards organization for the World Wide Web. Founded and headed by Sir Tim Berners-Lee, the consortium is made up of member organizations which maintain full-time staff for the purpose of working together in the development of standards for the World Wide Web. As of 8 September 2009, the World Wide Web Consortium (W3C) has 356 members. (W3C, 2009, *World Wide Web Consortium (W3C) Members*, September, http://www.w3.org/Consortium/Member/List, accessed May 24, 2010). The **International Organization for Standardization** (**ISO)** is an international-standard-setting body, based in Geneva, composed of representatives from various national standards organizations. Founded in 1947, the organization promulgates worldwide proprietary industrial and commercial standards. While ISO defines itself as a non-governmental organization, its standards often become law, either through treaties or national standards. The **International Electrotechnical Commission** (**IEC**) is a non-profit, non-governmental international standards organization that prepares and publishes International Standards for all electrical, electronic and related technologies. IEC standards cover a vast range of technologies from power generation, transmission and distribution to home appliances and office equipment, semiconductors, fibre optics, batteries, solar energy, nanotechnology and marine energy as well as many others. The IEC also manages three global conformity assessment systems that certify whether equipment, system or components conform to its International Standards. (IEC, 2006, *IEC Statutes and Rules of Procedure* (PDF). IEC. June 23. http://www.iec.ch/tiss/iec/stat-2001e.pdf, accessed May 24, 2010)

[73] The **Internet Protocol Suite** (commonly known as **TCP/IP**) is the set of communications protocols used for the Internet and other similar networks. It covers two of the most important protocols: the Transmission Control Protocol (TCP) and the Internet Protocol (IP), which were the first two networking protocols defined in this standard. Today's IP networking represents a synthesis of several developments that began

formal membership or membership requirements. All participants and managers are volunteers, though their work is usually funded by their employers or by sponsors.

It is noteworthy however that, in response to the current preoccupation with cyber security, the current chairperson is funded by VeriSign, US information security company, and the U.S. government's National Security Agency. This again indicates that, when deemed necessary by private industry, the government does play a role in the American standards system, albeit often an indirect one.

The IETF is organized into a large number of working groups and informal discussion groups, each dealing with a specific topic. Each group is intended to complete work on that topic and then disband. Each working group has an appointed chairperson (or sometimes several co-chairs), along with a charter that describes its focus, and what and when it is expected to produce. The working groups are organized into *areas* by subject matter[74]. Each area is overseen by an *area director* (AD), with most areas having two co-ADs. The ADs are responsible for appointing working group chairs. The area directors, together with the IETF Chair, form the Internet Engineering Steering Group (IESG), which is responsible for the overall operation of the IETF.

In principle, the process of creating an Internet Standard is straightforward: a specification undergoes a period of development and several iterations of review by the Internet community and revision based upon experience, is adopted as a Standard by the Internet Engineering Steering Group (IESG), and then is published.

In practice, however, the process is much more complicated. As is described in *The Internet Standards Process - Best Current Practice*, this is "due to (1) the difficulty of creating specifications of high technical quality; (2) the need to consider the interests of all of the affected parties; (3) the importance of establishing widespread community consensus; and (4) the difficulty of evaluating the utility of a particular specification for the Internet community." [75]

The goals of the Internet Standards Process are: technical excellence; prior implementation and testing; clear, concise, and easily understood documentation; openness and fairness; and timeliness. To achieve these goals simultaneously, IETF has developed procedures that are designed to be fair, open, and objective; to reflect existing (proven) practice; and to be flexible. "Openness" requires that "at each stage of the standardization process, a specification is repeatedly discussed and its merits debated in open meetings and/or public electronic mailing lists, and it is made available for review via world-wide on-line directories." (Bradner, 1996: p.3). And flexibility is considered to be critical to adapt not only to the complex decision-making processes that open standardization requires, but even more so to be able to adapt to unexpected changes in technology and markets.

Of particular interest for our purposes is the fairly rapid internationalization of IETF membership. A good proxy indicator is the increasingly important role played by

---

to evolve in the 1960s and 1970s, namely the Internet and LANs (Local Area Networks), which emerged in the mid- to late-1980s, together with the advent of the World Wide Web in the early 1990s (Abbate, 1999)

[74] Current areas include: Applications, General, Internet, Operations and Management, Real-time Applications and Infrastructure, Routing, Security, and Transport.

[75] Bradner, S., 1996, *The Internet Standards Process - Best Current Practice. Revision 3, Harvard University,* at **http://tools.ietf.org/html/bcp**. See also Hoffman, P. , 2009, *The Tao of IETF: A Novice's Guide to the Internet Engineering Task Force*, November 30, at **http://tools.ietf.org/rfcmarkup?doc=fyi17**, accessed May 8, 2010

Chinese companies like Huawei in the governance of the IETF. By May 2010, Huawei held 21 leadership positions in IETF, occupying for instance two powerful Area Director[76] positions for transport and routing, four chairs and 6 co-chairs of IETF working groups, and acting as a member of the Internet Architecture Board that oversees the technical and engineering development of the Internet. [77]

Note however that ITEF's insistence on openness and flexibility has created important trade-offs. One such trade-off is the need to devise very detailed and somewhat cumbersome procedures for conflict resolution and appeals. As Bradner (1996: page 3) explains: "As much as possible the process is designed so that compromises can be made, and genuine consensus achieved, *however there are times when even the most reasonable and knowledgeable people are unable to agree* [italics added, DE]. To achieve the goals of openness and fairness, such conflicts must be resolved by a process of open review and discussion."

Such procedures obviously require time and patience. This indicates a fundamental dilemma inherent in the model of largely self-governed standards development. On the one hand, the requirement for prior implementation and testing, and the need to allow all interested parties to comment all require significant time and effort. On the other hand, today's rapid development of networking technology demands timely development of standards. Over time, this dilemma has become more serious, especially now that the challenge is to organize a timely transition to a new generation of Internet architecture, the so-called Internet Protocol Version 6 (IPv6) that is supposed to cope with the increasing scarcity of internet addresses.

Thus far, attempts to improve within IETF the speed of standardization have only produced mixed results[78]. An additional concern is that corporate interests over the last few years have considerably gained in importance. As already observed by Abbate in her study of the transition from the ARPANET to the Internet, since the late 1970s, "…[t]he Internet and its creators were no longer operating in the insulated world of defense research; they had entered the arena of commerce and international politics, and supporters of the Internet technology would have to adapt to this new reality." (Abbate, 1999: page 153).

Today, the influence of leading corporations has further increased. IETF meetings attract more and more participants, giving rise to substantial increases in the cost of running these meetings. As a result, IETF increasingly relies on corporate sponsorship of those meetings.

Finally, and most importantly are the increasing difficulties that IETF is facing in its attempts to adjust its policies on intellectual property rights to the increasingly technology-centered global competition and the much more aggressive recourse to "strategic patenting" strategies by leading ICT corporations. IETF's general policy on

---

[76] Area directors (ADs) are expected to shape the agendas of IETF working groups and participate in the Internet Engineering Steering Group (IESG) that is responsible for the overall technical of IETF activities and the Internet standards process. Note however that these powerful positions are somewhat constrained by procedures that "ensure that an AD's 'pet project' doesn't make it onto the standards track if it will have a negative effect on the rest of the IETF protocols and that an AD's "pet peeve" cannot indefinitely block something." (Hoffman, 2009: page 4).

[77] Information provided by Huawei by email, May 4, 2010. For more discussion on Huawei's participation and influence in international standards development organizations, see Ernst, 2011.

[78] DeNardis, L., 2009, *Protocol Politics*, MIT Press, Cambridge, Mass.

IPR states that "…[i]n all matters of intellectual property rights and procedures, the intention is to benefit the Internet community and the public at large, while respecting the legitimate rights of others.", without defining who are the "others" (Bradner, 1996: pages 5, 6).

Equally ambiguous and loosely defined are IETF's procedures on how to handle the disclosure or non-disclosure of patents deemed to be essential for a particular standard. And the same evasiveness characterizes IETF's approach to the determination of "reasonable and non-discriminatory licensing terms." The relevant text states: "The IESG [the Internet Engineering Steering Group[79]] will not make any explicit determination that the assurance of reasonable and non-discriminatory terms for the use of a technology has been fulfilled in practice. It will instead use the normal [*sic*!] requirements for the advancement of Internet Standards to verify that the terms for use are reasonable… The IETF takes no position regarding the validity or scope of any intellectual property or other rights that might be claimed to pertain to the implementation or use of the technology….or the extent to which any license under such rights might or might not be available; neither does it represent that it has made any effort to identify any such rights." (Bradner, 1996: pages 11 and 12)

In short, while initially the IETF model of decentralized self-governance was an important organizational innovation, it may now face increasing limitations that reflect the cutthroat competition in this critical sector of the ICT industry[80].

4.5. Example 2: Outsourcing of component specification[81]

The outsourcing of detailed component specification to informal peer group networks provides another interesting example of the potential strengths of the decentralized US standards system. It reflects a fundamental distinction in standards development between system-level specification and component specification. While intense competition between leading global corporations dominates the process of system-level specification, component specification is outsourced to informal peer group networks of engineers.

An example of system-level specification is the highly influential International Committee for Information Technology Standards. INCITS is the primary U.S. organization for creating and maintaining formal *de jure* standards in the field of Information and Communications Technologies (ICT).

As for its governance, INCITS operates under rules, approved by the American National Standards Institute (ANSI), that are supposed "to ensure that voluntary standards are developed by the consensus of directly and materially affected interests." Note however that INCITS is sponsored by the Information Technology Industry Council (ITI), a trade association lobbying on behalf of "the leading [sic!] U.S. providers of information technology products and services". To find out who is shaping strategic decisions, it is useful to look at the INCITS Executive Board. Its members encompass a

[79] The Internet Engineering Steering Group (IESG) is responsible for technical management of IETF activities and the Internet standards process.

[80] See for instance, the intense battles fought to influence the Federal Communications Commission's Net Neutrality proceeding.

[81] This is based on interviews conducted September 8 and 23, 2009 with US standards experts who have requested anonymity.

"Who Is Who" of US Information Technology companies, research labs and US government agencies (i.e. Department of Defense, Department of Homeland Security and NIST)[82]. According to interview sources, a handful of companies, especially Microsoft and Intel, are prominent players.

In its more than 50 technical committees, INCITS develops *system-level* specifications for storage, processing, transfer, display, management, organization, and retrieval of information. These committees however only develop architectural specifications. INCITS does not want to develop detailed component specifications because this is tedious and time-consuming work and because it requires very detailed feedback from customers. Developing detailed specifications also requires extensive documentation, i.e. highly complex documents that are costly to generate and maintain.

As a result, INCITS outsources detailed component specifications to specialized outside informal peer-group networks of engineers that work on these issues in member companies. An example is the Small Form Factor Special Interest Group (SFF-SIG), an independent non-profit industry group that develops, promotes, and supports detailed specifications for Small Form Factor computers that are generally designed to support the same features as modern desktop computers, but in a smaller space. Examples include circuit boards, input/output devices and storage specifications for laptops, e-books or smart phones[83].

I have chosen this example because of its unique governance structure. SFF-SIG claims that it is run by an independent president who is not affiliated with any member company. Having an independent president is supposed to provide equal opportunity for members without undue bias or favoritism. Working Groups are formed to address specific topics in detail. All members may join the Working Groups, thereby ensuring broad perspectives, inputs and reviews. Voting Members cast votes on the resulting specifications. After approval, specifications are published and under strict change control for the long term by the relevant Working Group.

According to interview sources, participants in SFF-SIG working groups are part of informal peer group networks that have developed over time in this particular industry sector. Participants know each other well, their specialization, strengths and specific interests, and hence can work out things without much fuss. If problems arise, "…[y]ou know exactly whom you need to talk to." Trust is critical to get this tedious and challenging detailed specifications work done. Equally important are well-established relationships with customers and a continuous dialogue with them. Regular attendance in technical committee meetings is critical. "If you join, and you say you want to change, you get absolutely no attention. You have to go to the meetings. If you only show up at critical meetings, no one takes you serious".

In short, the real strength of the American standards system are the multi-layered informal peer group networks that are driving work in the technical committees in organizations like SFF-SIG. "Informal networks can work out something fairly quickly. Most of the decisions are finalized between meetings or in the hall ways." This highlights an important challenge for China's standard system - to create organizational

[82] Key corporate members of the INCITS Executive Board include Adobe, Apple, Google, HP, IBM, Intel, Lexmark, Microsoft, and Oracle, see http://www.incits.org/ebmem.htm, accessed May 6th, 2010.
[83] See http://www.sff-sig.org/, accessed May 7, 2010

arrangements that provide greater autonomy to standard development organizations to make their own standards (as discussed in Ernst, 2011).

5. What are drawbacks of the American system?

In short, the potential benefits of the decentralized American voluntary consensus standards system are well established in historical research, as well in theory and case studies. There is every reason for China and other emerging economies to acknowledge and learn from the significant strengths of the deeply rooted US tradition of bottom-up, decentralized approaches to standardization.

It is important however to emphasize that the literature also highlights significant drawbacks and possible limitations of the American system.

5.1. Intense conflicts

In a chapter, entitled "The Future of Consensus Standards", Carl Cargill highlights the inherent tendency towards controversy and conflict. He states: "I have a fondness for the present method …[of voluntary standards]…; I would prefer to see it survive… At the same time, there will always be someone or something that objects to current standards, standards organizations, and standards processes and will fight to change and improve them." (Cargill, 1989: p.120). This describes in a nutshell a fundamental dilemma of the American system: its very strength - the diversity of stakeholders in standardization - may also lead to intense conflicts and competition among standard development organizations and standards consortia, eroding the systems' effectiveness and fairness.

These concerns have been substantiated in a systematic and by now classic study of the US standards system, prepared by the Office of Technology Assessment for the House Committee on Science, Space, and Technology of the US Congress[84]. The study states that "…[c]concerns about the US standards setting process and recommendations for greater government involvement are based on the notion that the US approach no longer works as well as it should." (OTA, 1992: p.7). The OTA study emphasizes that the initial strengths of the US standards system have been a pragmatic, flexible and bottom-up approach and a capacity to react swiftly to specific needs of industry. Over time, however, the limitations of that system have outweighed its initial advantages. The US standards community is characterized by intense economic competition and personality conflicts. As a result, "…[i]nternecine warfare in the standards community … raises questions about the ability of the voluntary standards organizations to carry out the public trust delegated to them." (OTA, 1992: p.13).

5.1.1. The battle over open document standards

A well-documented case of such "internecine warfare" that results from a US-style governance structure is the battle to establish an international open document standard that pitted two competing standards consortia against each other – Microsoft's Office Open XML (OOXML) file format and the ODF file format developed by the OASIS consortium (with IBM, Sun Microsystems and Oracle as main supporters). The selection of Microsoft's OOXML as an ISO/IEC standard (ISO/IEC 29500) on April 2nd,

[84] OTA, 1992, *Global Standards: Building Blocks for the Future*, Office of Technology Assessment (OTA), Congress of the United States, Washington, D.C.

2008, gave rise to an intense controversy. According to an editorial of the *Financial Times*, "…[a]llegations of committee-stuffing, the outcome of votes overridden by political appointees, a final decision that many involved consider tainted: this may sound like a discredited election in some third world country. But it is actually a description of an ugly fight over international technical standards (i.e. the certification of Microsoft's OOXML standard by the International Organization for Standardization)."[85]

In an open letter, Nicos Tsilas, senior director of interoperability and IP policy at Microsoft, attacked IBM's opposition to OOXML, arguing that IBM has led a global campaign urging national bodies to demand that ISO/IEC JTC1 not even consider Open XML, because ODF had made it through ISO/IEC JTC1 first. According to Microsoft's Tsilas, IBM is "doing this because it is advancing their business model. Over 50 percent of IBM's revenues come from consulting services….[IBM is] "using government intervention as a way to compete" as they "couldn't compete technically."

In turn, Bob Sutor, vice president of standards and open source for IBM, criticized Microsoft's OOXML as "technically inferior … IBM believes that there is a revolution occurring in the IT industry, and that smart people around the world are demanding truly open standards developed in a collaborative, democratic way for the betterment of all,…If 'business as usual' means trying to foist a rushed, technically inferior and product-specific piece of work like OOXML on the IT industry, we're proud to stand with the tens of countries and thousands of individuals who are willing to fight against such bad behavior"[86]

The outcome of this fight is messy. According to the aforementioned *Financial Times* editorial, "Microsoft came out on top, but at the cost of tarnishing its reputation and the credibility of an important back-room process that oils the wheels of many global industries." (Financial Times, April 3, 2008). The irony is that, after all these mutual verbal attacks, Microsoft probably won a battle, but cannot be sure to have won the war. Alex Brown, who had been the Convener of the February 2008 JTC1 Ballot Resolution Meeting, has recently posted an entry on his personal blog in which he complained of Microsoft's lack of progress in adapting current and future versions of Microsoft Office to produce files in the Strict (as opposed to the Transitional) ISO 29500 format: "On this count Microsoft seems set for failure. In its pre-release form, Office™ 2010 supports not the approved Strict variant of OOXML, but the very format the global community rejected in September 2007, and subsequently marked as not for use in new documents - the Transitional variant. Microsoft is behaving as if the JTC 1 standardization process never happened…"[87]

5.1.2. Suggestions of the 1992 OTA study

To cope with the intense conflicts that result from the decentralized governance of standardization, the aforementioned OTA study suggested already in 1992 three strategies to reform and to upgrade the US standards system. First, OTA suggests providing more substantial government support for standards development processes to

[85] *Financial Times*, Editorial, April 3, 2008
[86] Quoted in Ars Technica, http://arstechnica.com/microsoft/news/2008/02/ibm-responds-to-microsoft-ooxml-is-technically-inferior.ars, accessed May 6, 2010
[87] Brown, A., 2010, "Microsoft fails the standards test", March 31, http://www.adjb.net/post/Microsoft-Fails-the-Standards-Test.aspx, accessed May 7, 2010

address market failures resulting from public goods aspects of standards. OTA highlights the coordinating role played by the national standards bodies of the UK (the BSI Group) and Germany (the DIN standards agency) and deplores that the current US standards system lacks a similar organization. OTA also emphasizes that US government agencies like the Commerce Department and USTR respond to *ad hoc* business queries and concerns, but that there is no agency that has a mandate to develop a national standardization strategy. OTA argues that such a central coordinating agency is necessary to reap the potentially significant advantages of the voluntary standards system.

As a second strategy, OTA suggests to promote the development of an Information Infrastructure for Accessing and Distributing Standards that uses the powerful tools provided by information and communications technologies for accessing and distributing standards, and for participating in the standardization process. OTA deplores that America's standards infrastructure is a patchwork of mostly unconnected data bases, most of them controlled by a handful of global industry leaders. According to the study, attempts to extend and coordinate the existing standards information infrastructures are constrained by institutional inertia, resistance against changing the status quo, and lack of financial resources that would be needed to make these investments.

A third strategy, proposed by OTA is to improve the process of standardization through organizational restructuring. To succeed, this strategy would have to overcome deeply entrenched barriers: "Organizational arrangements are not neutral; they define power relationships determining who shall control what and for what ends." (OTA, 1992: p.31).

Unfortunately, very few of these policy suggestions have been taken up and implemented, despite the fact that many of the findings of the 1992 OTA study still hold. In fact, rather than gaining more attention in public debates, standardization has further faded into the background. With but a few exceptions, it is hard to find substantial discussions about standardization in the media.

5.2. Shortfalls in the provision of strategic standards

Another critique of the decentralized, market-driven American system highlights a possible tension between the predominant role that for–profit private firms play in the governance of standardization processes and the role that standards are supposed to play in serving public policy objectives. The concern is that the dominance of private firms "…may lead to consensus without …[adequate]…public-interest representation" (Alic, 2009: p.8). This may lead to market imperfections, such as shortfalls in provision of public policy objectives.

For instance, already in the late 1980s, a study of the MIT Commission on Industrial Productivity has argued in a chapter entitled "Failures of Cooperation" that a fundamental weakness of the US system is "… the under-provision of such collective goods as joint research and development, standardization, education and training, which ..,[are] instrumental in promoting technological innovation and productivity growth."[88]

[88] Dertouzos, M.L., R.K. Lester, and R.M. Solow, 1989, *Made in America. Regaining the Productive Edge*,The MIT Press, Cambridge, Mass, p. 105

Standardization theory can help to understand why the US standards system may produce such shortfalls. A fundamental insight of this theory is that standards constitute a critical part of a country's economic infrastructure. Standards "…help to determine the efficiency and the effectiveness of the economy; the cost, quality and availability of products and services; and the state of the nation's health, safety and quality of life."[89] Standards reduce the costs and risks of market transactions; and they are necessary to reduce the costs of doing business.

But standards also provide the enabling infrastructure that is necessary to enhance a country's innovation capacity. In a widely quoted book (published in 2007) on the US innovation system, Greg Tassey (a senior NIST economist) argues that innovation requires a diversified and pervasive set of strategic standards, such as interoperability standards, security protocols, product specifications, and the formats and protocols that govern data transfer and interpretation[90]. Tassey emphasizes that standards are a critical technical infrastructure that defines the efficiency and effectiveness of a national innovation system. A broad portfolio of strategic standards is necessary to drive major innovations like the "Smart Grid" project or the development of new alternative energy technologies[91]. Strategic standards are as important for a country's innovative capacity as are R&D investment, IPR, human capital, venture capital and IT infrastructure. Underinvestment in strategic standards is as negative for growth as is underinvestment in education or in IT infrastructure. Innovation policy must therefore include the development of strategic standards as a key policy variable.

Creating and maintaining these strategic standards requires large amounts of financial and human resources. But when private interests dominate standardization, the 'public good' nature of these strategic standards may well lead to a market failure, i.e. an under-provision of the necessary investments. Tassey deplores the lack of a strategic vision in the US that integrates standards and innovation policy. He argues that in the US, the development of a technical infrastructure that supports innovation, and especially standards development is "not receiving adequate levels of resources due to a poor understanding of such infrastructures' roles in long-term economic growth." (Tassey, 2007: p.240). Tassey concludes that the failure of policy makers to understand the complementary relationship between technology development and the development of supporting standards infrastructures is likely to erode US competitiveness.

What explains this underinvestment in strategic standards? In theory, a neat distinction can be made between standards as public goods, as collective goods and as private goods (Kindleberger, 1983)[92]. As public goods, standards are available for use by all and use by any economic actor does not reduce the amount available to others[93]. In

---

[89] Garcia, L., 1993, A New Role for Government in Standard Setting?, *Standard View*, Vol. 1,#2, December: page 2

[90] Tassey, G., 2007, *The Technology Imperative*, Edward Elgar, Cheltenham

[91] Tassey uses the term "infratechnology' standards. I prefer to call them 'strategic standards', highlighting their critical importance for upgrading a national innovation system.

[92] More recently, Cornes and Sandler have added the concept of "club goods" as an additional category between public and private goods. See Cornes, R. and T. Sandler, 1996, *The theory of externalities, public goods, and club* goods, 2nd edition, Cambridge University Press, Cambridge. For our purposes, club goods overlap with both collective and private goods, as defined by Kindleberger.

[93] Samuelson, P.A., 1954, "The Pure Theory of Public Expenditures", *The Review of Economics and Statistics*, Vol. 36, pages 387-389. Economists typically define 'public goods' by two qualities: *non-rivalry*

reality however, and especially in the voluntary standards system, standards predominantly come as collective and private goods.

Following Kindleberger's distinction[94], I suggest to define standards as 'collective goods' when they are set by associations of private firms, like standards consortia, but enforced by government or by an institution like ANSI that is accredited to fulfill this function. In turn, standards as 'private goods' are *de facto* voluntary consensus standards set by firms with a dominant leadership position in a particular market (like the Wintel standard for PCs). Both collective and private standards have in common that they are provided through some form of exclusion - " … not all parties have equal access to the standard and to the standardization process."[95]

To explain why standards which are supposed to be an archetypical 'public good', do not meet the criterion of *non-excludability*, it helps to look at other inherent trade-offs of the US voluntary standards system that have been identified in the literature.

5.3. Lack of effective coordination

The decentralized form of governance of the American standards system and its reliance on for-profit private firms comes at a significant cost. One such cost is a lack of effective coordination among the several hundred intensely competing private standard development organizations that constitute the American standards system.

The American National Standards Institute (ANSI), a private sector organization, was established in 1969 with the explicit mandate to "serve as a coordinator of the voluntary standardization aspect of… [the American standards].. system". [96] But ANSI remains too weak. While formally the sole representative of US interests in international standards organizations, ANSI has been unable to reduce the intense rivalry among private standards organizations that continues to dominate the American standards system. What unites these private standard organizations is the "fear that a more centralized system would rob them of their revenues and eclipse their power and autonomy." (Mattli and Buethe, 2003: p.24).

In addition, ANSI has failed to attract the hundreds of consortia that have emerged in the ICT industry, in part, according to Andrew Updegrove, "because of the reticence of these global organizations to appear more US centric than many of them are already perceived to be."[97]

ANSI's weak position is reflected in its limited involvement with Congressional staff and US government agencies. In fact, Updegrove (2008: p.24) argues that "ANSI is currently underutilized by the United States government, which draws upon its expertise

---

in consumption (i.e. they are not depleted by an additional user) and *non-excludability* (i.e. it is generally difficult or impossible to exclude people from its benefits, even if they are unwilling to pay for them). (Baumol and Blinder, 1991: 617).

[94] Kindleberger (1983) distinguishes 'collective' standards set by wine-growing cooperatives and 'private' standards set by merchants for their traded goods.

[95] Bekkers, R., 2001, Mobile Telecommunications Standards GSM, UMTS, TETRA, and ERMES, Boston:Artech House: p.222

[96] Hurwitz, M., 2004, "United States Standardization Strategies and their Relationship to ISO' Long-Term Strategy", presentation at the ISO International Standardization Forum, Tokyo, October 25, page 6. Mr. Hurwitz was then president and CEO of the American National Standards Institute (ANSI),

[97] Updegrove, A., 2008, "Behind the Curve: Addressing the Policy dependencies of a "Bottom-Up" Standards Infrastructure" *Standards Today*, October-November, page 24

erractically rather than systematically. With minimum government assistance and funding ANSI could easily serve as a point of greater coordination between government and traditional SSOs to rapidly pursue administration goals."[98]

The fragmentation of the American standards system is well documented in the literature. For instance, a study on "National Varieties of Standardization" finds that the American standards system is "by far the most institutionally heterogeneous and fragmented of all advanced industrialized countries."[99] And another comparative study argues that , "…[i]n the absence of government control or any other central monitoring and coordinating agent, the system that emerges is characterized by extreme pluralism." (Mattli and Buethe, 2003: p.24).

A lack of effective coordination through non-profit public actors implies that decentralized self-government of standardization may well produce negative results. John Alic, a consultant for the U.S. Energy Innovation from the Bottom-Up project, argues that the current US standards system "depends on consensus, negotiated among competing interests…[and] may lock in inferior technologies. … [W]ithout public-interest representation,…[s]pecial interests have powerful incentives to seek control of the process."[100]

In short, without effective coordination, the American voluntary standards system faces a fundamental dilemma. The reliance on voluntary partnerships among for-profit private firms has created a dynamic and flexible system that is conducive for innovation. At the same time, however, the lack of effective coordination implies that the American standards system "must persevere [sic, DE] a perpetual state of controversy and conflict" (Russell, 2006: page 77).

5.4. US government fails to be an effective coordinator

A fourth important weakness of the American standards system is the limited capacity of the US government to play the role of an enabler, coordinator , and, if necessary, enforcer of the rules of the game in order to prevent possible abuse of market power by companies with large accumulated patent portfolios.

Take for instance a highly influential study of the American standards system, published in 1995, by Lewis M. Branscomb (Professor in Public Policy and Corporate Management, Harvard University, John F. Kennedy School of Government) and Brian

---

[98] Note however recent initiatives in US Congress to strengthen the role of NIST. See proceedings of witness panel on "NIST Structure and Authorities, Its Role in Technical Standards, and Federal Coordination on Technical Standards", the U.S. House of Representatives Committee on Science and Technology Subcommittee on Technology and Innovation, http://www.science.house.gov/Publications/hearings_markups_details.aspx?NewsID=2774, accessed May 31, 2010.

[99] Tate, J. (2001). National Varieties of Standardization. In P. A. Hall & D. Soskice (Eds.), *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage.* Oxford: Oxford University Press.

[100] Alic, J., 2009, *Energy Innovation from the Bottom Up. Project Background Paper*, prepared for the joint project of the Consortium fro Science, Policy, and Outcomes (CSPO), Arizona State University, and the Clean Air Task Force (CATF), March. For a detailed analysis, see Alic, J. and D. Sarewitz, 2009, "Accelerating Technological Advance for Climate Change:Lessons from Sixty Years of U.S. Innovation Policy", Testimony before the U.S. Senate Committee on Energy and Natural Resources December 2, http://energy.senate.gov/public/_files/AlicSarewitzTestimony120209.pdf Accessed May 4, 2010

Kahin (Senior Fellow at the Computer & Communications Industry Association)[101]. According to the study, the development of standards for complex technology systems requires a division of labor between the government (in the role of enabler and coordinator) and the private sector (in the role of investor and innovator). If one of these two complementary building blocks is missing, it will be difficult to provide an adequate balance between private and public interests.

In the American standards system, the interests of the private sector are well represented. The engagement of the private sector (as investor and innovator) represents a unique strength - standards are not imposed by the government, but "are expected to emerge from the experimentation, competition, and … the market response to the standards process and its expressions – reference models, architectures, draft specifications, or standards – and in the further response of the standards process to the market." (Branscomb and Kahin, 1995: p.4) In an ideal world where economic power is equally distributed among stakeholders in standardization, a private sector-driven standards system has what it takes to unlock barriers to innovation.

In the real world, however, standardization is a contested and "constantly changing field" (Branscomb and Kahin, 1995: p.6)**.** Technology-based competition is intensifying, with the result that standards are used everywhere to create and shape markets and to control competition. That does require a stronger role for the government as a coordinator, a repository of knowledge and a provider of strategic vision. In the US, the federal government largely lacks the mandate and the resources to provide these three fundamental public services. The Commerce Department and the USTR primarily respond to *ad hoc* requirements of leading private stakeholders in standardization. At the time of writing this paper, NIST has no mandate to play a coordinating role (except for the Smart Grid Interoperability project[102]), while the private non-profit ANSI lacks the resources and the authority to assume that role.

Linda Garcia (the lead author of the 1992 Office of Technology Assessment study mentioned earlier) has argued that, as long as the US government fails to act as an effective coordinator, this will disturb the balance between public and private interests. According to Garcia, there is no guarantee that "…the incentives that drive individual firms' standards decisions in today's highly competitive … (global knowledge economy, DE) will yield collective outcomes that coincide with broader-based public policy goals." In fact, "market failures at the firm level give rise to both 'collective action' and 'prisoner's dilemma' problems, which are played out and mutually reinforced at the level of standard setting organizations."

The result is that "public and private costs and benefits diverge" and that "…[i]ntervention at the government level is required to overcome these multiple, and interrelated, failures and dilemmas. " Specifically, public policies are necessary to support the standard setting process, "thereby reducing collective action problems"; to determine standards setting policy (the 'rules of the game') that reestablish transparency, fairness and consistency; and to "eliminate the uncertainties and risks associated with

[101] Branscomb, L.M. and B. Kahin, 1995, "Standards Processes and Objectives for the National Information Infrastructure", in: in: Kahin, B. and J. Abbate, eds, 1995, *Standards Policy for Information Infrastructure*, MIT Press, Cambridge, Mass.
[102] See section 7.

standards bargaining, which typically lead to prisoner's dilemma outcomes." (all quotes are from page 117 of Garcia, Leickly and Wiley, 2005).

A major source of such uncertainty that requires some sort of public governance is the lack of transparency with respect to property rights and standards. This is arguably one of the main problems of the current market-led US voluntary standards system.

5.5. Strategic patenting

As technology-based competition increases, the key to competitive success is a broad portfolio of 'essential patents' which are necessary to produce any product that meets the specifications defined in the standard[103]. According to Ray Alderman, the CEO of the VITA standards organization[104], essential patents "are asserted against makers of products that are compliant to the standard….The money is made through licenses and royalties, by asserting those claims against companies who, by implementing the requirements of the essential elements in the standard, must infringe the patent in order to make their products compliant to that standard." (Alderman, 2009: pages 2 and 3)

Research by Knut Blind and associates has documented the use of "essential patents" as a strategic weapon to prohibit, delay or obstruct standardization processes[105]. This is the case for instance when incumbent market leaders pursue so-called 'platform leadership' strategies through allegedly open but de facto proprietary standards[106]. While nominally 'open', these standards are designed to block competitors and to deter new entrants. Two highly influential studies on the licensing and disclosure of private standard-setting organizations by M.Lemley document the difficulties of finding fair and reasonable non-discriminatory (FRAND) compromises in private standard-setting organizations[107].

This is especially difficult for industries, like the information and communications technology sector, where interoperability standards are required to make products or services

---

[103] Patents are "essential" to a standard "when it is not possible to comply with the standard without infringing that intellectual property right." Tapia, C.G. and D. Ernst, forthcoming, "Intellectual Property Rights and Standards – Challenges for Chinese Exporters", East-West Center, Honolulu.

[104] For a description of VITA's patent policy see section 6.3. Testing the limits – Department of Justic support for VITA's *ex ante* disclosure of essential patents.

[105] Blind, K. et al, 2004, *Interaction between Standardization and Intellectual Property Rights. Final Report*, EUR 21074 EN, European Commission, Directorate-General, Joint Research Centre, 248 pages. See also the seminal article by M.A. Lemley and C. Shapiro, 2007, "Patent Holdup and Royalty Stacking", in *Texas Law* Review, Vol. 85, pages 1991 to 2041. For an analysis of implications for standard development organizations and policy makers, see Weiss, M.B.H. and M. B. Spring, 2000, "Selected Intellectual Property Issues in Standardization", in: Kai Jacobs, ed, *Information technology Standards and Standardization: A Global Perspective*, Idea Group Publishing, Hershey USA, London UK, pages 63-79.

[106] The overriding purpose of "platform leadership" strategies is to leverage the existing market power of industry leaders into the control of "systemic architectural innovations." (See Gawer, A. and M.A. Cusumano, 2002, *Platform Ledership. How Intel, Microsoft and Cisco Drive Industry Innovation*, Harvard Business School Press, Boston, Mass.: p. 39). For example, Intel has attempted to extend its control over microprocessors by creating widely accepted architectural designs that increase the processing requirements of electronic systems and, hence, the market for Intel's microprocessors (Gawer,A. and R. Henderson, 2007, Platform Owner Entry and Innovation in Complementary Markets: Evidence from Intel, NBER Working Paper, National Bureau of Economic Research, http://www.nber.org/papers/w11852.pdf, accessed June 1st, 2010.

[107] Lemley, M., 2002, "Intellectual Property Rights and Standard-Setting Organizations", *California Law Review*, # 90, pages 1889-1981: and Lemley, M. A. (2007) "Ten Things to Do about Patent Hold-up of Standards (and One Not to)," *Boston College Law Review*, Vol. 48, pp. 149-68

compatible with each other in order to maximize the benefits of network externalities. According to a recent study by the Federal Reserve Bank of Philadelphia, this is made even more difficult by "the potential for opportunistic behavior by participants who own patents on a technology essential to the standard. There is a risk that without sufficient transparency and sufficiently strong mutual interests, network participants could make large investments to implement a standard only to be held up by a firm threatening to withhold a key piece of technology."[108] The study argues that "…in all likelihood some kind of agreement would be reached, but on terms substantially worse than the participants initially expected. Indeed, the risk of such an outcome may discourage firms from adopting a standard or even participating in the standard-setting process. In other instances, awareness of a key blocking patent might lead to the adoption of a standard that poses less risk to participants but which is also technologically inferior." (ibid: page 3).

The root cause for these negative outcomes can be found in market imperfections that are typical for high-tech industries. The emergence of a "winner-takes-all" competition model, described by Intel's Andy Grove[109], implies that companies need to combine economies of scale and scope with flexibility and speed-to-market. Only those companies thrive that succeed in bringing new products to the relevant markets ahead of their competitors. Of critical importance is that a firm can build specialized capabilities quicker and at less cost than its competitors[110]. Hence, competitive success critically depends on "a capacity to control open-but owned architectural and interface standards."[111] It is hardly surprising that, under such conditions, as John Alic puts it, "firms may be tempted to seek profits through collusion rather than technological innovation. And when innovations do result, the costs may be high."(Alic, 2009: p.3)

What matters for our purposes are the policy suggestions drawn by scholars who have studied strategic patenting. Mark Lemley for instance argues that the law must accommodate the way private standard-setting organizations (SSOs) deal with intellectual property. Specifically, he argues that "… antitrust rules may unduly restrict SSOs even when those organizations are serving procompetitive ends. And enforcement of SSO IP rules presents a number of important but unresolved problem of contract and IP law, issues that will be needed to be resolved if SSO IP rules are to fulfill their promise of solving patent holdup problems." (Lemley, 2002: page 1891)[112] But Lemley also warns against the danger of excessive regulation.

The following quotes from Lemley (2002 pages 1891 and 1892), capture nicely the fundamental idea that underlies, at least in principle, the American standards system: "SSOs are a species of private ordering that may help solve one of the fundamental dilemmas of IP law: the fact that intellectual property rights seem to promote innovation

---

[108] Hunt, R.M, S. Simojoki and T. Takalo, 2007, "Intellectual Property Rights and Standard Setting in Financial Services: The case of the Single European Payments Area", Working Paper no. 07-20, Research department, Federal Reserve Bank of Philadelphia, p.3. http://www.phil.frb.org/research-and-data/publications/working-papers/2007/wp07-20.pdf Accessed May 17, 2010.

[109] Grove, A.S., 1996, *Only the Paranoid Survive. How to Exploit the Crisis Points that Challenge Every Company and Career*, Harper Collins Business, New York and London

[110] Kogut, B. and U. Zander, 1993, "Knowledge of the firms and the evolutionary theory of the multinational corporation", *Journal of International Business Studies*, 24 (4)

[111] Ernst, D., 2002, "The Economics of Electronics Industry: Competitive Dynamics and Industrial Organization. In Lazonick, William, ed., *The International Encyclopedia of Business and Management (IEBM)*, *Handbook of Economics.* London: International Thomson Business Press.

[112] See our discussion below in section 6.3. of recent changes in the approach of the Department of Justice relative to patent policies of standard development organizations like VITA.

in some industries but harm innovation in others." Lemley is optimistic that SSOs will find ways to "ameliorate the problems of overlapping IP rights in those industries in which IP is most problematic for innovation, particularly in the semiconductor, software, and telecommunications fields."

For Lemley, this implies that "*the best thing the government can do is to enforce these private ordering agreements and avoid unduly restricting SSOs by overzealous antitrust scrutiny* [italics added, DE]."

In short, the use of "strategic patenting" to generate rents from *de facto* industry standards has transformed the dynamics of the US standards system. It has certainly made it more difficult to retain "open access" as a fundamental principle of the American standards system. Interviews with American standards engineers have convinced me of their genuine commitment to an informal, flexible bottom-up approach and "open access". Unfortunately, however, the reality of standards consortia today is shaped by the race to squeeze profits out of the control of standards development.

This fundamental tension of the American standards system is well documented in the literature. For instance, Branscomb and Kahin (1995) show that the main drivers of standards consortia are companies with large portfolios of essential patents. A fundamental weakness of the existing US standards system is that users (both implementers, but especially final users) continue to lack voice. This implies that the role of the government should not be restricted to that of being a user of standards. Equally important – yet clearly missing - is a sufficiently strong capacity of the US government to play the role of enabler and coordinator of standardization.

5.6. The elusive concept of "open standards"

The lack of effective coordination gives rise to another important weakness of the US market-led voluntary standards system - the elusiveness of the concept of "open standards". Open standards have become almost an article of faith in the American standards system. Yet, according to the RAND Corporation's Martin Libicki, "all vendors pay lip service to open systems, but agreement ends here. The computer industry needs as many words for "open" as Eskimos need for snow." (Libicki, 1995: p. 43 and p.44).

And an in-depth RAND Corporation study on "Standards and Standards Policy for the Digital Economy", finds that "…[m]arket leaders are rarely friendly to open standards when they dominate and eager to see them when they do not…. Market leaders are also friendly to standards in layers above and below them so as to use the competition among others to increase choices, lower costs, and broaden the market."[113].

For Libicki (1995: p. 42), the elusiveness of the concept of "open standards" implies that a neutral form of public governance is needed "to avoid the Scylla of chaos and the Charybdis of monopoly". In short, market-led standardization needs to be complemented by the US government to channel "the struggles of competing vendors and their technologies and the power of vendor versus user".

In principle, this public governance role could be played by the American National Standards Institute (ANSI). According to the *ANSI Essential*

[113]Libicki, M et al, 2000, *Scaffolding the Web – Standards and Standards Policy for the Digital Economy*, Science and Technology Policy Institute, RAND, Santa Monica, CA, p.111.

Requirements: Due process requirements for American National Standards[114], standards developers accredited by ANSI must meet the Institute's requirements for openness, balance, consensus and other due process safeguards.

Note however that ANSI narrowly defines "openness" as "a collaborative, balanced and consensus-based approval process." According to ANSI's *Essential Requirements* document "openness" means that "…[p]articipation shall be open to all persons who are directly and materially affected by the activity in question. There shall be no undue financial barriers to participation. Voting membership on the consensus body shall not be conditional upon membership in any organization, nor unreasonably restricted on the basis of technical qualifications or other such requirements." (ANSI, 2010: page 4). While this sounds good, the criteria used for measuring "openness" are much too abstract to work in the rough and messy world of intensive technology-based competition.

Hence, some form of cooperation between public and private actors would seem to be necessary to address the serious problem of elusive "open access" criteria. On the positive side, economic historians have shown that the US has a long tradition of public-private partnership, such as the concept of the "Associative State"[115] (discussed below in section 6.4.) Unfortunately, however, the "deregulation wave" since the 1970s has eroded much of the foundations of public-private partnerships. 'Deregulation' is defined as the removal or simplification of government rules and regulations that constrain the operation of market forces[116]. In the US, deregulation gained momentum on the back of theories of economists like Ludwig von Mises, Friedrich von Hayek, and Milton Friedman who argued that the economy was overregulated and that this imposed unnecessary costs on consumers[117].

Starting with the deregulation of the transportation industry (especially the Airline Deregulation Act of 1978), deregulation was subsequently extended to cover the energy sector, communications (e.g., the Telecommunications Act of 1996) and finance (especially the by now infamous Gramm-Leach-Bliley Act of 1999, which repealed the parts of the Glass-Steagall Act which had not already been repealed). This 1999 Act took down barriers to competition between traditional banks, investment banks, and insurance companies, and allowed firms under certain conditions to participate in all three markets[118].

As deregulation worked its way through the US economy, this created a broad consensus in the Washington policy-making elite that actors in the private sector should be left free "to devise their own solutions to economic stagnation and international

---

[114] ANSI, 2010, *ANSI Essential Requirements: Due process requirements for American National Standards*, http://publicaa.ansi.org/sites/apdl/Documents/Standards%20Activities/American%20National%20Standards/Procedures,%20Guides,%20and%20Forms/2010%20ANSI%20Essential%20Requirements%20and%20Related/2010%20ANSI%20Essential%20Requirements.pdf, accessed May 18, 2010

[115] David M. Hart, 1998, "Herbert Hoover's Last Laugh: The Enduring Significance of the 'Associative State,'" *Journal of Policy History* 10, no.3: 419-444.

[116] Derthick, M. and P.J. Quirk, 1985, *The Politics of Deregulation*, Brookings Institution, Washington, D.C., September

[117] Baumol, W.J. and A.S. Blinder, 1991, *Economics. Principles and Policy*, 5th edition, page 656

[118] Today, there is a broad consensus that the repeal of the Glass-Steagall Act has played an important role in enabling the excessive financial innovation that culminated in the global financial crisis of 2008. See, for instance, Kaufman, H., 2009, *The Road to Financial Reformation. Warnings, Consequences, Reforms*, John Wiley & Sons, Hoboken, N.J.

competition." (Russell, 2006: p.77). For standardization, this implied that the role of the government should remain subdued and constrained to its function as a user of standards. In short, there was limited space for strengthening Public-Private Interaction in the American standards system.

A particularly controversial issue is the implementation of the concept of "voluntary consensus standards" that is central to the US standards system (Garcia, Leickly and Willey, 2005: pages 126-130). The National Technology Transfer and Advancement Act of 1995 (NTTAA) defines a "voluntary consensus standard" as a standard "that is developed through a process that entails 1)openness, 2) balance of interest, 3) due process, 4)an appeals process, and 5) consensus, defined as general agreement but not necessarily unanimity." (OMB Circular A-119, 1998). Garcia argues that, while on paper, this concept may look very attractive, its implementation has serious drawbacks. Hence it may be problematic to use this concept as a "best practice" model for reforming the international standards system.

Specifically, Garcia highlights the following drawbacks (Garcia, Leickly and Willey, 2005: pages 18 and 19):

- Section 4(B) of the circular does not establish a preference for "voluntary consensus standards". It explicitly allows for other private sector standards to include 'non-consensus standards', 'industry standards'. 'company standards', or 'de facto' standards that do not meet OMB's defining characteristics of 'openness."
- The role and nature of consortia has not been addressed. This has led to inconsistencies in the Act's implementation. For instance, while government agencies must report their progress in adopting voluntary consensus standards to NIST, consortia are not required to do so.
- As policymakers have avoided these important issues, "contests among standards setting organizations are likely to dissipate many of the public benefits associated with standards."

Garcia argues that such ambiguities in US public policy on standardization have unintended negative consequences (ibid.: pages 18 and 19). "Rather than providing flexibility, ambiguities in government policies relating to appropriate behavior of standards organizations have served to compound... (two types of)… social dilemmas":

- Rivalry among standards organizations have "led to incoherent standards and impeded government efforts to present a united front in international standards negotiations."
- "By converting standards from public goods to club goods, consortia served to overcome collective action problems. However, these organizations have been subject to prisoner's dilemmas problems – especially with regard to intellectual property rights in standards. …[T]he rise of consortia .. has exacerbated power struggles within the standards community, increasing uncertainty as well as incentives for opportunism."

5.7. The broader picture - jobless growth

Finally, the real litmus test for the success or failure of the US standards system is whether it supports innovations that generate a sufficient number of well-paid jobs.

Recent Bureau of Labor Statistics employment data present a disturbing picture[119]. From 1997 to 2007, the output of US manufactures expanded by more than a third while employment fell by 20%, generating a loss of 3.5 million jobs. This translates into a more than 60% growth of productivity, which however comes at a substantial cost to society. In fact, the gap between productivity and wages has turned into a chasm since the global recession began in 2007 - US real wage growth between the last quarter of 2008 and the last quarter of 2009 was negative while productivity rose by 5 %[120].

Such dire employment data have raised doubts whether it is appropriate to reduce "public policy objectives" to innovation and competitiveness. For instance, Ralph Gomory, a former IBM Senior Vice President of Science and Technology, deplores that, in the US "innovation has become almost synonymous with economic competitiveness."[121] Gomory argues that the notion that "our economic salvation can only be through innovation…is a totally mistaken belief and one that, if accepted, will consign this nation to second- or third-class status…. Thinking of innovation without production …leaves most Americans entirely out. After all, only a very small portion of Americans are engaged in R&D."

BLS data in fact demonstrate a growing divide in the US labor market: While the unemployment rate for the third of Americans with college degrees is now down to 5%, the unemployment rate is 10.5 % among Americans with only a high school degree (and even 15.6% among those with less than a high school diploma).

For Gomory, the growing divide in the US labor market indicates that "the interests of many of our global corporations and the interests of the nation have diverged."[122]

On a conceptual level, this broader perspective on how to measure innovation policy objectives has important implications for standardization theory, as well as its closely related sibling, innovation theory. It is necessary to broaden the research agenda and explore how different systems of innovation and standardization are affecting employment generation capacities of different countries.

So far, our review of the American standards system shows that the extraordinary strengths of a market-led approach that is driven by the private sector are accompanied by significant weaknesses that result from the ambiguities in public policy.
We have also seen that the American approach to standardization reflects the unique characteristics of its history and economic institutions. Thus, even if the strengths outweigh the weaknesses of the American standards system – which I think is the case – it would still be hard to replicate the American system in other countries.

Let us now turn our attention to the missing link of the American standards system – the role that the Federal government has played in shaping and coordinating that system.

---

[119] Quoted in Houseman, S., C. Kurz, P. Lengermann, and B. Mandel, 2010, "Offshoring and the State of American Manufacturing", Federal Reserve Board and Upjohn Institute, Washington, D.C.
[120] http://www.bls.gov/data/ accessed April 24, 2010
[121] Gomory, R., 2010, "The Innovation delusion", March 1, page 1, http://www.huffingtonpost.com/ralph-gomory/the-innovation-delusion_b_480794.html, accessed June 1, 2010.
[122] Testimony of Ralph E. Gomory, Research Professor, NYU Stern School of Business and President Emeritus, Alfred P. Sloan Foundation1 To the U.S.-China Economic and Security Review Commission March 24, 2009

6. The role of the US government

It is important to emphasize that the US federal government has played an important role in shaping the evolution and the defining characteristics of the US standards system. A study by the RAND Corporation's Martin Libicki finds that, "…[p]rotests to the contrary, the US government is a major, indeed increasingly involved, player in virtually every major standards controversy." (Libicki, 1995: page 35)

Hence, the real issue is not whether the US government has a role to play in standardization. Instead, we need to ask the following questions: What role precisely has the US government played in fostering and shaping the American standards system? How has this role of the government evolved over time? Has the government's role in standardization helped to coordinate and channel the tremendous entrepreneurial and innovative energies that are set free in the pluralistic regime of creating voluntary consensus standards? And what can we say about its contribution to accomplishing the objectives of an innovation policy that seeks to strengthen America's innovation capabilities?

To answer these questions, we will first review the findings of research that examines the government's role in the US innovation system. On that basis, I will examine the Federal Government's role in standardization, using a simple taxonomy that distinguishes between direct and indirect standards policies.

6.1. What do we know about the role of the government in the US innovation system?

As is well documented in research on the US innovation system, the Federal government has been very active, but mostly behind the scene. We will see that the same is true for the American standards system.

In a classic study of "The US National Innovation System", David Mowery and Nathan Rosenberg document the significant role played by the US government, in both the Executive Branch and Congress[123]. Until the Second World War,

> *…[t]he federal government played a modest role as a supporter of research in the nonagricultural sector, and state governments funded both public higher education and the "engineering extension" activities of many of these universities….[However], [t]his structure was transformed beyond recognition by World War II… [and the Cold War]….Federal research funding expanded and displaced the role of state governments as actors in this innovation system and contributed to some weakening in the informal ties that linked many corporate and academic research institutions."* (Mowery and Rosenberg, 1993: pages 61 and 62)

But the study also emphasizes the absence of a consistent economic development strategy, apart from military R&D and procurement: "The powerful role of the federal government within the postwar US innovation system was … being motivated largely by

[123] Mowery, D and N. Rosenberg, 1993, "The US National Innovation System", in Nelson, R.R. (ed), *National Innovations Systems,* Oxford University Press. Similar arguments are presented in Block, F. and M.R. Keller, eds., 2011, *State of Innovation. The U.S. Government's Role in Technology Development*, Paradigm Publishers, Boulder, London.

national security concerns, … and policy-making devoted minimal attention to its domestic economic payoffs." (Mowery and Rosenberg, 1993: p.62). Nevertheless, the large, well-financed federal defense R&D program had a powerful catalytic effect – it increased the demand for professional engineers and scientists, but also generated a huge and highly profitable market for new technologies, especially in information and communications technologies, that gave birth to Route 128 in Massachusetts and, later on, in Silicon Valley[124].

An early influential study on the US semiconductor industry documents that military markets have shaped the direction of semiconductor technology and the structure of the industry: "defense and aerospace R&D and procurement created a market incentive for entrepreneurial risk-taking, helping to spawn an independent sector of semiconductor component manufacturers."[125] Equally important are government-industry partnerships established to promote America's key high-tech industries.

A series of studies on Government-Industry Partnerships, commissioned by the National Research Council's Board on Science, Technology, and Economic Policy (STEP), has documented the strategic role of the Federal Government in promoting innovation through direct funding of R&D, tax incentives or institutional support in biotechnology, nanotechnology, computing and semiconductors[126].

The critical role of the US government as a source of R&D funding and as a performer of R&D is well documented in the National Science Board's *Science and Engineering Indicators 2010* report[127]. Until the mid-1960s, the Federal Government was the predominant sponsor of the nation's R&D, funding some 67% of all US R&D in 1964. That share decreased in subsequent years, falling to a low of 25% in 2000. "Between 2001 and 2004, however, this decades-long trend was attenuated as private [R&D] investment slowed in the face of the 2001-02 recession. In addition, federal R&D spending expanded, first in health, and then in defense and counterterrorism", reaching 30% in 2004 (National Science Board, 2010: pages 4-13 and 4-14).

That share declined again during the following boom to 26% in 2008. However, in response to the severe recession of 2008, the Federal Government's share in the nation's total R&D has increased again, primarily driven by the American Recovery and Reinvestment Act of 2009. In fact, the US government seeks to use a significant part of the $787 billion budget of the American Recovery and Reinvestment Act of 2009 on energy ($61.3 billion) and on scientific research ($8.9 billion)[128].

While direct funding of R&D and support for public-private partnerships are important, they are only the tip of the iceberg. The Federal Government has at its disposal an impressive "…portfolio of policy tools to draw from in encouraging and accelerating

---

[124] For an in-depth analysis, see Flamm, K, 1988, *Creating the Computer. Government, Industry and High Technology*, The Brooking Institution, Washington, D.C.

[125] Borrus, M., 1988, page 63. The author is General Partner at X/Seed Capital, the venture capital firm in Menlo Park, CA.

[126] See, for instance, Wessner, C.W., editor, 2001, *Securing the Future. Regional and National Programs to Support the Semiconductor Industry*, The National Academies Press, Washington, D.C.

[127] National Science Board, 2010, *Science and Engineering Indicators* 2010, Arlington, VA: National Science Foundation, especially chapter 4.

[128] See http://en.wikipedia.org/wiki/American_Recovery_and_Reinvestment_Act_of_2009, accessed May 25, 2010.

innovation, and different combinations of tools may be appropriate depending on the technology and on market conditions. The tools include procurement, tax credits and subsidies to producers and users, loan guarantees, patents, demonstration projects, technical standards, distribution of information, provision of technical support to firms, and education of consumers."[129]

Take tax credits. The research and experimentation (R&E) tax credit, established by the Economic Recovery Tax Act of 1981, covers R&D activities performed in the United States by domestic and foreign-owned firms but excludes R&D conducted abroad by U.S. companies. It is subject to periodic extensions and, at the time of writing, was last renewed by the Emergency Economic Stabilization Act of 2008 through 31 December 2009. According to the most recent IRS Statistics for 2006, U.S. companies claimed an estimated $7.3 billion in federal R&E tax credits in 2006, involving close to 11,000 corporate tax returns, compared with $6.4 billion in 2005. It is remarkable that much of these tax credits go to larger corporations. According to IRS, the proportion of R&E credits going to corporations with business receipts of $250 million or more has fluctuated narrowly between 75% and 80% since 2003 and was 75% in 2006[130].

Government procurement is often among the most important of these policy instruments, especially when stimulus packages are designed to accelerate post-crisis recovery. Historically, government procurement has provided a major stimulus for R&D and innovation in the aerospace and the electronics industries. In chapter three below we will explore what this implies for debates on China's approach to government procurement as a tool for its indigenous innovation policy.

According to Sarewitz and Alic (2009: page 7): "If private sector innovators and entrepreneurs see government purchases as a meaningful market, they will design and develop products and services accordingly, tapping internal funds along with whatever R&D contracts they may win from DOE or other agencies." In fact, the National Technology Transfer and Advancement Act of 1995 (NTTAA) was specifically designed to strengthen the Federal Government's role as a sophisticated user of private sector innovations. NTTAA requires the Federal Government to use private industry voluntary consensus standards in procurement wherever possible, enabling the government to purchase commercial off the shelf (COTS) goods rather than much more costly custom-made products. In 1998, the Office of Management and Budget (OMB) issued a revised document (Circular A-119) to provide additional guidance to accelerate the conversion within federal agencies from customized and compulsory government-only standards to voluntary industry standards.

As discussed in section 5.5., while this conversion process has made significant process, the main stumbling block now remains the elusive definition of what constitutes "open standards".

6.2. US government's direct role – standard-setting labs and *de jure* standards

[129] Sarewitz, D. and J. Alic, 2009, "Accelerating Technological Advance for Climate Change: Lessons from Sixty years of US Innovation Policy", Testimony before the U.S. Senate Committee on Energy and Natural Resources, December 2, page 4.
[130] IRS Statistics of Income Division data are quoted in National Science Board, 2010: page 4-31.

Direct government action involves the development of standards in government labs and the codification of mandatory standards that require the use of specific standards through the force of laws or regulations.

In response to the establishment of national standard-setting laboratories in Germany and Britain, US Congress created the Bureau of Standards in 1901. The initial mandate was to coordinate the rapid proliferation of scientific standards as well as to carry out scientific research in its own laboratories[131]. Initially, the Bureau of Standards focused its efforts narrowly on standards for weights, measures, heat, and optics. Over time, the Bureau of Standards (which changed its name to the National Institute for Standards and Technology [NIST] in 1988) expanded its mission to include electricity research as well as testing of materials quality, and also provided technical assistance and product evaluations for regulatory bodies. But it never played a role comparable to the German Institute for Standardization (DIN) in shaping, coordinating and implementing the nation's standards strategy and policies[132].

As we saw earlier, the American National Standards Institute (ANSI) has a much more limited mandate. Its primary objective is to represent the interests of its nearly 1,000 members, most of them private companies. ANSI's role however is restricted to "promoting and facilitating voluntary consensus standards and conformity assessment systems and promoting their integrity..., by accrediting the procedures of …[about 200 independent]…standards developing organizations (SDOs). … Accreditation by ANSI signifies that the procedures used by the standards body in connection with the development of American National Standards meet the Institute's essential requirements for openness, balance, consensus and due process."[133]

The government's direct role in the US innovation system received a big push during the Second World War, as well as from the perceived threat from the Soviet Union and China during the Cold War. This gave rise to substantial investments by the Federal Government in the development of basic standards, such as the development of programming languages, measurement standards for optical fibers, and coordination for emerging computer-aided design technologies, as documented in Flamm (1988). And Janet Abbate highlights the critical role played by the federal government, through the Defense Advanced Research Projects Agency (DARPA) for the development of the basic Internet standard TCP/IP (Abbate, 1999: chapter 5). But, as Abbate emphasizes, it was the community of "sophisticated network users" in universities and research labs that transformed the ARPANET into the Internet that we know. And, as John Naughton puts it in his study of

---

[131] Rexmond C. Cochrane, 1966, *Measures for Progress: A History of the National Bureau of Standards*, U. S. Department of Commerce, Washington, D.C.

[132] According to its website, DIN, the German Institute for Standardization, "develops norms and standards as a service to industry, the state and society as a whole. A registered non-profit association, DIN has been based in Berlin since 1917. DIN's primary task is to work closely with its stakeholders to develop consensus-based standards that meet market requirements. By agreement with the German Federal Government, DIN is the acknowledged national standards body that represents German interests in European and international standards organizations. Ninety percent of the standards work now carried out by DIN is international in nature." http://www.din.de/cmd;jsessionid=AE8D5D82479D566B1F1E4873FC9AE59A.3?level=tpl-bereich&menuid=47566&cmsareaid=47566&languageid=en. Downloaded April 27, 2010

[133] ANSI, "Introduction to ANSI", at http://www.ansi.org/about_ansi/introduction/introduction.aspx?menuid=1, page 1, accessed May 18, 2010.

the origins of the Internet: "Does anyone seriously believe that a military-industrial complex left to its own devices would have consciously willed a network entirely devoid of central control, powered by a technology based on open standards which allows anyone to hook up to it?"[134]

Overall, however, the direct role of the Federal government remained limited. Typically, *de jure* or regulatory standards were restricted to safety and health issues (such as the Pure Food and Drug Act in 1906, and the Meat Inspection Act of 1906) and the prevention of abuse of market power (like the Federal Commission Trade Act of 1914).

A fundamental guiding principle of the US standards system is that "regulators …need to be realistic (read cautious) about the effectiveness of government-mandated standards… [and that]… it is essential to obtain the consent and cooperation of private actors." (Russell, 2007: p.18). Even during the Great Depression and Roosevelt's New Deal, the resistance against federal control over standardization remained deeply entrenched[135].

In short, "…American regulators have rarely taken *direct* control over economic functions, but have consistently implemented a variety of *indirect* measures—such as antitrust regulation, investments in the scientific knowledge base, and procurement for the military and other branches of government—with decisive consequences for the trajectory of American economic development in the private sector." (Russell, 2007: p.9)

6.3. Government's indirect role - the impact of antitrust policy

There is a broad consensus that antitrust policy has played an important role for the development and rapid diffusion of standards in US industry. Opinions however are deeply divided on the pros and cons of aggressive versus more passive antitrust policies.

Until the outbreak of the global economic crisis in 2008, the dominant opinion has been that the deregulation movement since the Reagan administration, and the resulting "… relaxation of antitrust prosecution and deference toward private ordering … have, on the whole, had positive consequences for the creation and dissemination of standards in American industry."(Russell, 2007: p.15) In fact, a fundamental premise of the current US standards system is that deregulation and the promotion of market competition are necessary to reduce "policy imperfections", due to incompetent bureaucracies that are perceived to stifle innovation and productivity growth. In addition, it is believed that voluntary standards developed within informal consortia are best qualified to solve "collective action" problems (identified in Mancur Olson's classic study) that prevent "*…rational, self-interested individuals*..[to]*…act to achieve their common or group interests*."[136]

That dominant consensus however is now under pressure, as the global economic crisis has shown the limits of deregulated markets. Today, there is a greater willingness in in Washington, D.C. to revisit the merits of more activist anti-trust policies and regulations. In fact, earlier research by leading US innovation economists demonstrates

---

[134] Naughton, J, 1999, *A Brief History of the Future. The origins of the internet*, Weidenfeld & Nicholson, page 270.

[135] David M. Hart, 1998a, *Forged Consensus: Science, Technology, and Economic Policy in the United States, 1921-1953,* Princeton University Press, Princeton.

[136] Olson, Mancur, 1971/ 1965, revised edition, *The Logic of Collective Action : Public Goods and the Theory of Groups*, Harvard University Press.

that, if handled appropriately, antitrust policy can be a powerful enabler of innovation and standardization. Take the 1956 consent decrees, resulting from antitrust pressures by the Justice Department, that were ordering the compulsory licensing of roughly 8,600 AT&T patents and the nearly simultaneous decree affecting IBM patents. Both cases inspired intense public scrutiny.

A study by Frederic M. Scherer (a leading innovation economist at Harvard University) [137]finds a "profoundly surprising" positive effect for "small new enterprises seeking a competitive foothold against well-entrenched rivals"[138]. By enabling small start-up companies to gain access to technological advances, the consent degree provisions for compulsory licensing of AT&T and IBM patents arguably have been a powerful catalyst for the development of Silicon Valley start-up companies.

This finding is supported in a comprehensive and by now classic study on the *Sources of Industrial Leadership*, by UC Berkeley's David Mowery and Columbia University's Richard Nelson. The study emphasizes the important positive role of the active US postwar antitrust policy:

> *"Although it rarely receives extensive attention in discussions of technology and competitiveness, the relatively stringent postwar competition policy of the United States aided the growth of new industries. US antitrust policy weakened the ability of incumbents in such industries as computers and semiconductors to control new technologies and markets…. [due to]… a relatively weak intellectual property rights environment for most of the first three decades of the US industry's development."* [139]

In fact, empirical research has shown that US antitrust policies have played an important role in IBM's decision to unbundle its hardware and software[140]. And, as documented by Baldwin and Clark, IBM's unbundling decision has been one of the fundamental drivers behind the spread of modular design across the computer, semiconductor and telecommunications industry[141].

6.4. Testing the limits – the Department of Justice supports VITA's *ex ante* disclosure of essential patents

A recent example of the potentially important role that US antitrust policy could play for the American standards and innovation system is the October 2006 decision by the Department of Justice to support a proposed patent policy by the VITA standard

---

[137] F. M. Scherer, *The Economic Effects of Compulsory Patent Licensing* (New York: New York University, Graduate School of Business Administration, 1977).

[138] F.M. Scherer, 2006, "The Political Economy of Patent Policy reform in the United States", pages 5 and 6, at http://www.nber.org/~confer/2007/si2007/PRL/scherer.pdf, downloaded April 25, 2010.

[139] Mowery, D.C. and R.R. Nelson, eds, 1999, *Sources of Industrial Leadership*, Cambridge University Press, pages 379, 380. See also Mowery, D.C., 2009, Plus ca change: Industrial R&D in the "third industrial revolution", *Industrial and Corporate Change*, Volume 18, Number 1, pp. 1–50, January

[140] Mowery, D.C., 1999, "The Computer Software Industry", chapter 4 in Mowery, D.C. and R.R. Nelson, eds, *Sources of Industrial Leadership*, Cambridge University Press, page 144

[141] Baldwin, C.W. and K.B. Clark, 2000, *Design Rules: The Power of Modularity*, MIT Press, Cambridge,Mass

development organization that requires *ex ante* disclosure of essential patents and their licensing terms[142].

In a letter, dated October 30, 2006, to the attorney representing VITA, the Assistant Attorney General states that the Department of Justice "has no present intention to take antitrust enforcement action against the conduct you have described."[143]Specifically, the letter states (quotes are from pages 6,7 and 8 of the letter):

> *"Once a particular technology is chosen and the standard is developed, however, it can be extremely expensive or even impossible to substitute one technology for another. In most cases, the entire standard-setting process would have to be repeated to develop an alternative standard around a different technology. Thus, those seeking to implement a given standard may be willing to license a patented technology included in the standard on more onerous terms than they would have been prior to the standard's adoption in order to avoid the expense and delay of developing a new standard around a different technology.*
> *Requiring patent holders to disclose their most restrictive licensing terms in advance could help avoid this outcome by preserving the benefits of competition between alternative technologies that exist during the standard-setting process. …*
>
> *The disclosure of each patent holder's most restrictive licensing terms would allow working group members to evaluate substitute technologies on both technical merit and licensing terms. Working group members are likely to use this information when deciding which technologies to include in the standard. This use likely will create incentives for each patent holder to compete by submitting declarations that will increase the chances that its patented technology will be selected….*
>
> *Adopting this policy is a sensible effort by VITA to address a problem that is created by the standard-setting process itself. Implementation of the proposed policy should preserve, not restrict, competition among patent holders. Any attempt by VITA or VSO members to use the declaration process as a cover for price-fixing of downstream goods or to rig bids among patent holders, however, would be summarily condemned."*

The above decision by the Department of Justice constitutes an important change in the Department's approach to standard-setting processes. Until then, the prevailing assumption was that the collaborative standard-setting process could result in exclusionary and collusive practices that would harm competition and violate the antitrust

---

[142] Accredited by ANSI as an American National Standards developer and a submitter of Industry Technical Agreements to the IEC, the VITA Standards Organization provides its members with the ability to develop and to promote open technology standards. Standards development takes place in working groups and study groups. VITA has created more than 30 standards in the past 10 years that promote open technology systems. Within the VSO no one individual holds the power to decide what technology may become a standard — that power belongs solely to the membership. http://www.vita.com/vso-stds.html, accessed April 29, 2010

[143] Department of Justice, 2006, "Response to VMEbus International Trade association (VITA)'s Request for Business review Procedure", letter from Thomas O. Barnett, Assistant Attorney General, Department of Justice to R.A. Skitol, Drinker, Biddle & Reath, LLP, Washington, D.C., October 30, at http://www.justice.gov/atr/public/busreview/219380.pdf, accessed May 26, 2010.

laws. However that earlier policy led many SDOs to implement rules that strictly forbid all activities that could potentially result in antitrust liability, including restrictions on discussions about the terms and conditions of licenses to patents that are essential to a standard.

The Department of Justice argues that VITA's proposed policy on *ex* ante disclosure could help to avoid such unintended negative side effects\, and that it could motivate other SDOs to gradually relax the above restrictions. The following quote nicely summarizes the Department of Justice's new position:

> *"Unless the standard-setting process is used as a sham to cloak naked price-fixing or bid rigging, the Department analyzes action during the standard-setting process under the rule of reason. The Department's analysis of VITA's proposed patent policy under the rule of reason examines both the policy's expected competitive benefits and its potential to restrain competition."*(Department of Justice, 2006: p.6)

The DoJ's decision and VITA's implementation of this new patent policy has generated a lively controversy that still is continuing. As summarized by the Department of Justice letter, the expected benefits of *ex* ante disclosure are substantial. Yet, leading global ICT companies have raised strong opposition.

Opponents argue that *ex ante* disclosure will have disruptive effects on the smooth functioning of the American standardization process and that it would stifle innovation. Specifically, opponents claim that the inherent uncertainty of technical change prevents correct and timely disclosure or would require extensive patent searches at very high cost. An additional critique is that important companies with large patent portfolios are unlikely to accept *ex ante* disclosure and hence would leave an SDO that seeks to implement such a policy.

In fact, Motorola left VITA in protest against the new *ex ante* policy. However, more than 20 new companies (including GE, Boeing, Ratheon, Northrop Grumman, General Dynamics) have joined VITA after the new patent policy was established.

To express its fundamental opposition to the policy of *ex ante* disclosure, Motorola also filed an appeal against the decision by ANSI's Executive Standards Council to reaccredit VITA. This appeal however was dismissed by ANSI's Appeals Board Panel. [144]

In the academic literature, the claims of opponents have largely met with skepticism. For instance, a recent PhD thesis by Claudia G. Tapia examines these and other related arguments against *de facto disclosure* and concludes that "it is questionable

---

[144] ANSI, email letter to Mr. Miguel Pellon, Vice President, Technology – Standards Corporate, Motorola, January 22, 2008, http://www.vita.com/disclosure/ANSI%20Appeals%20Board%20Decision%20in%20Motorola%20Appeal%2022Jan08.pdf, accessed May 27, 2010. See also the original decision by ANSI's Executive Council, dated October 1st, 2007, which states:" Motorola's Argument that VITA's Disclosure Obligation Impermissibly Removes a RAND Option Guaranteed by the ANSI Patent Policy and Impermissibly Imposes a *De Facto* Duty to Conduct a Patent Search in Violation of the ANSI Patent Policy Are Without Merit", http://www.vita.com/disclosure/ANSI%20ExSC%20Panel%20Decision%20in%20Motorola%20Appeal%20of%20VITA%20Reaccreditation%2001Oct07.pdf, accessed May 27, 20010.

whether the current skepticism towards *ex ante* disclosure is really justifiable." But she also adds that, "without further in-depth analysis, it remains unclear whether the mandatory process works and, if so, under what circumstances." [145]

And a recent study, prepared for NIST, concluded that "…the information elicited by the organization's *ex ante* policy was important and improved the overall openness and transparency of the standards-development process. Thus, …l the process-based criticisms of *ex ante* policies and the predicted negative effects flowing from the adoption of such polices, are not supported by the evidence reviewed."[146]

The main problem seems to be that, in the critically important ICT industry, the strength of the opposition is such that, until now, no other US standard development organization has decided to follow VITA's example. In short, despite of the potentially substantial benefits of *ex ante* disclosure policies, opponents have succeeded in preventing the general acceptance of that principle.

VITA itself is alive and well, but its main focus now is on the defense industry. In that industry, adopting *ex ante* mandatory disclosure policies is possible, as companies can afford not to pursue a 'pure IP' business model, given the strict procurement requirements of the Pentagon.

In contrast, the 'pure IP' business model is shaping competition in large globalized industries (like telecommunications, cellular phones and integrated circuits) that are scale-intensive, that depend on venture capital and private equity, and where speed-to-market is of the essence. In these industries, competition is shaped by "winner-takes-all" strategies, and management must squeeze profits out of every stage of the value chain, including IPR and the standards process. Market inefficiencies in these industries are pervasive and systemic. These market inefficiencies constrain innovation and the supply of necessary innovation infrastructure (like interoperability standards), and they obstruct the "normal workings of the market."

This has important implications for the dynamics of voluntary standards-setting in the US. Standardization processes must be *context*-specific, i.e. they must take into account the structure and competitive dynamics of specific industries and market segments. In other words, there is no one-best approach to establish a "transparent IPR policy" and an open standards system.

A second important implication is that, at present, *ex ante* remains a niche activity. One way to interpret this is to conclude that in the US the time is not ripe yet for strengthening the role of the government in the American standards system. Note however that this contrasts with the situation in China. China's policy makers and SDOs like CESI, AVS and IGRS have taken great interest in VITA's *ex ante* disclosure policies and have arguably come up with their own organizational innovations to foster the transparency of standardization[147]. This poses an important challenge for the American

---

[145] Tapia, C.G., 2009, "Intellectual Property Rights, Technical Standards and Licensing Practices (FRAND) in the Telecommunications Industry", unpublished PhD study, Max Planck Institute for Intellectual Property, Competition and Tax Law, Munich and Universität Augsburg, page 198.

[146] Contreras, J.L., 2011, *An Empirical Study of the Effects of Ex Ante Licensing Disclosure Policies on the Development of Voluntary Technical Standards*, study prepared for the National Institute of Standards and Technology (NIST, Department of Commerce under NIST contract No. SB 134110SE1033, June 27.

[147] See Ernst, 2011a, chapters 4 and 5.

standards system and its search for ways to adjust and upgrade that system to the new challenges of rising complexity.

6.5. The "Associative State" – an enduring mechanism of the US standards system?

In short, the role played by the Federal Government in the evolving US standards system does not easily fit into simple stereotypes. The US standards system is defined by a unique approach to public-private interaction. The private sector dominates, but the Federal government certainly has a role to play.

The interesting question really is whether the balance between public and private sector has remained unchanged or whether, over time, there have been adjustments. In fact, there is evidence for some shifts in that balance. An authoritative study of the US innovation system since the 1920s shows that conflicting visions have struggled to forge a consensus and to create a unified strategy (Hart, 1998a). The study identifies five alternative strategic visions - conservatism, the "Associative State", reform liberalism, Keynesianism, and the national security state – and traces their shifting influence through different periods.

For observers outside the US it may be difficult to really understand the concept of the "Associative State". In essence, this concept highlights a defining characteristic of the US standards system, and arguably its greatest strength – "… the central importance of collaborative efforts to set standards in the private sector." (Russell, 2007: p.20) In principle at least, such multilateral cooperation enables "a diverse range of stakeholders from government, industry, and consumers … [to] come together to express their preferences during the standardization process… [It] greatly enhances the likelihood that the resulting standards will be adopted and used."

But the origins of the concept of the "Associative State" also indicate why China and other countries with a different history and political culture may find it hard to replicate its guiding principles and organizational and governance arrangements. In fact, the concept of the "Associative State" goes back to the aftermath of World War I, when the then Commerce Secretary Herbert Hoover was searching for ways to use government agencies (like the National Bureau of Standards) to work and cooperate with private sector institutions to "reduce waste in industry."[148] The idea was to capture the benefits of engineering and rationalization while also fostering "American Individualism". [149]

According to David Hart, the concept of the "Associative State" describes a fundamental characteristic of the American innovation system - the role of the state is to remedy "…the informational failures of capitalism through cooperative inter-firm and business-government interaction." (Hart, 1998b: p.420) Hart argues that, despite the twists and turns of antitrust policy and the rise and fall of the welfare state and the warfare state, a basic commitment to an "associative vision" of business-government relations has endured.

But how sustainable is this "associative vision" of business-government relations in a world where hyper-competition and return on investment are the primary determinants of business decisions? In an email exchange with David Hart, I asked him

[148] Samuel Krislov, 1997, *How Nations Choose Product Standards and Standards Change Nations,* University of Pittsburgh Press, Pittsburgh.

[149] Hawley, E.W., 1974, "Herbert Hoover, the Commerce Secretariat, and the Vision of an 'Associative State', 1921-1928", *The Journal of American History*, 61: 116-140

(April 24, 2010): “You had written that article before the Bush administration pushed the deregulation agenda to the extreme. When you look at the situation today, would you qualify your earlier statement? Has the "associative vision" of business-government survived?” David Hart answered (April 26, 2010): “… [T]he associative ideal does still live on, especially among moderate Democrats. One area that … uses this model is the "smart grid," in which NIST is setting standards in a collaborative fashion with industry participants.”

7. The Smart Grid Interoperability project – A new approach to public-private standardization partnerships?

The Smart Grid Interoperability project, coordinated by NIST, provides an important example of recent attempts in the US to move beyond the legacy of deregulation and to search for a new approach to public-private standardization partnerships.

7. 1. The challenge of rising complexity

The main driving force is the need to cope with the new challenge of rising complexity of technology and the required organizational approaches. The Smart Grid Interoperability project faces a daunting task. “The North American electric power system grid might be the most complex machine ever built,” writes Massoud Amin, professor of electrical and computer engineering at the University of Minnesota and an expert on electrical grid security[150].

However, today the grid is "aging, inefficient, and congested, and incapable of meeting the future energy needs of the *Information Economy* without operational changes and substantial capital investment over the next several decades."[151]

According to George Arnold, the NIST coordinator for Smart Grid Interoperability, nothing less than a complete transition is necessary “from today's electric grid, in which there has been a tradition of proprietary interfaces and product customization for individual utilities, to an interoperable grid based on open standards…[This]… is a huge change for the industry.” (quoted in Updegrove, 2009a, page 2)[152] An important task is to accommodate traditional, centralized generation and distribution resources while also facilitating the incorporation of new, innovative Smart Grid technologies, such as distributed renewable energy resources and energy storage.

The *NIST Framework and Roadmap for Smart Grid Interoperability Standards* describes an unprecedented standardization challenge[153]. To upgrade the existing

---

[150]Amin, S., 2010, "Securing the Electricity Grid," *The Bridge*, quarterly publication of the U.S. National Academy of Engineering, Volume 40, Number 1, pp. 13-20, Spring

[151] "Grid 2003" A National Vision for Electricity's Second 100 Years, United States Department of Energy, Office of Electric Transmission and Distribution (July 20023), p iii., at http://www.climatevision.gov/sectors/electricpower/pdfs/electric_vision.pdf. Accessed on May 11, 2010.

[152] For details, see Testimony of George W. Arnold, National Coordinator For Smart Grid Interoperability, *National Institute of Standards and Technology (NIST)/United States Department of Commerce* before the *Subcommittee on Technology and Innovation Committee on Science, Space, and Technology United States House of Representatives* “Empowering Consumers and Promoting Innovation through the Smart Grid”, September 8, 2011.

[153] NIST, 2010, *NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0* NIST Special Publication 1108, Office of the National Coordinator for Smart Grid Interoperability, National Institute of Standards and Technology, U.S. Department of Commerce, Washington, D.C..

patchwork of the North American power system grid, more than 75 existing major standards need to be reviewed, adjusted and approved so that they can work together. In addition, to master the transition to a smart grid, hundreds of new standards, specifications and requirements need to be created in priority areas, such as energy efficiency, energy storage, electric transportation, advanced metering infrastructure, distribution grid management, cyber security, and network communications.

Rising complexity in the case of the smart grid project results from the inherent limitations of disparate and uncoordinated networks. In the US, 3,100 utilities are involved in the electric power system grid, and more than 15 standard development organizations. This compares with a much simpler ownership structure that the automation of the telecommunications network was facing in the late 1970s. At that time, the US telephone network was all owned by one company. So coming up with a plan and setting standards was easier — it was done by Bell Labs.

The Smart Grid Interoperability standards also need to account for an extraordinarily complex regulatory environment - in addition to the federal government, there are 51 jurisdictions (50 states plus DC). And to top it all, the project needs to establish effective cooperation within a very short time frame between two industries whose business models and strategies could hardly be more different.

The utility industry moves slowly, at least partly because of the complex regulatory environment. But equally important for the slow pace of change in this industry is the highly fragmented ownership structure. On the other hand, the providers of information hardware and software for integrating the grid are all from the fast-moving ICT industry where profits depend on speed as well as on strategic patenting. According to one observer, trying to make these two players work together is "… like, over the next week or so, let's solve the Palestinian-Israeli Problem."[154]

It is obvious that such rising complexity drastically increases requirements for interoperability standards. Specifically, interoperability standards are required for two types of interfaces – interfaces among technology domains (say between distribution grid management and cyber security), and interfaces among different actors, primarily private firms engaged in all the different industries that are involved in the construction of the integrated Smart Grid. This requires that the interoperability framework should be "flexible, uniform, and technology neutral." (NIST, 2010: page 7)

A review article by Andrew Updegrove nicely summarizes the rising complexity challenge of Smart Grid project[155]:

> *"While there are technical antecedents for such an effort (most obviously, the upgrading of the telecommunications infrastructure), no such initiative in the past has involved so diverse a mix of industries, with such divergent realities and approaches to their respective businesses. Even the contemporaneous and equally ambitious effort to deploy electronic health records (EHRs) nationally pales in*

[154] Bob Gohn, senior analyst at Pike Research, quoted In Harbert,T., 2010,"The not-so-msrat-grid" *EDN,* May 25, http://www.edn.com/article/print/509094-The_not_so_smart_grid.php pages 1 and 2, accessed June 1st, 2010.

[155] Updegrove, A., 2009b, Standards and the Smart Grid: The U.S. Experience, page 20, at http://www.consortiuminfo.org/bulletins/apr09.php#feature, accessed on May 11, 2010

comparison, due to the fact that transition to a Smart Grid will require a larger number of standards to be agreed upon, and the technical areas in which those standards will operate are more diverse."

7.2. A paradigm shift in US innovation and standards policy?

In order to cope with this extraordinary complexity, the Smart Grid is conceived as a "complex system of systems for which a common understanding of its major building blocks and how they interrelate must be broadly shared. NIST has developed a conceptual architectural reference model to facilitate this shared view. This model provides a means to analyze use cases, identify interfaces for which interoperability standards are needed, and to facilitate development of a cyber security strategy."(NIST, 2010: page 8)

NIST believes that

"interoperability standards …[for the Smart Grid] should be open. This means that the standards should be developed and maintained through a collaborative, consensus-driven process that is open to participation by all relevant and materially affected parties and not dominated by, or under the control of, a single organization or group of organizations. As important, the standards resulting from this process should be readily and reasonably available to all for Smart Grid applications. In addition, Smart Grid interoperability standards should be developed and implemented internationally, whenever practical."(NIST, 2010: page 9)

However, on its own, the bottom-up American standardization process that depends on private industry to develop consensus-based voluntary standards is ill-equipped to cope with such complexity. As we have seen, a defining characteristic of the American standards system has been the largely indirect role that the government has played in the development of standards. And since the 1980s, the push towards deregulation has further reduced the government to a largely passive player, allowing private industry to lead the way.

In the absence of effective coordination, private for-profit companies typically concentrate their efforts on pushing their own proprietary technologies that address specific problems but are not designed to provide solutions for the system as a whole. This leads to the production of many standards that however are poorly coordinated. This approach obviously does not work well for complex, very-large scale technology systems that involve layers and layers of separate standards that need to be identified, harmonized and, most importantly, broadly diffused to an extremely diverse community of standards implementers and users.

NIST believes that the key to success is a pragmatic approach that uses whatever approach works best and that discards approaches that do not deliver technically sound, open standards quickly. As emphasized by George Arnold:

"We are trying to do something with the grid that has not been done before. The interoperability in the telecommunications network is done almost entirely through voluntary standards, and it seems to work. However the electric grid is much more fragmented … and has more a tradition of using proprietary systems. …[Hence]. …[s]ome combination of voluntary and mandatory standards will

likely be needed [Underlining added, DE]." (quoted in Updegrove, 2009 a: page 6).

NIST argues that today such a more flexible approach to standardization is made possible by the ubiquitous use of embedded software in many important standards. In addition, new approaches to programmable system-on chip devices make it possible to continuously update relevant equipment[156].

At the same time, the development of the Smart Grid faces tremendous time pressures. A major initial source of funding, around $ 11 billion, comes from the Recovery Act of 2009. According to George Arnold, "… [t]here is a concern that we cannot allow these investments to become stranded because the standards are not yet there to ensure interoperability. So the standards work has to move much faster than it usually does." (quoted in Updegrove, 2009a: page 4).To achieve quick results in the context of high complexity further increases the need for 'open' interoperability standards.

But developing such open standards will only be possible, if new forms of public-private standards development partnership are developed. NIST expects that the process of developing the Smart Grid will be a catalyst for developing "new collaborative methods and vehicles for developing and deploying standards in technology-based markets, especially during the early phases when standards – or the lack of standards – can strongly influence the course of further technological development and diffusion and the growth and competitiveness of industries [underlining added, DE]." (NIST, 2010: page 11)

In other words, NIST considers the Smart Grid project as an important experimentation field for developing new governance methods and mechanisms for public-private standards development partnerships.

7. 3. Multiple stakeholders with conflicting interests

But implementing this concept will not be easy. The Smart Grid project covers many different industries involved in the generation, management, distribution and use of power. This project has attracted an extraordinarily large number of organizations that all seek to shape decisions on the Smart Grid interoperability standards and to profit from them.

Two powerful incentives explain this strong interest: First, a fairly strong demand pull effect results from the huge size of the market for Smart Grid related products and services. And, second, a large pot of federal money is available in the short term as part of the 2009 stimulus package.

Hence, the Smart Grid project has to cope with multiple stakeholders with sometimes conflicting interests. An important characteristic is the involvement of a multitude of government agencies. In addition, main stakeholders that seek to shape Smart Grid interoperability standards include private standard-setting organizations and consortia, as well as trade associations and lobbying groups.

---

[156] For a economic analysis of the impact of these new chip design methodologies, see Ernst, D., 2005, "Complexity and Internationalization of Innovation: Why is Chip Design Moving to Asia?", *International Journal of Innovation Management*, 2005, 9(1), March: pages 47-73

7.3.1. The critical role of government agencies

An important distinguishing feature of the Smart Grid Interoperability project is the prominent role played by government agencies in shaping its agenda and in providing and controlling key resources and project outcomes. Under the *Energy Independence and Security Act of 2007* (EISA) signed into law in December, 2007, the Department of Energy (DoE) has overall responsibility for the Smart Grid Project, while NIST was appointed to coordinate the development of Smart Grid Standards. Both NIST and the DoE's Office of Electricity Delivery and Energy Reliability (OEDER) are co-charged (with the Smart Grid Task Force) with reporting to Congress on a regular basis regarding "the status of Smart Grid deployments and any regulatory or government barriers to continued deployment."[157]

In addition, the Department of Homeland Security will monitor whether the Smart Grid will be properly secured against cyber attack, and EISA mentions Homeland Security by name as an agency whose input the Secretary of Commerce is to seek in preparing the reports to Congress required by EISA.

7.3.2. Private sector organizations

A wide range of private sector standard-setting organizations (SSOs) are active in the creation of standards relevant to Smart Grids, and their role is a recognized and essential element of the Smart Grid transition envisioned by Congress in EISA. Several SSOs (IEEE and NEMA) are mentioned by name in Title XIII, Section 1305(a)(2) of EISA). About 15 or so of these SSOs will play an important role in supplying the standards that will populate the Interoperability Framework.

Some of the most important organizations that are working in this space include IEEE, NEMA, IEC, IETF, NERC, in addition to NIST (for cyber security). There are about 15 organizations in total. In addition to traditional SDOs, consortia such as ZigBee are in the mix. It is interesting to note that ANSI does not play an overly prominent role. As George Arnold puts it diplomatically, "…ANSI also [sic!] has a key role in ensuring there is a good process for standards development and facilitating access to IEC and ISO." (quoted in Updegrove, 2009 a: page 4)

What matters is that, at least on paper, all private sector players (even the most powerful ones) have agreed to accept the coordinating function of NIST. For standards, that coordinating role is played by George Arnold, the nation's first National Coordinator for Smart Grid Interoperability who was appointed to that role in April 2009. Arnold is a well respected player in the standards community, and a former Vice President at Lucent Technologies' Bell Laboratories, who was active in the development of international standards for Intelligent Networks and IP-based Next Generation Networks.

The nomination of George Arnold highlights an important strength of the American standards system. Not only have standards association a long history of independence, but they can also draw on a large pool of well educated and experienced

---

[157] U.S. Congress Research Service,2007, "Energy Independence and Security Act of 2007: A Summary of Major Provisions", prepared by Fred Sissine, Coordinator, Specialist in Energy Polic Policy Resources, Science, and Industry Division, December 21, at http://energy.senate.gov/public/_files/RL342941.pdf, accessed May 27, 2010

standards experts who have developed their own strong peer group networks. In the American system, these individuals can often play a decisive role as gatekeepers, matchmakers and coordinators in shaping the decisions on standardization and in facilitating the implementation of the resulting standards.

In short, private sector organizations matter in the design and implementation of the Smart Grid project. But it is assumed that, at least initially, private organizations will play second fiddle relative to the role played by government agencies. Private organizations presumably accept this subordinate role, in order to reap the substantial externalities that result from heavy tax-financed public investment in the required R&D, support institutions and infrastructure. An additional explanation for this accommodating position of the private sector may be the high-level attention that the Smart Grid project has received not only from the secretaries of Commerce and Energy, but also from the White House.

There is in fact Big Money involved in the Smart Grid project. The American Recovery and Reinvestment Act (ARRA) of 2009 has earmarked $4.3 billion for the smart grid, most of it for demonstration projects and existing deployments. Public-private matching funds are expected to bring total funding to $8.6 billion. And North American utility spending on Smart Grid (hardware, software and services) is projected to rise from $ 10.7 billion in 2009, to $ 13 billion in 2010, $ 15 billion in 2011, and $ 17.6 billion in 2013.[158] According to one expert, "there's nothing like a few billion dollars dangled in front of a bunch of vendors to get everybody to cooperate and play nice"(Bob Gohn, quoted in Harbert, 2010, page 1).

7.4. Outsourcing of governance to private contractor

It is an open question however how long this arrangement will last. In fact, it is noteworthy that NIST has decided to use a private for-profit company, *EnerNex Corporation*, to establish the Smart Grid Interoperability Standards Panel (SGIP) as the main body for governing the development of Smart Grid Interoperability Standards. As stated in its $8.5M contract with NIST. *EnerNex* is tasked to support the agency in its role of coordinating and accelerating development of Smart Grid interoperability standards.

This outsourcing of key public governance tasks to a private contractor is an institutional approach that reflects some fundamental beliefs of the American standards system. Before discussing the pros and cons of this arrangement, let us first look at the tasks of SGIP and the current membership of SGIP Governing Board.

SGIP, a group of more than 450 vendors, standards organizations, utilities and related companies, is tasked to perform interoperability tests on the 25 approved standards as well as try to resolve problems or conflicts in the other 50 standards that have not yet been approved. The main tasks of SGIP are

- "to provide a more permanent process with stakeholder representation in order to support the ongoing evolution of the Smart Grid Interoperability Framework;
- to identify and address additional gaps, reflect changes in technology and requirements in the standards;

[158] IDC Energy Insights projections, as quoted in Harbert, T., 2010, "The not-so-smart grid", iEDN, May 25. 2010, page 1. athttp://www.edn.com/article/print/509094-The_not_so_smart_grid.php, accessed May 27, 2010. There is no information on whether these data are corrected for inflation, so I assume that these are nominal investment projections.

- and to provide ongoing coordination of SSO efforts to support timely availability of new or revised Smart Grid standards."(NIST, 2010: page 116)

As specified in the Energy Independence and Security Act (EISA) of 2007, the SGIP Governing Board is "an open, transparent public-private partnership to support NIST in its primary responsibility to coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems." In order to maintain a broad perspective of the NIST interoperability framework, the SGIP Governing Board is responsible for approving and prioritizing the work of the SGIP and coordinate necessary resources to effectively implement action plans.

To ensure all stakeholder categories are fairly represented on the SGIP Governing Board, the criteria for membership includes: extensive experience in one or more stakeholder categories and the ability to support overall SGIP and NIST goals. Current SGIP Governing board members have been selected from over 23 stakeholder categories, including utilities, renewable power producers, standards development organizations, professional societies, manufacturers and vendors, consumers, and IT and system developers.

The SGIP Governing Board does not directly develop or write standards; rather its stakeholders participate in the ongoing coordination, acceleration, and harmonization of standards development. Key corporate members include for instance Honeywell, Ford Motor Company, Lockheed Martin, Google, ABB Inc, and GE Energy, and corporate industry associations like the National Electrical Manufacturers Association [NEMA].

Let us now look at some background information on *EnerNex* Corporation, the private contractor used by NIST to establish the main governance body of the Smart Grid project. On its website, *EnerNex* describes itself as a provider of engineering and consulting services, along with software solutions and customization, for the electric power industry, with a focus on the development and application of new and emerging electric power technologies for the Smart Grid[159]. Of particular interest is that the company's senior management have all long professional careers in the power industry and are well connected with key players especially in the development of relevant standards.

Take Erich W. Gunther, who is Chairman and Co-Founder of EnerNex Corporation[160]. Gunther's CV emphasizes his expertise in helping "EnerNex clients define their strategic direction in basic R&D, technology, and product development". He has worked in important US power companies, including Electrotek and McGraw-Edison (now Cooper Industries). Most important for our purposes is Mr. Gunther's long involvement in leading positions in national and international standardization organizations, including among others the IEEE PES Intelligent Grid Coordinating Committee and other relevant IEEE task forces; the UtilityAMI working group and OpenHAN task force, various task forces of IEC and Europe's ECE.

[159] See www.enernex.com, accessed May 13, 2010.
[160] See http://www.enernex.com/staff/staff_erich.htm, accessed May 13, 2010.

This demonstrates again the critical importance that informal peer group networks play in the American standards system where a limited number of key individuals often act as *de facto* gate keepers and coordinators among the diverse private industry players.

6.5. Open questions

It is too early to judge whether the Smart grid model of outsourcing key governance functions to private consulting firms provides a robust framework for solving the daunting tasks of the Smart Grid Interoperability Standards project. Speed and efficiency it might well improve, but what about providing a reasonably fair distribution of the costs and the rents to be reaped from Smart Grid standardization?

In other words, will this outsourcing of governance functions lead to yet another example of skewed distribution of standardization benefits that has haunted much of the standardization in the ICT industry? Or are industry players more willing this time around to compromise, taking into account the greater willingness of Congress to provide the tools for a more active approach to regulation in case of market failures?

NIST is not overly concerned at this stage that Smart Grid project may be hijacked by powerful industry players. Here is how George Arnold sees it:

> *"I have to say that so far I have not seen this to be a big problem. There are a few cases of competitive standards but in the areas I have seen there is market demand for multiple solutions and our standards framework needs to accommodate it. What has pleasantly surprised me is that everyone sees this as a once-in-a-lifetime opportunity to redesign one of the most important infrastructures of the nation, and that if we do this right the pie gets bigger for everyone. There is a level of cooperation that I have not seen before."*(Quoted in Updegrove, 2009a: p.7)

It is encouraging to see that one of the chief architects of the Smart Grid Interoperability Standards project sees reason for optimism. Nevertheless, we obviously need thorough empirical follow-up research that examines the impacts of this important large-scale standardization experiment.

8. Conclusion

The flexibility and bottom-up character of the US market-led system of voluntary standards has been an important source of America's extraordinary record in generating commercially successful innovations. These benefits are well established in historical research, as well as in theory and case studies. Grounded in a tradition of decentralized local self-government, America's standards system has given voice to diverse stakeholders in innovation, and hence has avoided the pitfalls of top-down government centered standards systems that are hard to start and steer, and even harder to adjust or stop once they get going. Examples of these strengths discussed in the paper are the IETF model of system-level standardization for the Internet and intricate arrangements, especially in the IT industry, of outsourcing of component specification tasks that are tedious and time-consuming and that require detailed feedback from customers.

For countries that seek to upgrade their standards systems, it thus makes sense and study the strengths of the American system. However, the paper documents as well

significant drawbacks and possible limitations of the US market-led system of voluntary standards. Intense conflicts and a lack of effective coordination of multiple stakeholder strategies have created important constraints to effective and open standardization processes, especially in the management of essential patents and in the timely provision of interoperability standards.

As standardization is a contested and constantly changing field of economic activity with far-reaching implications for competition and market structure, the government has an important role to play as an enabler, coordinator, and, if necessary, an enforcer of the rules of the game in order to prevent abuse of market power by companies with large accumulated patent portfolios. Globalization and the increasing complexity of advanced technology imply that public policy needs to complement the strengths of the market-led approach to standardization.

As Greg Tassey of NIST puts it succinctly: *"The era of the one-country technology-based growth model and lack of recognition of modern technology's complexity is over. Recognition of this fact and proper policy adjustments are essential for future competitiveness.*"[161] In order to cope with the new challenges of the global knowledge economy, America's standards system needs to be reshaped and upgraded as part of an integrated innovation policy. Both the US government and the private sector need to join forces and develop a national innovation strategy that seeks to combine productivity improvements with the creation of quality jobs while minimizing energy usage, materials waste and other environmental impacts.

A closer look at the role of the US federal government shows that it has been very active, but mostly behind the scene. While direct government action through standard-setting labs and *de jure* standards remains limited, the government has played an important indirect role, primarily antitrust policies. The paper argues that after an extended period of passive antitrust policies, the pendulum now seems to swing back to a more active approach, as illustrated in the Department of Justice's support of *ex ante* disclosure of essential patents.

Of great interest for observers from foreign countries, and especially from China, are current attempts to establish and strengthen again robust public-private standards development partnerships. To learn more about this important development, the paper has analyzed in detail the Smart Grid Interoperability project coordinated by NIST. An important distinguishing feature of this project is the prominent role played by government agencies in shaping its agenda and in providing and controlling key resources and project evaluation.

This provides an important message for standards and innovation policy in other countries around the world, and especially for China. Attempts to copy and replicate the American standards system will face clear limitations. While standards everywhere are confronted with similar tasks, there are significant differences in the organization and governance of standardization processes. These differences reflect unique characteristics of a country's economic institutions, its level of development, its economic growth model, as well as its culture and history.

Word Count: 28,769 (02 17 12).

[161] Tassey, G., 2009, "Rationales and Mechanisms for Revitalizing U.S. Manufacturing R&D Strategies", NIST, December, p.49 .