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Abbate, Janet. *Inventing the Internet*. Cambridge, MA: MIT Press, 1999.

Summary: History of the internet focusing on the social, cultural and political factors that influenced its design and use (end of 1950s to mid 90s).

"Like all technologies, the Internet is a product of its social environment." p. 2

"Their dual role as users and producers led the ARPANET's builders to adopt a new paradigm for managing the evolution of the system: rather than centralize design authority in a small group of network managers, they deliberately created a system that allowed any user with the requisite skill and interest to propose a new feature." p. 5

Electronic mail and WWW are informally created applications that became popular not through marketing but "through the spontaneous decisions of thousands of independent users." p. 6

Network arch. Designed to accommodate a lot of competing tech along with informal and inclusive management style gave the system an ability to adapt. P. 6

Chapter 1: Origins & Meanings of Packet Switching. ARPANET, Packet Switching in the US and the response to Soviet thread in the Cold War. Paul Baran and initial design for survivable communications systems. AUTOVON - AT&T developed large scale comms network in 1960 & other messaging systems under development. P. 7-21.

British/UK concerns RE technology gap with US. Labour party response to fund and drive resources toward technology/computer industry. More funding for NPL. Focus on interactive computing research/user friendliness of computers (Donald W. Davies). Batch processing vs. Time Sharing design considerations and tradeoffs. Packet Switching in Davies's System. Proposed UK Network & competitive response to ARPANET. P. 21-33

Impact of Davies Work. Mark 1 terminals. Packet Switching, Davies & Baran putting it all together at ARPANET. A bit of founding ARPA history + key players: President Johnson's role, Lawrence Roberts, BBN, Robert Kahn, NPL, Roger Scantlebury, Leonard Kleinrock. P. 33-39

Social Construction Theory applied to Packet Switching p. 39-41

Chapter 2: Building the ARPANET: Challenges and Strategies. J.C.R. Licklider & IPTO. "Man-Computer Symbiosis" paper as a manifesto. Licklider identified several challenges to this symbiosis and funded projects. Robert Taylor. MIT Lincoln Lab. Maps of IPTO research centers and early ARPANET. P. 43-47

Initial Challenges for ARPANET. Communications Engineers vs. Computer Science Engineers at odds from the very beginning! P. 47.

"Incompatibility wasted time and programming resources…. Roberts viewed the diversity of computers not as an unfortunate necessity but as a strength of the system, since a network that connected heterogeneous systems could offer users a wider range of resources." p. 48

"Almost every conceivable item of computer hardware and software will be in the network… This is the greatest challenge of the system, as well as its greatest ultimate value." Roberts, qtd p. 48

ARPANET PI resistance to the initial system design (difficulty + unwillingness to share computing resources). "In order for the project to succeed, Lawrence Roberts would need to create some sense of common purpose." p. 50
System Building Strategies - Layering & Informal management. Each higher level function builds on the capabilities provided by layers below. A layered system is organized as a set of discrete functions that interact according to specified rules. P. 51
Network and Layer Models of ARPANET. Protocol Stack. P. 52-53
Informal & Collegial Management Style or ARPA & PI/Researchers. "...ARPA's Management style was aimed at fostering the cooperation required to integrate those elements into a coherent whole." p 54
How Contracts/Funds were awarded in early ARPA p. 56-57
Stanford Research Institute tasked with creating online resources regarding the network. "Roberts also re-established the informal networking group, now named the Network Working Group, to develop software specifications for the host computers and to provide a forum for discussing early experiences and experiments with the network." p. 59 (Note: Vint Cerf was a member as a PHD student)
Organization of the ARPANET project (figure) p. 60
Managing Technical Complexity: Layering and the IMP. "As practiced by Heart and his group, the technique of layering became a way to manage social relations as well as to reduce technical complexity." p. 63
Collaborative Process of defining host protocols. Development of the Network Control Program + addition of another layer in the ARPANET model. First applications developed (FTP, email (1972)) P. 66.-69.
Managing Social Issues. Meetings & Dynamics between Researchers, Contractors, Students, ARPA management. Benefits & tensions/conflicts. BBN forced to make source code for IMP freely available. Conflicting priorities of participants. P. 69-73
The Network Working Group. Lack of authorities + newness of the field meant NWG had to form tech problems and propose solutions on their own. "We were just rank amateurs, and we were expecting that some authority would finally come along and say, ' Here's how we are going to do it.' and nobody ever came along." Vinton Cerf qtd. P. 73
Interesting observations on the impact of student/NWG group on development & dynamics p. 73-74
NWG Documentation Conventions & Process, Governance (how they worked) - great quote from Crocker RE value of content in NWG notes: "....These standards are stated explicitly for two reasons. First, there is a tendency to view a written statement as an ipso facto authoritative, and we hope to promote the exchange and discussion of considerably less than authoritative ideas. Second, there is a natural hesitancy to publish something unpolished, and we hope to ease this inhibition." p. 74
ARPANET in the political environment of the Vietnam War. p. 74-78
Launching ARPANET with a dramatic gesture/demo; public response. Encouraged hardware designers to develop terminals that could be used with a variety of systems rather than just a single local computer. P 78-81
Chapter 3: User Impact on the ARPANET. Impact of users on early ARPANET, challenges, experience and design of system. Levels of participation early on. Authorized and unauthorized users (access control) NIC "white pages" directory of users. Costs for getting started. Searching & finding resources. Competition from commercial networks. 83-90.
"One challenge in making the ARPANET user friendly lay in translating activities that build community-sharing of information, support, recreation - to the network environment." p. 84
"The road to becoming an active ARPANET user was long and hard…" p. 84
"Unauthorized users who contributed improvements to the system may even have received tacit encouragement from ARPA."
""I don't think that any of the hosts were all that easy to use if you weren't part of the computer community...substantial documentation tended not to be tutorial in nature...You learned to use a host by

talking to the other users down the hall… it wasn't even easy for computer scientists to learn how to use a remote system, much less for other communities to do so."" p. 89
Improving the system: user Activism. "Users also began to organize to press for more support from ARPA- an activity that exposed tensions between segments of the ARPANET community. Three aspects of the system that users' experiments affected noticeably were terminal interfaces, connection paths between hosts, and applications protocols." p. 90
Tensions allowing users to alter TIPs: "BBN was responsible for maintaining and upgrading the machines, a task that would be much harder if users were to make non-standard, possibly damaging changes." p. 92
ARPA did not always welcome user feedback or attempts to steer the system. Tension with Users Interest Working Group (USING). "Faced with organized action by users, the ARPA managers were evidently afraid that the network might slip out of their control." p. 95
"The fate of USING revealed the limits of ARPA's generally non-hierarchical management approach… Individual users or research teams had tacit or explicit permission to add hardware and software to the system… However, users as a group had no say in the design decisions or funding priorities of the ARPANET project. The ARPANET experience is a reminder that the efforts of individuals to build virtual communities are constrained by the realities of money and power that support the infrastructure of cyberspace." p. 95
Rethinking the ARPANET's Purpose: Successes and Failures of Resource Sharing. P96-99.
Who Benefitted - ARPA's computer scientists benefitted most obviously/readily from the ARPANET, not the broader scientific community. Information sharing, programming language development, networking. Short list of non-CS research "collaboratories" that benefited from the early ARPANET. P. 100-104
""Another thing that happened a lot in the 1970s was benign theft of software. We didn't protect our files and found that both programs and data migrated around the net rather quickly, to the benefit of all…"" (Les Earnest, qtd p. 101)
Lawrence Roberts announces in 1970s that the network would be used to support ARPA's researchers in other sciences - people for whom computers were a tool, not a research focus. This is a "silent majority" of ARPA users?
The decline of the Ideal of Resource Sharing. Factors included non-expert computer users wanting access & having many obstacles. Disinterest in using hardware & software "non-invented here" People prefer running programs on their local machine vs. it's native computer. P. 104-106
Email is the "Smash Hit" Application. History and development of email protocols. Development of "email hosts" and adoption of email addresses. Email touches an uncovered "nerve" and need- rather than access to computing power, it provides power in access to people. P. 106-111
"At ARPA's headquarters, the appeal of the network had nothing to do with computers but everything to do with access to power." p. 108
"The rationale for building the network had focused on providing access to computers rather than people...The paradigm of resources sharing may have blinded the ARPANET community to other potential uses of the network." p. 109
"Email laid the groundwork for creating virtual communities through the network. Increasingly, people within and outside the ARPA community would come to see the ARPANET not as a computing system but rather as a communications system." p. 111
Chapter 4: From ARPANET to Internet. Evolution of one network into network of many networks. Impact of commercial and military concerns. New Directions in Packet Switching. Alohanet and Ethernet. Packet Radio and Satellite. Development of the Internet program in 1973, Cerf team and key collaborators (NPL, Cyclades). International Network Working Group. (p122-127) P. 113-127.
Designing the Internet. TCIP. History of. P. 127-133
"Perhaps as important, the common protocol would create a particular type of experience for Internet users." p. 128

“Having to translate between different protocols would have emphasised the boundaries between networks, and the Internet’s designers wanted the system to appear seamless.” p. 108
“The designers of the Internet had to devise a system of host addresses that would enable packets to be directed to a particular host on a particular network. They chose to create a hierarchical address system: one part of the address would specify the name of a network, while another part would give the name of an individual host within that network.” p. 129
History of splitting TCP into TCP/IP. P. 130. ARPA funds implementations of TCP/IP in various operating systems including UNIX and popular IBM systems. P. 133
Military involvement in the Internet. P. 133. Network hardware to receive common carrier license from the FCC. ARPANET as a defense system - Access and controls begin to tighten and be enforced by ARPA as military use of the system increases. P. 137
Security concerns increase; growth of home computer systems encourage exploration by “computer freaks”. Phone phreaking. DCA (defense communications agency) involvement. AUTODIN I & II. Switching over the internet protocol as a response. Competition with competing ISO standards being developed at the time. p. 138-139
Transition to TCP/IP. “The reality beneath Parker’s inspiring words was that the DCA and ARPA were forcing a traumatic upheaval in the ARPANET community.” p.140.
Buttons that read “I survived the TCP Transition” p. 141
“Hosts had to make sure that all their network applications produced packets with the new headers; if not, they would be unable to use the ARPANET as of January 1981…. Hosts would also have to adopt updated versions of the applications protocols ftp and telnet, a new mail standard called Simple Mail Transfer Protocol (SMTP), and a new addressing scheme for mail.” p. 141
‘The name server was created by a large group of ARPANET members and went into service at the Network Information Center at SRI in July 1982.” p. 141
Every site has the new protocols running & “a major milestone” of the evolution of the internet is passed by June 1983. P. 142
Steps toward a “Civilian Internet” and ushering in the internet era. MILNET and ARPANET. Commercialising internet technology. ARPA funding for key projects. P. 142-145
“All of the major computer companies took advantage of this opportunity, and by 1990 TCP/IP was available for virtually every computer on the American market. This gave a tremendous momentum to the spread of the ARPA protocols, helping to ensure that they would become a de facto standard for networking.” p. 143
“The internet was not built in response to popular demand, real or imagined; its subsequent mass appeal had no part in the decisions made in 1973. Rather the project 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.” p. 145
Chapter 5: The Internet in the Arena of International Standards. TCP/IP standards were created in the 1970s and became a de facto standard in the 1980s; commercialization led international SDOs then proposed formal network protocols that did not include TCP/IP. Types of standards, standards strategies. P. 147-148
“Standards are a political issue because they represent a form of control over technology.” p. 147
Standards Makers: A Web of Interests. P. 148-152. Further discussion of the origin and process of technical standards. Difference between de facto and formal standards. Examples incl. QWERTY keyboard. TCP/IP as a de facto standard & competing network standards from Xerox.
“Proprietary standards tend to favor large manufacturers and may do little to increase compatibility between different products.” p. 149

History of "Byzantine" & complex national & international standards groups claiming jurisdiction over Computer/ICT standards in the 1970s. ANSI. Growth of incompatible standards & rivalry over networking standards. P. 150-152.
Recommendation X.25 - flair up between computer manufacturers and telecom companies. P. 152-156
Virtual Circuits and the Distribution of Control. Switching Nodes + Ethernet Cable or Radio Link. p. 156-161.
"The more technically sophisticated users were often willing to take on this additional responsibility in return for greater flexibility and control over the system." p. 159
Internetworking and the Role of Private Networks. Lessons of X.25. Figures of X.25, ARPA and CCITT internetworking schemes. P. 161-167
Open Systems Interconnection. OSI & ISO. The impact of OSI. OSI & The standards debate. Lessons of OSI. 7 protocol layers for hosts and nodes defined by OSI + graph. P. 167-179
"Early in 1978, concerned ISO members from the US, Britain, France, Canada, and Japan formed a new committee to tackle the problem of network standards, naming their project Open Systems Interconnection. To computer users, "open systems" represented an ideal that was defined in opposition to the manufacturer's proprietary systems." p. 168
OSI's view of closed vs. open systems. P. 168-169
"Their plan was to start by developing a model of how a set of protocols should fit together to form a complete network system… The OSI model would be a "meta-standard"- a standard for creating network standards." p. 169
Chapter 6: Popularizing the Internet. P. 181-220. Growth of the internet from a research tool to a mass comms medium starting in the 1990s. Growth of networks and question of controls - government role / oversight. Author's own arguments/ points regarding this growth.
"I argue that the combination of an adaptable design and a committed user community accounts for its success." p. 182
"On the social side, ARPA (and later the NSF) worked hard to expand access to the internet and to make TCP/IP easily available to potential users… The Internet community's decentralized authority, its inclusive process for developing technical standards, and its tradition of user activism encouraged new groups to participate in expanding and improving the network, and the openness of the system invited users to create new applications (of which the World Wide Web would become the most dramatic example." p. 182
Increasing civilian participation from the 1970s-80s. Split between CSNET/ARPANET/MILNET. P. 183-186
Growth at the periphery - role of LANS, PCs, university system, etc. p. 186-188
"In the fall of 1985, about 2000 computers had access to the Internet; by the end of 1987 there were almost 30,000, and by October of 1989 the number had grown to 159,000. (MERIT 1997)" p. 186
"ARPA managers Cerf and Kahn permitted and encouraged contract sites to connect their LANs to the Internet. THis would have been a rather extraordinary move for a commercial network; however, ARPA was not in the business of selling Internet service, so its managers had no incentive to restrict access for economic purposes. From their perspective, having a larger user community enhanced the value of the Internet as a research tool with little extra cost to the agency, and the robust and decentralized nature of the system minimised the need for ARPA to exercise central control over its expansion." p. 187
"No one in Congress was arguing over who should or should not be allowed access to the Internet, or at what cost." p. 188
Central coordination of the DNS - Creation of the host & Domain system p. 188-191
NSF takes over from ARPA - MERIT, NSFNET. p. 191-194
The end of ARPANET. Transition from ARPANET to NSFNET. Feb. 28, 1990 ARPANET is formally decommissioned. P. 194-195
Requiem for ARPANET poem by Vint Cerf (1989):

“It was the first, and being first, was best,
But now we lay it down to ever rest.
For auld lang syne, for love, for years and years
Of faithful service, duty done, I weep.
Lay down thy packet, now, O friend, and sleep.”
Privatizing the Internet - p. 195-200
“ARPA managers had tried as early as 1972 to persuade a commercial operator such as AT&T to take over the ARPANET, but they had not been successful; in 1972 it was not evident that the market for data network services was big enough to interest a giant corporation.” p. 195
Convergence with other networks. UUCP. News exchange systems. Birth of USENET “a poor man’s ARPANET”. Remote Job Entry Protocol. BITNET. FIDONET. Commercial online services aka conferencing systems such as Prodigy, America Online, CompuServe. Email. p. 200-205
“With the privatization of the Internet, the independent networks contributed a large population of experienced network users to the Internet community, as well as some new applications that would appeal to the public in search of social interaction or amusement on the Internet.” p. 200
“By the mid 1980s the grassroots systems were being imitated by commercial email services on existing telephone or computer network systems: MCI Mail, AT&T Mail, Telenet’s Telemail, DEC’s EasyLink, and others.” p. 203
Management Issues. NSF Management style. Ongoing protocol development with the Internet Program, Internet Configuration Control Board, which was replaced by Internet Activities Board. Role of the IAB. Convergence of NSF tech committees and IETF. Global connections to the Internet. P. 205-212.
“If consensus on a proposed protocol seemed to emerge, the ICCB would often arrange for a few Internet sites to create implementations of the protocol to see how it worked under actual use; if the protocol was tested successfully, the ICCB would declare it an official Internet Standard.” p. 206
“In January of 1992, the Internet Society, a nonprofit organization, was assigned formal oversight of the IAB and the IETF.” p. 207-208
Legal authority of these bodies is unclear. Difficult to satisfy concerns of varying interest groups. “As the Internet becomes more of an international resource, the continued authority of the United States in administrative matters will, no doubt, be challenged more and more.” p. 208
The World Wide Web. Gopher System. Wide Area Information Server. Ftp. mail. Building the web- history at CERN, TBL, etc. Birth of hypertext concept. p. 212-220
“The computing tradition on which Berners-Lee drew was far removed from the military roots of the ARPANET and the Internet: the hacer counterculture of the 196Os and the 1970s. In 1974, Ted Nelson, a vocal champion of this counterculture, had written a manifesto, Computer Lib, in which he had urged ordinary people to learn to use computers rather than leaving them in the hands of the “computer priesthood”. P. 241
“Our experience… is that any attempt to enforce a particular representation… leads to immediate war… Format negotiation allows the web to distance itself from the technical and political battles of the data formats.” Berners-Lee quoted p. 215
France Minitel system - did not allow users to create their own content. P. 216
Birth of Mosaic. Released to the public in Nov. 1993. P. 216-218
“On the web, links between sites were made laterally instead of hierarchically, and each individual could be a producer as well as a consumer of information.” p. 218
“If the Internet is to continue as an innovative means of collaboration, discovery, and social interaction, it will need to draw on its legacy of adaptability and participatory design.” p. 220

Henning, Michi. "The Rise and Fall of CORBA." *ACM Queue* 51, no. 5 (August 2008): 29-34.

Summary: Essay by first hand expert on CORBA about the technical and social issues affecting the failure of CORBA. Related critique of standards process.

Industry will not wait on technology to respond to opportunity/changes in the marketplace: "Instead of waiting for CORBA to deliver a solution, companies turned to other technologies and started building their e-commerce infrastructures based on web browsers, HTTP, Java, and EJB" p. 29-30

Why CORBA Component Model Failed as a standard (p. 30):

1) *The Specification was large and complex and had much of it had not been implemented, not even as a proof of concept.*
2) *No Commercial CORBA vendor made a commitment to implement CCM, not even as a proof of concept.*
3) *EJB had become entrenched in the industry (period was 1997-1999)*

Other CORBA Issues p. 30: Commercial CORBA implementations cost several thousand dollars + royalties; Platform had a steep learning curve - lead to long development times, high defect rates, poor documentation.

Fragmented market provided golden opportunity for a standardized technology (SOAP) to help put nail in the coffin p. 30: "For customers, this added more uncertainty about CORBA's viability and, in many cases, prompted them to put investment in the technology on hold."

"Technical excellence is not a sufficient prerequisite for success but, in the long term, it is a necessary prerequisite. No matter how much industry hype might be pushing it, if a technology has serious technical shortcomings, it will eventually be abandoned." p. 31

"The most obvious technical problem is CORBA's complexity- specifically, the complexity of its APIs. Many of CORBA's APIs are far larger than necessary." p. 31

Other technical failings of CORBA: insufficient features including security and versioning p. 32

Technical issues were symptoms of procedure issues: "Technical problems are at the heart of CORBA's decline. This raises the question of how it is possible for a technology that was produced by the world;s largest software consortium (referring to OMG) to suffer such flaws. As it turns out, the technical problems are a symptom rather than a cause." p. 32

Critiques of OMG Standards process p.33:

1) *There are no entry qualifications to participate in the standardization process.*
2) *RFPs often call for a technology that is unproven (users vs. implementers, browsers v. devs)*
3) *Vendors respond to RFPs even when they have known technical flaws*
4) *Vendors have a conflict of interest when it comes to standardization. "For vendors, standardization is a two-edged sword. On the one hand, standardization is attractive because it makes it easier to sell the technology. On the other hand, too much standardization is seen as detrimental because vendors want to keep control over the features that distinguish their product from the competition." p. 33*
5) *RFPs are often answered by several draft specifications. "By combining features, specifications end up as the kitchen sink of every feature thought of by anyone ever." p. 33*
6) *The OMG does not require a reference implementation for a specification to be adopted. (Note: ECMAScript is a reference implementation of JS)*

"It seems inevitable that Web services will enact a history quite similar to CORBA's" p. 34

Author's suggestions for a better standards process & thus better middleware: p 34:

1) *Standards consortia need ironclad rules to ensure that they standardize best practice. "There is no room for innovation in standards."*
2) *No standard should be approved without a reference implementation.*
3) *No standard should be approved without having been used to implement a few projects of realistic complexity.*
4) *Open source innovation usually is subject to a Darwinian selection process.*

5) *To create quality software, the ability to say "no" is usually far more important than the ability to say 'yes'.*

"At the heart of these open source practices are two essential practices: cooperation and trust. Without cooperation, the evolutionary process cannot work; and without trust, no cabal of experts can act as an ultimate arbiter." p. 34

Wirfs-Brock, Allen. "Programming Language Standardization: Patterns for Participation." Proceedings of 5th Asian Conference on Pattern Languages of Programs, Taipei, Taiwan. https://pl.csie.ntut.edu.tw/asianplop2016/proceedings/A14.pdf.

Summary: Author proposes a pattern language and provides 3 initial patterns for programming language standardization participants. Some history and examples from Ecma TC39 are provided. Guidance for an individual RE how to be an effective and productive participant on a programming language standards committee.

"Design teams and standards committees are social organizations and each has its own challenges for members who want to be effective participants." p. 1

Lifecycle management of a programming language; each lifecycle requires different things/skills. "Once a language is standardized in this manner the responsibility of managing the ongoing evolution of the language largely transfers from the language's original designers to the participants in its standards committee." p. 2 "In order to exert influence, members need to learn how to effectively work within the committee setting." p. 2

Why programming languages are standardized. How they get started and are transferred to standards sending organizations. Issues related to standardization: 1) differing implementations affecting movement of programs 2) technical mistakes that affect implement-ability or degrade program performance 3) idiomatic patterns found to make language more precise. 4) language used in ways or in support of application domains that were not contemplated by the original design. P.2-3

Issues and concerns of community and business stakeholders. P 3

"When the popularity of a programming language and the backlog of pending language evolution issues reach such levels, a common solution is to form a standards committee to resolve the issues and to assume overall responsibility for the ongoing evolution of the programming language." p 3

General description of standards committees and how they operate. Discussion of roles of delegates and invited experts. Group decision making generally via consensus. Evolution of a TC & impact of size of TC (# of delegates). High Level specification development process/cycles. P. 3-4

"Consensus on a particular decision does not require that every delegate enthusiastically support the decision, but it does require that every delegate is willing to accept that decision." p. 4

"Development of a language standard is not a green-field development activity… A language standards committee exists to solve problems that arise from the current state of the language." p. 4

Pattern language needed for language standards delegate in order to assist with technical and social onboarding. Phases of participant lifecycles. "Because of this turnover, standards committees have the continuing challenge of integrating new delegates as effective collaborators and contributors." p. 5

Proposed Patterns for joining a standards committee p. 5-6:

1) *Don't talk too much*
2) *Learn the history*
3) *Understand other players*
4) *Volunteer to take notes*

Proposed patterns for participating p 6-7

1) *Have goals and plans*

2) Be a contributor
3) Start Small
4) Claim a Territory
5) Find Allies
6) Pick Your Battle
7) Back Pocket Alternative
8) Break Consensus as Your Last Resort

Patterns for Leading p. 7-8

1) Become an Editor
2) Always have a draft
3) Release Goals and Schedule
4) The Max-Min solution
5) Fork and Ancillary Standard
6) Volunteer to take notes

DeNardis, Laura. "Global Controversies over Open Standards." In *Opening Standards: The Global Politics of Interoperability*, Ed. Laura DeNardis. vii-xv. (2011). Cambridge, Massachusetts: MIT Press, 2011.

"Technical standards not only provide technological interoperability but also produce significant political and economic externalities. Battles over standards are sometimes market conflicts [which stand to benefit]." p. viii

"... standards that are not published or have underlying intellectual property restrictions imposed on them can be used as barriers to trade in global markets." p. Ix

[on electronic health standards] "A striking aspect of this form of policy making is that standards are established primarily by private institutions rather than elected representatives. This has raised many questions about legitimacy and the necessary degree of openness and transparency of the development process for standards that might have direct policy implications." p. ix

p. ix- Questions about openness exist in four general areas: 1) The development process (who is permitted to participate in designing a standard or to access information about that standard's development process); "If standards development sometimes involves battles among companies and decisions that have public interest implications, then the degree of procedural openness and transparency is a relevant concern." 2) Implementation - the degree of a standard's openness in its implementation (is published, is free or some fee)... and "to what extent the standard has underlying IP restrictions on its implementation in products." 3) Standards Use - how standards influence product competition and user choice of technologies; 4) Government involvement in standardization - what is the appropriate role of governments in promoting open standards.

"Finally, Opening Standards makes it clear that, despite the historical traditions of the internet, openness is not a given but must be defined and promoted in an information society in which technical standards increasingly control the pace of innovation, the extent of freedom online, and access to knowledge." p. xv

Morris Jr., John B. "Injecting the Public Interest into Internet Standards." In *Opening Standards: The Global Politics of Interoperability*, Ed. Laura DeNardis. 3-12. Cambridge, Massachusetts: MIT Press, 2011.

Summary: examples of how private standards bodies operating outside of traditional structures of government and public accountability make policy choices. How to add public interest into the process. IPv6 and Privacy. OPES and Censorship. DOCSIS and data capacity.

- The need to inject the public interest into standards development processes
- Challenges and successes in raising public policy concerns in technical standards bodies

- Standards bodies should work to develop procedures to identify policy concerns

"Even if a technical standard that impacts a public concern is made freely available to all technology designers, it cannot be considered to be "open" unless it was developed with an effective opportunity for public input. [...] the necessary public policy analysis must also shift into the standards process." p. 3
"Standards organizations typically (and appropriately) have emphasized technical goals over broad societal ones, but in the Internet's early history there was a significant overlap between the two. Openness, accessibility, anonymity, and robustness were all technical features of the network that became public values as well." p. 7
"The subsequent explosion in commercial use of the Internet prefigured a significant increase in privately motivated participants in the standards process. [...] the extent to which participants can be expected to agree about the network's architecture is diminished because of diverging market interests." p. 7

Baird, Stacy. "The Government at the Standards Bazaar." In *Opening Standards: The Global Politics of Interoperability*, Ed. Laura DeNardis. 13-31. Cambridge, Massachusetts: MIT Press, 2011.

Summary: Government Role in enforcing technical interoperability & reluctance to do so. Industries are well structured to develop standards. Many avenues for standards development (listed many voluntary consensus forums from formal to informal). This is an abridged & updated version of "Government at the Standards Bazaar" Published in Stanford Law & Policy Review 18 (2007) 35-101.
Author defines term 'standard' as a written specification that facilitates interoperability between networks and applications or services, enabling components to exchange/use information. P. 29
Definition of Consortia - the process can be more efficient in consortia. List of consortia standards. P. 15. Consortia can be less transparent but are important:

> *"The information technology industry does have a special challenge because it uses every kind of standardization process imaginable, ranging from the most informal meeting possible to the very formal processes that result in an ANSI standard…" Oliver Smoot, ANSI Chairman, qtd in Baird. P. 16.*
>
> *"[...] Consortia provide the speed while the formal standards system, through its openness and balance, takes a little longer, but I believe that there needs to be the right mix of using both the formal and the consortia and that needs to be chosen by the users of the standards and the players in the process." Gerald Ritterbusch, director of standards for Caterpillar, qtd in Baird. P. 16*

Definition of patent pool/patent pooling w/ examples p. 17
Standards are by nature IP & potentially subject to copyright or patent law - owners may control through licencing terms. "Many, if not most, information technology standards, including open standards, have patented components that are owned or controlled by one or a few companies." p. 19
The National Technology Transfer and Advancement Act (NTTAA) mandates that federal government agencies use commercially developed "voluntary consensus standards" p. 17
Brief discussion of De Facto standards and development into other standards p. 17-18
Two most prominent types of standards are "open standards" and "proprietary standards." Author defines open standards as technical specs that have 4 primary characteristics. p. 18-19.
Testimony from NIST in 2005 - there are over 450 US Standards-setting orgs and 150 consortia standards dev. Activities ongoing. more than 13,000 private sector standards in use by the federal government. P. 20
"A standards system is strengthened whenever standards developers share a common vision for meeting stakeholder needs… standards are essential to a sound national economy and to the facilitation of global commerce." 2005 ANSI publication qtd in Baird p. 21

Note about RAND royalties and licensing striking the proper balance between the needs of the patent holders and the standard implementers on the other p. 29

Garcia, D. Linda. "Government, the Public Interest, and Standards Setting." In *Opening Standards: The Global Politics of Interoperability*, Ed. Laura DeNardis. 33-43. Cambridge, Massachusetts: MIT Press, 2011.

Summary: The market doesn't always/necessarily produce efficient results & there are some times reasons governments should take an active interest/role in standards. In the US, standards setting is a private affair. In other countries like France, the national government leads.

"Because standards exhibit many characteristics of public goods, standards setting is subject to considerable market failures (Farrell and Saloner 1988; Berg 1989)." p. 33

Standards setting in the united states. P. 34

Standardization and the industrial revolution: "The emergence of standards setting in the united states is closely linked to the industrial revolution." p. 34

> *"Chief among the other elements in the patterns of mass production is the principle of standardization. Stemming from the rudimentary division of labor, standardization involved the continuous pursuit and progressive realization of uniformity of the materials, operations, and products of industry, which made possible the future subdivision and mechanization of labor." Harold Williamson, qtd in Garcia p. 34.*

+ *Relationship between standards and mass production is self-reinforcing.*

Plurality of people and standards orgs: necessity for specializing standards-setting operations. P. 35.

Standards orgs emerge to deal with specific needs as they arose on industry-to-industry basis (35-36).

"Though many efforts were made to coordinate their activities through the ANSI - the internationally accepted body in the ISO and IEEE - they have continued to operate on a pluralistic basis, with many of them circumventing ANSI." p. 36

References Werle 2001 p 392 - jurisdictional conflict at the rise of consortia conflicting with the SOs of national bodies.

Graphic/visualization of standards as a complex, adaptive process involving society, government, industry, & other influences. P. 37

The market may make suboptimal choices - transaction + coordination costs are high. The market may not tip in favor of a common standard. Public goods are underproduced & so are information about standards. P. 38

"However, whereas in the techno-economic field we find market failures, in the standards organizational field we find social dilemmas - situations in which the dominant strategies pursued by individual actors lead to outcomes that are sub-optimal for the collective as a whole." Heckathorn, Kollock & Miller qtd. In Garcia p. 39

Two sets of dilemmas: 1) who will bear the cost of organizing to set standards 2) a prisoner's dilemma entailed in allocating and appropriating benefits. P. 39

Reconciling public and private interest p. 40

Kuerbis, Brenden & Mueller, Milton. "Securing the Root." In *Opening Standards: The Global Politics of Interoperability*, Ed. Laura DeNardis. 45-62. Cambridge, Massachusetts: MIT Press, 2011.

Summary: Case study about the politics of a single Internet Protocol/Standard (DNSSEC). Policy problem of managing the root zone file of the DNS. Who has authority over the DNS is a divisive issue. Despite DNSSEC being an open standard the US government used implementation of the standard to further entrench its authority.

DNS's success as a reliable and effective lookup directory places a heavy burden of proof on new proposals p. 47
Adoption of DNSSEC is chicken and egg problem p. 47
ICANN vs. US Dept. of Commerce p. 53
Paypal and IAB weigh in on Root Zone Signing p. 55
Principal-Agent Relationships and Control of the Secured Root p. 56-57
"First, it is not enough to be concerned simply with pursuing the development of open standards. DNSSEC was developed in a setting (i.e., the IETF) that many consider an exemplar of open standards development. Second, there is a need to pay more attention to the governance arrangements in which open standards are implemented. The underlying relationships of institutions involved warrant closer examination, as they may be used strategically, even when relatively open and transparent processes are in place, to control outcomes." p. 57

Rens, Andrew. "Open Document Standards for Government: The South African Experience." In *Opening Standards: The Global Politics of Interoperability*, Ed. Laura DeNardis. 63-71. Cambridge, Massachusetts: MIT Press, 2011.

Summary: Challenges involved in framing South Africa's open standards policies. South Africa has a national framework for adopting and preferring open standards within public sector tech. Critique of ISO standards setting process. Raises questions about the difference between a standard labeled "open" by a standards body and the ability of that standard to actually meet the government's objectives for an open standard.

"Information policy is the proprioceptive organ of the nation-state, the means by which it senses itself and, therefore, the medium through which all other decision-making, public or private, takes place." (Sandra Braman, qtd) p. 63
Issues of Software and the State - state recognition of problems with proprietary software, as discussed through word processing software (Word & ODF) p. 63-65
"Since almost all proprietary software vendors are located in the global North, the use of proprietary software results in developing country taxpayers financing royalty payments to the global North, with negative consequences for the balance of payments and the tax base." p. 65
South Africa's Minimum Interoperability Standards for Information Operability Standards (MIOS) states a standard should meet all of the following criteria in order to be regarded as open: p. 66

- *Maintained by a non-commercial organization*
- *Participation in the ongoing development work is based on decision-making processes that are open to all interested parties*
- *Open access: all may access committee documents, drafts and completed standards free of cost or for a negligible fee.*
- *It must be possible for everyone to copy, distribute, and use the standard free of cost.*
- *The intellectual rights required to implement the standard (eg essential patent claims) are irrevocably available, without any attached.*
- *There are no reservations regarding reuse of the standard*
- *There are multiple implementations of the standard.*

History of Document Formats Standards and International Standards Organizations including ISO and ECMA (ODF & Office Open XML) p. 67

Ghosh, Rishab. "An Economic Basis for Open Standards." In Opening Standards: The Global Politics of Interoperability, Ed. Laura DeNardis. 75-96. Cambridge, Massachusetts: MIT Press, 2011.

Summary: defining open standards by the beneficial economic effect of ensuring full competition among suppliers. Public procurement should support open standards to help promote competitive markets for software products; policies should exclude compatibility with proprietary technologies as a requirement; open standards should be mandatory in the case of electronic government services and preferred in other public software procurement.

Most of what is claimed for open standards was already served by the term standards - the different term is needed only if it is clearly defined in order to provide a distinct economic effect: "... open standards, properly defined, can have the particular economic effect of allowing "natural" monopolies to form in a given technology, while ensuring full competition among suppliers of that technology." p 75.

Guidelines for effective policy in relation to open standards and interoperability p 75-76:

1) *Open standards should be defined in terms of a desired economic effect: supporting full competition in the market for suppliers of a technology and related products and services, even when a natural monopoly arises in the technology itself.*
2) *Open Standards for software markets should be defined in order to be compatible with FLOSS licenses, to achieve this economic effect.*
3) *Compatibility with proprietary technologies should be explicitly excluded from public procurement criteria and replaced by interoperability with products from multiple vendors.*
4) *Open standards should be mandatory for e-Government services and preferred for all other public procurement of software and software services.*

Economic definition for open standards: Network effects & network externalities (additional value provided by the network effect) p. 76

"Another approach to network effects, however, is to try to abstract the network externalities from specific products. This is achieved by identifying a feature of the technology that provides the network effect, and ensuring that its use is not limited to a specific product or service. Rather, products and services from different producers are made interoperable by agreeing on standards for the basic technology components that provide the network externalities." p. 77

Licensing policies, rights holders, incentives, and use of standard influence to economic benefit p. 77

De facto standards and monopolistic economic advantages: "usually, such a standard emerges through market dominance of the technology, often hand in hand with market domination of the technology vendor." p. 78

De jure rights holders and monopolistic economic advantages; examples thereof p. 78

Standards bodies try to limit "bad behavior" through processes and policies like RAND and RF terms p 78-79

Economic effects of types of standards including proprietary, "semi-open" standards, and Open Standards (Author defines semi open on page 75) p. 79 (Note, very strong economic definition of Open Standard):

- *Full competition*
- *No a priori advantage based on the ownership of the rights*
- *Available to all potential economic actors on equal terms (further dissects this)*

Normative frameworks/definitions: "To the extent that monopolies harm welfare, the ability to augment the natural monopolies in technologies with a competitive market in the supply of goods and services based on these technologies is positive. Thus there is a basis for consumers in general and policy makers in particular to encourage these normative frameworks, and to attempt to drive suppliers and markets toward the "open standards" at the competitive end of this progression." p. 80

Markets may vary: "In such markets, licensing terms may be less important than the processes involved in determining a standard … which is why discussion of open standards relating to hardware or telecommunications often focuses most on due process, participation in standards setting, and the publication of specifications rather than pure competition effects." p. 81

"However, in a market in which competing products and services could be implemented nu small firms or groups of individuals without significant funds or the ability to control or audit the use of the licensed technology [...], the economic effect of open standards as described may only be achieved by licensing terms that are free of royalty and license audit requirements." p. 81
Examples of positive network effects without Royalty Free patent policy in GSM space p. 82
Example of competitive economic dynamic between Microsoft and OpenOffice p. 82-83
GNU LGPL key features: "Arguably, these features are the basis for the success of OpenOffice as a competitive product with significant market share." p. 83
Further discussion of licensing and economic dynamic in word processing formats: "... in the market for word processing, royalty free licensing alone would be necessary but not sufficient to create an open standard." p. 84
EU IDABC EIF definition for open standards: p. 84:

1) *Adopted and maintained by a non-profit organization with a decision making process open to all interested parties*
2) *Published specification document available at nominal or no charge*
3) *Patents irrevocably made available on a royalty free basis*
4) *No constraints on the reuse of the standard.*

Effects of defensive suspension; Adobe PDF example p. 84-85
FLOSS & Open Standards: "As West writes…. For complex digital systems standards, the formal specification is inherently incomplete and the actual; standard is defined both through the written specification and through actual implementations…. For any firm trying to implement a standard, knowledge of both the formal specification and the existing implementations is valuable….. So a typology of openness must consider the openness both of the specification and the implementation." p. 85
Reference implementations may achieve the effect of an open standard without the institutional process of standards setting p. 85
FLOSS and open standards are not equivalent but are closely related in terms of the economic effect they achieve. P. 86
"The main advantage of an open standard is its capacity to be interoperable with other software systems." p. 87
Citations from FLOSSPOLS Survey, pgs 87-93

- *Public authorities are not generally aware of the economic effect of their own procurement choices*
- *Prefer interoperability but buy compatibility*
- *Local governments that consciously use FLOSS are much stronger supporters of interoperability*
- *FLOSS users rely on more vendors on average than non users*
- *Relationship between perceived over-dependence on vendors and a desire to increase FLOSS use*
- *OPen standards are not the same as FLOSS, public administrations generally support the principle of open standards even when they are reluctant to support a FLOSS policy*
- *Most ICT managers do not know for sure which standards are open and which are closed.*

"... Similar effects with respect to interoperability may be achieved by the support of FLOSS, or the support of open standards… This may require that the definition of open standards be tailored to specific software domains, and perhaps the classification of individual standards as open or not." p. 93
Definition of open standards must sometimes be compatible with FLOSS development and licensing models. P. 93

Tsilas, Nicos L. "Open Innovation and Interoperability." In *Opening Standards: The Global Politics of Interoperability*, Ed. Laura DeNardis. 97-117. Cambridge, Massachusetts: MIT Press, 2011.

Summary: Argues for a "balanced" definition of open standards. Discussion of shift from closed to open innovation model. Argues this is related to strict IP frameworks. Definitions of interoperability.

Key issues facing IT industry today: 1) transition from closed to open innovation model, 2) various types of interoperability & optimal roles, 3) the importance of a balanced definition of open standards to ensure that IP holders and implementers have proper incentives to work together. P. 97

"IP is a key enabler of greater innovation and enhanced interoperability in the IT marketplace." p. 97

Discussion of IP strategies in closed and open innovation models: "Different companies may pursue diverse business models that emphasize and rely on different aspects of IP...but these are value and opportunity driven distinctions. … IP's legal power to exclude is increasingly being replaced by its real-world ability to serve as a bridge to collaboration…" p. 97-98

"... definition of open standards that embraces the inclusion of, amd reasonable licensing for, patented technology actually enhances the open standards process and the resulting technological solutions. P. 98

Brief history of shift from closed to open innovation models p. 98-99

"Simply put, Open Innovation may be defined as the sharing of knowledge (including human, organizational capital, amd know-how) and intellectual property innovations to both foster economic growth and meet customers' needs." p. 99

In defense of Microsoft - MS interoperability principles in 2008 p. 100-102

Importance of IT Licensing strategies. "IT companies must think creatively and strategically about how best to use IP to build technology bridges - not only with their customers and partners, but also with their competitors." p. 103

3 Ways IP Licensing promotes competition & consumer interests p. 103

How IP policy positions vary based on diff. Business models p. 103

Types of Interoperability, pgs 103-107:

1) *Technical Interoperability*
    a) *Four Methods of Accomplishing Technical Interoperability*
        i) *Products*
        ii) *Community*
        iii) *Access*
        iv) *Standards*
    b) *Importance of choice and flexibility in regulatory approaches*
        "Policies of choice will avoid advantaging or disadvantaging companies based on their business or licensing models and instead allow flexibility..." p 105 (Note: this passage highlights tension between freedom of choice and other public policy requirements for open standards)
2) *People Interoperability*
    a) *Organizational Interoperability*
    b) *Semantic Interoperability*
    c) *Policy Interoperability*
    d) *Overarching "environmental" factors in interoperability*
        i) *Cultural/Social Factors*
        ii) *Political Factors*
        iii) *Economic Factors*

"...officials sometimes focus too heavily on the technical interoperability issues … which the IT industry is already well equipped to address, when they should really be focusing instead on the more difficult people interoperability issues.." p. 107 (Note: standards dev. Activities bring both into play!)

Critique of IDA Definition of Open Standards & Free Software Foundation. "...to equate open standards with patent-free standards is squarely at odds with the approach taken by the world's leading standards development organizations." p. 109
SDOs and IPR policies p. 109-110
ANSI rebuttal of an open standards definition created at 2004 FTC Summit p. 110-112
"..Most standards bodies adopt a patent policy that seeks to balance a) the legitimate ownership rights of participants who are willing to contribute their innovative technology to a standards development effort with b) the needs of those seeking to implement the standard so they have sufficient access to that technology on a reasonable ad open basis." ANSI, qtd. P. 111
"Open source software refers to software that is distributed under a certain specified software distribution license. It has nothing to do with the process by which a technical standard or specification is formulated and embedded technology is licensed." ANSI, qtd. P 112
Discussion of RAND and RF patent licenses as well as ref. To W3C p 112-113
Author provides own "proper" definition of open standards p. 113

Wilson, John S. "Standards, Trade, and Development." In *Opening Standards: The Global Politics of Interoperability*, Ed. Laura DeNardis. 119-131. Cambridge, Massachusetts: MIT Press, 2011.

Summary: standards and global trade issues. Tariff & non-tariff technical barriers to trade, government influence of markets via standards. Suggests forming a global standards consortium to address policy questions at the intersection of development economics, tech and standards.
Global trade, economic growth and poverty reduction: "The removal of policies that distort production of new technologies, prevent effective diffusion of innovation, and block private sector participation in world markets is also part of reaching these overall goals." p. 119
"The rise of nontariff technical barriers to trade, including government attempt to shape technology markets, is a threat to global welfare and the poverty reduction that open markets and trade promote." p. 119
The WTO information technology agreement (1996) & elimination of tariffs on ICT. Extension of measures including standards. P 120.
General pros and cons of standards - consumer safety, network reliability, interoperability, etc. product standards help overcome market failures. "For consumers, efficient and nondiscriminatory standards allow comparison of products on a common basis in terms of regulatory characteristics, permitting enhanced competition. From the producers' perspective, production of goods subject to recognized and open international standards can achieve economies of scale and reduce overall costs. Because standards themselves embody information about technical knowledge, conformity to efficient standards encourages firms to improve the quality and reliability of their products." p. 120
"Standards may also reduce transaction costs in business by increasing the transparency of product information and compatibility of products and components" p. 121
"Standardization reduces the costs of uncertainty associated with assessing product quality. Cost savings are reflected in the reduction of time and effort that consumers spend on product searches." p. 121
ICT standards and issues related to strategies in developed and developing nations. Harder for bootstrapping in these areas/industries.
"There have been few empirical studies that examine the impacts of standards imposed within the framework of tradeoffs of setting standards at international levels, unilaterally, via consortia, or other methods." p. 122
Results from selected studies related to trade barriers, imports/exports, and role of standards on costs to firms (fixed & variable). P 122-126

"Negotiations involving standards raise issues that are both politically and analytically challenging. Unlike tariffs, standards cannot be simply negotiated away. The primary purpose of standards should center on the enhancement of welfare by remedying market failure - arising =, perhaps, from safety attributes of products, negative environmental externalities, or product incompatibility due to the producers' failure to coordinate." p. 124
Three main types of agreements dealing with technical barriers to trade. Mutual recognition of existing standards. Harmonization. Recognition of each others conformity assessment requirements. (MRA= mutual recognition agreement) p 124-125
ICT stats on cellular subscriber growth, relation to trade and economic growth in developing nation p 126
"Standards, as noted, can provide important positive externalities if they are adopted in a transparent and open manner. But as standards are also an important factor in the technology diffusion process, which in turn is important for firms' competitiveness in the information and communication industry, they give rise to incentives for governments and policy makers to try and influence how voluntary standards are set. These incentives have become much stronger as the industry has grown. In this regard, the question of how standards are developed- and where necessary mandated in technical regulations- is increasingly relevant to international trade and development." p. 127
Interesting case study on China's WAPI infrastructure & government mandate of standard. Debate in ISO and impact on market. P. 127-128
Conclusion that standards affect international trade, imports and exports. Costs of compliance, etc. 128-129

Samuelson, Pamela. "Questioning Copyright in Standards." In *Opening Standards: The Global Politics of Interoperability*, Ed. Laura DeNardis. 135-157. Cambridge, Massachusetts: MIT Press, 2011.

Summary: Role & debate of Copyright and Patents in the standards process. Review of case law related to copyrightability of standards. Copyrights as incentives. SDOs & Copyright ownership.
"Everytime people send email, for example, more than two hundred formally adopted Internet standards are implicated." p. 135
Importance of claims of copyright in standards as illustrated by the ISO's policy clarification in July 2003. Ensuing debate over the copyrightability of country, language and currency codes and W3C response to proposed policy change. Potential negative impact on Open Source. ISO has backed down but not committed to keeping these standards free of charge. P. 135-136
Arguments that standards, especially those whose use is mandated by government rules and/or that focus on standardizing a system or codes should not be copyrightable. Case law examples involving ADA, AMA, Southco, ATC & others arguing standards unprotected systems under Sec. 102(b). (cases on Numbering systems). P. 136-147.
Coding systems make great standards. P 136-137
Why systems are uncopyrightable p. 142-147
"The comprehensibility of maps would be impeded if subsequent developers had to use entirely different symbol systems for each map" p. 143
"Selden could protect his description of the system through copyright, but not the system itself." p. 144
"When faced with assessing whether a particular information artifact is an uncopyrightable "system," courts should start by recognizing that systems, by their nature, consist of interdependent, interrelated parts that are integrated into a whole scheme." p. 144
Examples of uncopyrightable systems: Math formulae and periodic table of elements: The periodic table is a useful tool for teaching students about the fields of chemistry and physics precisely because of its standardized representation of atomic phenomena." p 144-145

Example of computer languages as unprotectable systems under 102(b). Lotus v. Borland (Lotus 1-2-3).
"AMA characterized the purpose.. As to "provide a uniform language that accurately describes medical, surgical, and diagnostic services, and thereby serves as an effective means for reliable communication among physicians, and other healthcare providers, patients and third parties"…. Similarly, the ADA had encouraged use of its code by dentists, insurers and others because "standardization of language promotes interchange among professionals." p. 145
"The naming and numbering of dental procedures in ADA's code were also products of an incremental collaborative effort of skilled practitioners…" p. 146
Factors relevant to whether systematic organizations of information are unprotectable under 102(b): 1) system is useful art and copyright would give it patent-like protection 2) when second comers need to use the system to compete or communicate effectively 3) When systematising the information is necessary to achieve efficiencies 4) when the system is incidental to uncopyrightable transactions or processes 5) when systematizing the information will produce social benefits from uniformity and the social costs of diversity would be high. "Standard systems of this sort are born uncopyrightable" p. 147
Standards may be or become unprotectable by Copyright under the Scenes a Faire or Merger Doctrines p. 147-150
Expressive choices of subsequent authors may become constrained by emergence of industry standards p. 147
Example of Mitel v Iqtel Inc controller case - Mitel codes embodied industry standards and thus were unprotectable p. 148-149
"The interoperability case law… recognizes that the design of computer program interfaces may be the product of considerable skill and judgement, and thus might seem to qualify for copyright protection. However, once an interface has been developed, the parameters it establishes for the effective communication of information between one program and another constrain the design choices of subsequent programmers. The interface thus becomes an unprotectable functional design, and the scenes a faire doctrine is often invoked in decisions coming to this conclusion." p. 149
User investment in the standard is also relevant as to whether standard should be copyrightable. QWERTY example. "Industry standards may become unprotectable over time" p. 149
Government adoption of a privately drafted standard may also cause it to become uncopyrightable. Case law example of Texas towns adopting private standard for building codes. P. 149-150
Summary factors determining whether standards are protectable under copyright under scenes a faire or merger doctrines. P. 150
Incentives and competition policy concerns about copyrights in Standards. Claim that SSOs need copyright incentives in order to develop standards is dubious. "Copyright protection is not available to information artifacts just because they are products of industrious efforts and their developers assert the need for copyright incentives." p. 150-152 Author provides 6 considerations for why this is not the case. P. 151
The long-term credibility of SSOs depends not only on their being able to produce sound standards, but also on producing standards in which the SSOs do not have so strong a financial interest that they succumb to the temptation to abuse the standards process by making a standard into a cash cow that must be purchased by anyone affected by that standard." p. 151-152

Russell, Andrew L. "Constructing Legitimacy: The W3C's Patent Policy." In *Opening Standards: The Global Politics of Interoperability*, Ed. Laura DeNardis. 159-176. Cambridge, Massachusetts: MIT Press, 2011.

Summary: Details 2001 controversy over W3C Patent Policy and ultimate adoption of RF patent policy. Possibilities for democratic control over technology. Some historical and philosophical context for the evolution of the W3C. "The web became worldwide because its standards were open."

Context matters. “However, amid the extended academic effort to isolate the precise economic and strategic effects of patent licensing and disclosure, we risk losing sight of how patents and patent policies are linked to fundamental questions of power in a technological society.” p. 160
“... the voluntary character of Web and internet standards creates an additional dimension of complexity. By definition, voluntary consensus standards bodies lack any inherent authority to enforce the use of their standards. Instead, authority is conferred through legitimacy, which arises through a social process constructed over time, in the face of competing jurisdictional efforts.” p. 160
Cultural and economic dimensions of social construction of authority and legitimacy as it applies to TBL and the W3C. TBL attempt to institutionalize his “moral authority” in the W3C. Role of 2001 patent policy ‘kerfuffle’ in undermining that legitimacy. P. 160
Economic lens: “The ultimate success or failure of a voluntary consensus standard is determined by market demand and acceptance. Within the market for standards, any participant in the process can choose from three options: loyalty, voice, or exit.” p. 160
Brief history of open web standards as viewed from the creation of the WWW, HTML, and the W3C. Influence of Richard Stallman on TBL: “Now, a third alternative is becoming significant in what some see as a revolution in software supply. Richard Stallman’s almost religious campaign for free software led to the creation of the Free Software Foundation and the GNU General Public License…. Just as we publish our physics for free, should we not in certain cases ‘publish’ our software?” (TBL autobiography quoted in Russell) p. 161-162
Economic & “bureaucratic” benefits for open sourcing. Avoidance of procurement processes helped shape the web as an open info platform. Comparison of the web to Gopher, which was a similar network that the University of Minnesota attempted to charge for. P. 162.
CERN decision to place web technology in the public domain officially in April 1993. Issues and decisions considered by TBL in how to foster and protect the web from there: operate commercially, find alternative structure such as IETF, ultimate decision to create W3C at MIT. p. 163
Birth and initial vision for the “experiment” that is the W3C; comparison of philosophy to the IETF “reject kings, rough consensus, run code” and “democratic” vision. TBL motivations. Choice of ‘Recommendation’ over RFC or Standard. Impact of the commercial interest in the web (browser wars) and TBL view of management and IPR/Patent policy during that time: “Software patents are new… “The internet ethos in the seventies and eighties was one of sharing for the common good, and it would have been unthinkable for a player to ask for fees just for implementing a standard protocol such as HTTP. Now things are changing.” p. 164-165. (TBL autobiography quoted in Russell)
“Open standards... fueled the growth of the web.” p. 165
History of the Patent Policy Working Group from Oct. 1999-May 2003. Pressure of the shifting “dot com economy” on industry and W3C membership to better define W3C IPR policies. Charter of new working group and appointment of new chair to advance a defined policy. PPWG process, decision-making, efforts to include public and resulting last minute backlash on public mailing channel. Debate between member orgs on that channel over RAND policy. Spillover into public tech media (like Slashdot). Resulting discussion and revision of policy to be RF, but include exception that allows for patented technologies to be included in Recommendations if no royalty-free alternative exists. P. 165-171.
“Any policy was better than no policy, but the best policy was one that maintained the loyalties of the various constituencies in the W3C. Yet one has to pause at the irony of this episode of reform: The decision to keep the W3C’s standards open was made behind closed doors.” p. 171
Author’s conclusions and takeaways. “The legitimacy problem, that is, the tension between meritocracy and democracy, is exacerbated by the decentralized structure and competitive nature of markets for information and communication technology (ICT) standards.” p. 171-172
Meritocracy - leadership based on trusted technical elites - can work for small projects that can fly under the radar but “democracy helps ensure that rules for an expanding and diverse constituency are created

with the consent of the governed." Challenges of change when tech grows from ad hoc to more formal/bureaucratic measures. "We should not be surprised, then, if an institution such as the W3C resists openness and transparency in order to preserve its ability to change course quickly." p. 172.

Kahlin, Brian. "Common and Uncommon Knowledge: Reducing Conflict between Standards and Patents." In *Opening Standards: The Global Politics of Interoperability*, Ed. Laura DeNardis. 177-189. Cambridge, Massachusetts: MIT Press, 2011.

Summary: Problems and tensions between the standards and patents systems. Patent thickets, patent pools, patent grants, undisclosed patents. Value of patents is in exclusivity whereas value of standards is in ubiquity.

Tension between standards and patents: "Standards have become critical for advancing technology and new markets in the ICT sector. At the same time, patents have become easier to obtain, more potent, and readily available for software and business methods." Companies and entire sectors are vulnerable to attacks from patent holders who do not participate in standards development. "It is remarkable how little policy-level attention is accorded to standards" given their importance. p. 177

"Standards assure buyers that they are investing in technology that works with and adds value to other investments, value that will not disappear at the whim of a particular vendor." p. 178

National standards bodies vs. consortia. Some variance due to differences in government philosophy (US vs. EU, China); "Even within firms, standards activities are widely dispersed among operating divisions… in marked contrast to patents. Standards suffer from a history and reputation as common denominators in a world where market presence and competitive strength have historically been defined by differentiation and control." p. 178

The paradigm of complementarity. "No single company had the resources, ingenuity, and entrepreneurship to create the internet explosion on its own." "Participants must be concerned about how the standard will evolve in the future, given that IT standards often continue to evolve as surrounding technologies change." p. 179

The relationship between patents and standards. Patents are intangible assets. Brief history of US Courts evolution of patent law, emergence of patent trolls, lowering standards of patentability. Burden of product clearances to ensure/assess patent use in standards. Risk to standards organizations and judicial burden of proof. RAND Commitments and Ex-ante licensing. P 179-183

"A good standard should be largely invisible. It can be taken for granted. Its value stems from commonality and ubiquity- not exclusivity or scarcity as in the case of conventional goods." p 179

"In contrast to the murky patent landscape, standards development demands highly focused and explicit communication and generation of specific knowledge that is easy to understand and implement. The need for certainty and economy cautions against duplicative, potentially incompatible standards-setting efforts. The standards process must produce, validate, and publicize useful information. Its value is affirmed when multiple firms adopt and implement the standard successfully." p 183

Standards as an asset.. Standards are shared intangible assets for a market segment, industry, or multiple industries. Standards are essential but beyond control of individual users…. The more open the standards process the more vulnerable to patent claims. Patents encourage arbitrage and extortion, resulting in systemic bias against open collaboration in favor of legal maneuvering. P. 183-169

"The private value that can be realized from the patent is roughly equal to the staggering costs that can be imposed on the rest of the world." p. 183

"With little coordination among standards organizations, there has been no collective response to the problem of participants who act in bad faith or to the problem of ambush by non-participants. Despite the strategic importance of standards in information technology, standards setting remains largely a function

of an engineering community with an underappreciated relationship to business strategy and public policy." p. 184
"...The development of open standards occurs only if there is a shared, focused conviction that a standard is worth investigating, negotiating, and implementing." p. 185
Aligning patents and open standards. Author provides suggested approaches for better resolving tension between patents and standards, including changes to US judicial policy/patent law. Provide relief/limit patent holder's ability to extract damage and enjoin unwitting infringers. Use of the laches doctrine (people should not sit on their rights). P 186-187
"Patents hold unique leverage against standards, and if patent holders wish to threaten investments on industry standards, they should at least be obliged to make their rights known in a timely manner." p. 186

Updegrove, Andrew. "ICT Standards Setting Today: A System Under Stress." In *Opening Standards: The Global Politics of Interoperability*, Ed. Laura DeNardis. 193-208. Cambridge, Massachusetts: MIT Press, 2011.

Summary: Issues in today's standards development infrastructure. Summary of shortcomings, implications, potential alliviations. Brief history of industrial standards setting.
Brief history/summary of modern standards process as a result of industrial age standards setting. Focus on physical objects and products, especially pertaining to safety and interoperability features. Evolution of standards setting, standards orgs, as production and networks shifted. Evolution of ICT standards setting from this environment. Brief intro to IEC, ITO, ISO, around WW2. p. 193-195
"When cycles of innovation are widely spaced and their results long lasting (edison's light bulbs, in comparison to yesterday's floppy disks, remain in use today) taking time to achieve the best standards result represents a wise investment due to the length of time that the market will be "locked in" by the decisions made." p. 194
"... ICT access is becoming a prerequisite to enjoying the full rights and opportunities of society, democracy, and the economy. That access is only feasible, however, if standards exist to address local character sets, languages, and physical disabilities." p. 195
"Who, then, should - and who is competent- to develop the standards required to feed the needs of this brave new ICT-enabled world?" p. 195
Standards challenges - everything about the standards setting infrastructure has changed given the ICT needs of today/the future. Challenges include: (p. 196-199)

1) *Interoperability demands*
2) *Innovation Cycles - "...The useful life of the standard is short"*
3) *Network Prevalence*
4) *Freedom from Lock-in*
5) *IPR infringement*
6) *Convergence*
7) *Globalization - "standards can favor some participants more than others" in a global market*
8) *More complex standards problems*

Standards tools available to deal with the aforementioned challenges, limitations to: (p. 199-202)

1) *Accredited Standards Development Organizations (ANSI, etc)*
2) *Consortia (W3C, OASIS, OMG)*
3) *ISO, ITU, IEC (includes a bit of how these orgs work)*
4) *Liaison Relationships (between orgs)*
5) *Participation (of users, stakeholders) - "But in those areas where interests of all those affected are not congruent, the absence of a watchdog for the unrepresented can be of concern." p. 201-202*

Social challenges to ICT standards setting. Examples of how ICT standards "cyberinfrastructure" is failing to rise to the challenge of modern societal needs: p. 202-204

- *"There is no consensus on the definition of open standards at a sufficiently useful level of granularity. New challenges, such as the increasing popularity of open source software, are widening the gap." p. 203*
- *"The IPR policies of most consortia that develop software are inadequate to ensure the implementation of such standards in open source software." p. 203*
- *"There is no mechanism for consumers or other stakeholders to participate, or to make their concerns known, in most ICT SSOs, despite the increasing impact that ICT standards have on their welfare." p. 203*
- *Issues with US disengagement from ICT policy*
- *Implementing accessibility standards on a global level*

Author provides examples of what has been done so far and what he imagines the future might look like, Including 1) IPR policy convergence of major SDOs, Meta Standard consortia, simultaneous innovation and standardization (akin to web "living standard"). Questions that determine future success. "Will that group become more substantive, or will it simply debate?" etc. p. 204-208.
"Given the history of standards setting to date and the fact that ICT standardization occurs primarily in consortia today, it would appear that at minimum the leading consortia that are influential in creating cyber infrastructure would be well advised to consider adopting a greater sensitivity to social concerns, if they wish to retain their independence of action when they create standards in that domain." p. 207-208.

Sutor, Robert S. "Software Standards, Openness, and Interoperability." In *Opening Standards: The Global Politics of Interoperability*, Ed. Laura DeNardis. 209-217. Cambridge, Massachusetts: MIT Press, 2011.

Summary: approachable/layman's definitions of standards, open standards, relationship to interoperability (vs. intraoperability). Open standards as a non-binary idea. Suggestion of framework for measuring open standards and for defining interoperability.
"Unfortunately, there remains basic confusion between what a standard does and what the rules are when one implements it." p. 209
Standards as a blueprint analogy. Example of the phone, jack and plug. "To extend my earlier analogy, we know that a Web page ("the plug") will fit into the browser ("the jack") and then I can interact with the page ("I can talk on the phone"). P. 209-210.
De facto standards, Community standards. Tension between vendor and customer RE data access. Community standard development process (light description) p. 211-212
"The basic problem with a de facto standard is that it is controlled by a single vendor who can - and often does- change it whenever the vendor decides to do so. This frequently happens when a product goes from one major version to another." p. 211
"The value of creating a standard in a community is that products from different sources can work together to build solutions that solve real customer problems… if you can't compete (by providing superior product or service)... then I would suggest you have problems beyond not controlling the creation of the standard." p. 212
Author defines open standards not as a binary condition, but as a scale by asking 5 questions: 1) how is that standard created, 2) how is it maintained after version 1.0 3) what is the cost of getting a copy of the standard 4) Are there restrictions on how I can implement the standard 5) Can I use just a part of the standard or extend it and still claim compliance? P. 213
"From these and perhaps other criteria we should be able to come up with some sort of "Standards Openness Index" p. 213
Abuse of the term "open" and "interoperability." Interoperability vs. Interoperability. P 213-215.

"Interoperability driven by open standards increases competition, provides more choice of applications to customers, and drives down prices." p. 215
Framework: Author provides 10 ways in which you can tell whether you will be able to get more or less interoperability among software applications. P. 216-217
"Open standards are insurance policies for customers, including governments." p. 217

Krechmer, Ken. "Open Standards: Definition and Policy." In *Opening Standards: The Global Politics of Interoperability*, Ed. Laura DeNardis. 219-237. Cambridge, Massachusetts: MIT Press, 2011.

Summary: framework and perspectives for various definitions of open standards based on interest group and other concerns. Suggestion of 10 requirements for open standards. Somewhat confusing discussion of Compatibility standards, Similarity standards, evolution toward Adaptability Standards.
Competing definitions of an open standard depend on viewpoint and technology. Openness is a direction, not a destination. P. 219
"A "technical standard" is defined as a codified (an independent model or written representation) and quantified (measurable) rule, imposed by an authority, committee, or market (Hayek 1973)" p. 219
Figures and tables of open interface standards by interest grouping p. 220-223
"Open standards are not an idle desire. The search for open standards indicates people's need to influence standards that affect them." p. 221
The succession of standards. Waves of different standards throughout periods (agrarian, Industrial, information). Succession of standards is the range of standards required to support a new wave of civilization. P. 223-224
"During the industrial revolution, the importance of creating public similarity standards was understood… The use of patents emerged during this same period as a means to offer value to the entrepreneur… In the information age, the standards necessary to define interfaces have emerged as the compatibility standards succession." p. 223
Balance of public vs private interests, patents and IPR policies between similarity and compatibility standards. P. 224
"Compatibility standards define interfaces. Communications interfaces created in standardization committees are mutual agreements, not inventions." p. 224
"The standards that define how to identify, negotiate, and select among different interface requirements are termed adaptability standards" p. 224
Author lists and the discusses, point for point, 10 requirements of open standards as distilled from the interested groups in prior figures: p. 225-234

1) *Openness - all stakeholders may participate in the standardization process.*
2) *Consensus - all interests are discussed and agreement found, no domination*
3) *Due Process - balloting and an appeals process may be used to find resolution*
4) *One world - same standard for the same function, worldwide*
5) *Open IPR - low or no charge for IPR necessary to implement the basic standard, IPR is allowed for options and proprietary extensions. - "High tech equivalent of taxation without representation" p. 227*
6) *Open documents - all may access and use committee documents, drafts, and completed standards for their intended purpose. IETF procedures as a positive example of this. 228*
7) *Open Change - all changes are proposed and agreed in the standardization organization.*
8) *Open Interfaces- support migration (backward compatibility) and allow proprietary advantage, but standardized interfaces are not hidden or controlled.*

9) *Open Access - objective conformance mechanisms for implementation testing and user evaluation. "For products that conform to similarity standards, a simple mark of conformity is often sufficient." p 232 - note, this is like GH Badges! Open Badges!*
10) *Ongoing support - standards are supported until user interest ceases; "Ongoing support of hardware, software, and services, and their associated standards, is of specific interest to end users as it may increase the life of their capital investment in equipment or software." p. 233*

Table of the standards life cycle and major interest group. P. 233
Author offers policy and procedure recommendations. "Each standardization organization should maintain and publish a listing of how they address each of the ten open standards requirements" - Research opportunity??
"The wide applicability of the policy and procedure changes suggested here indicates the importance of gaining greater understanding of how standardization impacts modern high-technology societies. Perhaps the most important change of all would be to teach the requirements for open standards in appropriate engineering, business, law, political science, and economics courses." p. 235

Pein, Corey. "Blame the Computer." The Baffler Issue No. 38. Accessed August 24, 2018. thebaffler.com/salvos/blame-the-computer-pein.

Critique and summary of response to Hawaiian missile crisis false alarm is a case of "technological pass-the-buck"
"In other words, the system had, in fact, worked as designed - it was just obeying a cosmically disastrous user prompt."
"...the false alarm in January was a snaful of software engineering-and the implicit faith that every problem, even nuclear apocalypse, awaits a simple, convenient, digital solution."
Tech is a distrust of the human mind. Errors in human judgement can be resolved by better programming. Better to have "nominal human decision-makers"
"This reflexive distrust of the human mind is the conventional wisdom of our technological age."
"The great peril we face comes not from an over-reliance on human judgment, but from a distinct lack of it. Indeed, the most bone-jarring risks before us have less to do with human error than with engineering hubris."
Computer science as a function of reinforcing capitalism. "The basic setup is as follows: we're victims of a terrible subroutine that's been grinding away for more than seventy years within the larger program of capitalism. The imperative for economic efficiency has created irresistible incentives for the automation of thinking. Every decision that can be made in advance by managers, and reduced by engineers to a series of switches inside a computer program, has been dutifully ground down into a binary decision tree. All that's left for humans is to make a selection from a drop-down menu."
"In a few short generations, we've reached such an atrophied mental state that nuclear geopolitics works exactly like the customer service department at Comcast or Wells Fargo."
Critique of Computer Science as a field, references to the commentary and work of Dr. Joseph Weizenbaum as a CS researcher and critic of CS. "In Weizenbaum view, many in his field were no more than "tinkerers with techniques"—charlatans who had managed to associate themselves with science in order to "siphon legitimacy from the reservoir it has accumulated."
History of the Computer Science department and influence of Frederick Terman/Stanford University. Marketing and branding of CS in the 1950s. Role of computer salesman Louis Fein in launching this effort. Stanford Research Institute. "Such institutes created a system whereby the taxpayers would pick up the bill for research leading to such innovations as the computer mouse and the internet, but the profits from their commercialization would accrue to a few lucky insiders."

Use of demos, marketing materials, etc. not to further research but to play to economic fantasy of management. "Tellingly, the first example he concocted to demonstrate the power of applied synnoetics involved the deployment of robot Pinkertons to break a strike."
"Universities could buy computers at a discount from the manufacturers, on the condition that they train a certain number of students, staff, and faculty in how to operate the devices—thus effectively covering the cost of workforce training for those companies. As an added sideline, universities could sell time on their fancy new machines to interested third parties, especially private companies. Adopting this model, the university computer lab immediately became a profit center, and faculty from other departments found themselves competing for resources with private companies that had become paying customers of the university."
Critique of the consideration of CS as a "supra discipline" "Computer science is the most exalted field in the new academic paradigm of STEM supremacy. The profit- fueled fetish for "digital learning" has coincided with the chauvinist denigration of the humanities and social sciences. Computer skills have become synonymous with talent and ingenuity. And the occupation of programming, which in its earliest iteration carried the stigma of "women's work," has become a high-status, highly compensated, and highly male-dominated field."
Lack of Ethics education in CS. "A 2006 study by Michael J. Quinn, a computer science professor at Oregon State University, polled a sample of fifty accredited computer science programs to determine how they taught students about ethical issues—presuming, that is, they even bothered to try. Most gave ethics minimal consideration—a single credit hour's worth, taught either by a professor inside the computer science department (unversed in ethics) or an outsider from the philosophy departments (ignorant of computers)."
"In practical terms, the omission of such instruction, or any other form of reflexive self-criticism within the field, means that mercenary military contractors funded the creation of a pedagogy without ethics, which supplied the labor for a tech industry without ethics, which powered the rise of state-sanctioned monopoly tech corporations that exercise unprecedented control over global markets and have intrusive access to all the digitized data of our lives."
Cognitive deficiencies of CS. "In sizing up the gross cognitive deficiencies of computer science, Weizenbaum went even further, noting that every computer system "permits the asking of only certain kinds of questions" and "accepts only certain kinds of 'data.'" To create a computer program is not to enhance one's mental abilities, as boosters like Fein claimed, but rather to restrict one's options to a set of (always biased and often mistaken) assumptions. "A computing system has effectively closed many doors that were open before it was installed," Weizenbaum wrote."
"If it's not online, it doesn't exist"
Critique of the rise of Boot Camps as a means to perpetuate this process/cycle/indoctrination. "Computer science education inevitably promotes authoritarianism."
Computers stand in the way of necessary revolution & Code is ideology. ""The computer, as presently used by the technological elite, is not a cause of anything. It is rather an instrument pressed into the service of rationalizing, supporting, and sustaining the most conservative, indeed, reactionary, ideological components of the current Zeitgeist," he wrote. Computerization meant that no one had any incentive to take responsibility for difficult decisions—and, by the same token, no one could be held accountable for bad ones. Sound familiar?" (Weizenbaum).
"The discipline has given us a system that can only ask, "Shall we launch the missiles now? Or shall we merely pretend to launch some missiles?" (if we're asking that question, is there really a difference?"

Coyle, Karen. "Open Source, Open Standards." ***Information Technology and Libraries*** **21, no. 1 (March 2002): 33-36**

Summary: Brief article discussing the impact of open source and open standards on ICT issues in Libraries and information sciences. Some discussion of popular open standards in libraries, such as MARC and Z39.50. Why some open standards in libraries have failed and some critique of SSOs.
"When people speak of open source software they are referring to computer code..[]...The success of an open source project will clearly depend on the clarity of the shared vision of the goals of the software and some strong definitions of basic functions and how they will work." p. 33
Author identifies "Goals of Open Standards": p.33-34

1) *The need for interoperability*
2) *To create the framework for a community. "The use of common cataloging rules does not so much allow libraries to intercommunicate as it does create a certain look and feel and a commonality between libraries that is an aid to users. It allows users to move between libraries without having to learn a whole new process for finding materials, and it makes it possible for the library profession to train librarians and hire from among a pool of candidates." p. 33*
3) *To encourage decentralized development. Example of P3P at the W3C. P3P is the standard, not the code.*

Author compares and contrasts "open" vs. "really open" via description of the IETF and W3C process/working methods. Also mentions national bodies such as ANSI. p. 34-35.
"The IETF is open to anyone who wishes to participate. That last statement needs qualification, however: participation in the IETF requires a high level of technical knowledge and a considerable amount of a person's time. Those who make up the various IETF committees are a self-selected technocracy." p. 34
"Still, there is no other standards organization that is as open as the IETF, and there is still considerable input from the academic and research communities." p. 34
"Standards making is an expensive enterprise and standards bodies have traditionally made money on the sale of the printed form of their standards." p. 34
Open standards and Libraries - brief history of standards efforts in libraries from the card cataloguing system itself, role of Library of Congress, MARC, and z39.50. P. 35-36
"The first of the library technology standards was the decision at the first annual ALA meeting in September of 1877 to standardize the catalog card at 7.5 x 12.5 cm." p. 35
There are a number of reasons why standards might not be adopted: p. 35-36

1) *The technology that the standard responded to… may be eclipsed by a newer technology*
2) *People seem less likely to accept standards that affect the content aspects of their computer systems. "Successful standards tend to define background functions, and leave a great deal of flexibility for system developers in terms of presentation."*
3) *"Yet another reason is that standardizing the command line gains you very little where the underlying indexes of the system are not themselves standardized."*

"...not all aspects of systems are ideal candidates for normalization….. Standards need to facilitate functionality without suppressing the creativity of system developers or their ability to meet the needs of their particular target audience. Standards work best in the underlying technology layers and less will the closer one gets to the actual user." p. 36
"Not only are libraries missing from the standards groups, so also are schools and non-profit organizations, which are kept out not only by the membership fees but also by the labor requirements for active participation: the need to dedicate a significant amount of time of a highly skilled technical worker to the standards process." p. 36

West, Joel. "Seeking Open Infrastructure: Contrasting Open Standards, Open Source, and Open Innovation." *First Monday* 12, no. 6 (June 4, 2007). Accessed August 6, 2018. http://firstmonday.org/ojs/index.php/fm/rt/printerFriendly/1913/1795.

Summary: Comparison of ideals and tensions in common definitions of Open standards, open source, and open innovation in cyberinfrastructure. Comparison through economic/business lens (value creation, capture). Suggestions for future research.

"While "open" normally has connotations of public goods, the idea of "open"–ness has been used for decades as a competitive strategy by firms in the computers and communications industries. Phrases like "open standard," "open source" and more recently "open innovation" have been used to refer to these strategies."

On Open Standards - SSOs are under pressure to open up both sides but lack ability to capture value to sustain the firm.

"However, no standardization activity that is economically self–supporting can be perfectly open: from an economic perspective, there are limits to openness (West, 2006b). Simcoe (2006) observes that in standardization, firms face an inherent conflict between value creation and value capture. A completely open standard creates lots of value, none of which can be captured; a completely closed standard captures 100 percent of no value created. So a profit–maximizing firm must seek an intermediate point that partially accomplishes both goals."

"Thus to pay the bills, there has to be value capture somewhere: everything has some level of openness and some level of proprietary–ness."

On Open Source: "Compared to open standards, open source has one huge advantage: you can use the technology without bearing the cost of implementing it."

"Certainly there is open source software that is developed for shared benefit by altruistic volunteers [2]. However, the provision of labor and other resources for major open source projects has been increasingly driven by contributors working to advance the goals of their employers, i.e. corporate interests (Hars and Ou, 2001). When firms sponsor open source projects, they have an easier time providing transparency to outsiders than sharing control with them (O'Mahony and West, 2005)."

Enabling Collaboration and Competition. "For open standards, open source and open innovation, the "open" part refers to collaboration by firms in producing some form of shared output."

"Openness can be deliberately used to attract user adopters (West, 2003), as well as others in the value network. It also can be used to align the interests of firms across the value network. Systems industries (such as in the IT sector) inherently require a value network in which the suppliers, customers, competitors and complementors collaborate to create value (West, 2006a). If anything, being open only cements these relationships as it more closely aligns the interests of the various firms in the network."

"At the same time, in even the most open business ecosystem, firms will pursue their own (inherently competing) private interests (Iansiti and Levien, 2004). O'Mahony (2005) refers to this as "competing on a common platform." Such private interests require that firms ultimately capture value."

"Both open standards and open source must serve the interests of those stakeholders that provide the essential resources. If firms choose not to participate (or not participate seriously) in a standards effort, that is a signal from the market about how well they feel that effort fits with their business model. While standardization cannot be held hostage to the private interests of any one firm, SSOs have long known that a standard not endorsed by major vendors is the tree that falls in the forest — and thus incorporate such market signals into their decisions."

"Conversely, open standards and open source provide existence proofs for building effective institutions that align and coordinate the interests of potential competitors."

Openness in Infrastructure: "Standardization is an important prerequisite to the deployment and use of a shared infrastructure."

"Any form of standardization must include the relevant stakeholders if the backers hope to see widespread development and deployment of implementations. One way to facilitate development is to combine standardization with open source implementations, much as the open source Globus Toolkit

from the Globus Alliance is helping deploy the grid computing that will be an essential part of cyberinfrastructure."
"One obvious implication is that cyberinfrastructure standards must define the interfaces to allow interconnection of these various infrastructural elements. Another is that even with such standards, a key prerequisite to deployment will be the willingness of vendors to modify their existing products to support these interfaces and thus enable cyberinfrastructure connectivity."
Facilitating Deployment and Adoption: Switching Costs and prior path dependencies.
"A key factor in adoption is what Rogers (1995) terms "relative advantage," which I.T. buyers have come to expect means "better, faster and cheaper.""
"One solution is to make the core implementation widely available, to facilitate a migration path for legacy technologies by reducing the development time and costs faced by vendors of such technologies [5]. Open source software is one solution — much as the Berkeley implementation of TCP/IP allowed the networking protocol to become ubiquitous among computer companies in the 1980s and 1990s. Open innovation provides another possibility, if multiple organizations work together to develop a shared implementation of a commodity technology (West and Gallagher, 2006)."
Future Research:

1) *Normative questions for policymakers*
2) *Cost benefit tradeoffs for those deploying such infrastructure*
3) *Openness of process vs. openness of outcome, what degree of openness is required, and for whom it should be opened*
4) *Relationship between standards creation and standards implementation.*
5) *When it comes to implementations, which goal is most important: technical competition, market competition, or eliminating redundant investment?*

Chiao, Benjamin, Josh Lerner, and Jean Tirole. "The Rules of Standards Setting Organizations: An Empirical Analysis." RAND Journal of Economics 38, no. 4 (2007): 905-30.

Summary: empirical analysis of policy choices using mathematical proofs for defining positive/negative relationships between technology sponsors and concession level, as well as sponsor friendliness and the "quality of the standard." Authors find a negative relationship between the extent to which an SSO is oriented to technology sponsors and the concession level required of sponsors, as well as a positive correlation between the sponsor friendliness of the selected SSO and the quality of the standard. Authors test the hypothesis that provisions mandating royalty-free licensing are negatively associated with disclosure requirements, and the relationship between concessions and user friendliness is weaker when there is only a limited number of SSOs.
"Over the past fifteen years, consortia and informal standard-setting bodies have in many cases supplanted formal national and international standards-development organizations (Cargill, 2002)" p. 905
Citing earlier research, authors assert that the sponsor of an attractive technology can afford to (make fewer) concessions such as RF licensing to prospective users and to choose an SSO that is relatively friendly. P. 906
"This suggests that the relationship between concessions and user friendliness is likely to be weaker when there are fewer SSOs" p 906
Authors state to have built the "first database of SSOs" - 60 SSOs analyzed for the research - link provided in bibliography is dead
"Our results are largely consistent with the theoretical predictions:
I. First, we find a negative relationship between the SSOs' orientation toward sponsors and the strength of the concessions they demand. This significant negative relationship continues to hold even when we control for industry efforts.

II. Second, the data reveal a statistically significant association between sponsor friendliness and maturity of the technological subfield in which the standard is located, which we suggest should be a proxy for attractiveness.
III. Third, we find that the presence of a provision mandating royalty-free licensing is negatively associated with the presence of a disclosure requirement, whereas weaker (RAND) licensing requirements are strongly associated with such a provision.
IV. Finally, when we divide the SSOs into those with above and below the median number of other SSOs in their technological subfield, we find that the relationship between user friendliness and concessions is considerably tighter among SSOs located in classes with many other organizations." p. 906
Strategic interactions and standards bodies. Case for economic benefits of standards. Standardization process can be competitive - notably "Being included or excluded from an important standard can have substantial impact on a firm. For instance, having one's IP deemed essential to a new standard can help insure a steady stream of licensing revenue in future years. A standard that demands backward compatibility can insure ongoing revenues for a legacy product for many years." p. 907-909
Extent to which the rules of SSOs are enforceable; three bodies of law are relevant - contract law (weakest), patent law (equitable estoppel, implied license), Torts (Sherman Antitrust, Fraud). Disclosure issues are the majority of cases to date (2007) involving SSOs p. 907-908
Excerpts from Lit review: little cross-sectional work addressing how these orgs are or should be organized. "(Farrell and Saloner 1988) show that the committee process is more likely to arrive at a high-value consensus than product market competition…" Standards-setting process as a "war of attrition" between sponsors of competing standards. Sponsors prefer their own tech and have private information about its quality. Reducing vested interests reduces delay. p 909-910.
"SSO patents are cited far more frequently than a set of control patents, and that SSO patents receive citations for a much longer period of time. Furthermore, they find a significant correlation between citation and the disclosure of a patent to an SSO, which may imply a marginal impact of disclosure. (Rysman and Simcoe, 2005)." p. 909

Russell, Andrew L. *Open Standards and the Digital Age*. New York, NY: Cambridge University Press, 2014.

"These technologies together create a communication infrastructure that has the potential to evade the ability of established authorities to control, censor, or ignore. For individuals, "open" is shorthand for transparent, welcoming, participatory, and entrepreneurial; for society at large, "open" signifies a vast increase in the flow of goods and information through a global, market-oriented system of exchange." p. 2
"... openness (and its ally, transparency) is easy to promote in rhetoric but more complicated to adhere to in practice." p. 3 what evidence can we look for in practice?
Connection between standards development and the social construction of technology (Thomas Hughes theoretical framework) p. 3-4
Engineers, Managers, regulators make ideological beliefs explicit in their work; some of which were held implicitly & unstated but used as the basis/justification for action p. 5
"The "open systems" created in the late twentieth century, and the "Open standards" described by the title of this book, thus constitute critiques and rejections of ideologies of centralized control." p. 6
***Making Open Systems (historical overview)** p. 6-8: American colonies, control of printed information, stamp act, free press, commercialization of the press; American foreign policy in China (Open Door ideology) p. 8-9*
Closed Morality vs. Open Morality: the former is described "an exclusionary and static society that promoted social cohesion and carried a deep preoccupation with strict internal obedience and war against

all enemies. “Open morality” on the other hand had a higher regard for creativity and progress; it was, according to Bergson, inclusive, universal and peaceful.” p. 9
Closed & Open Systems - “open economy”: “All scientific problems...begin as closed-box problems, ie, only a few of the significant variables are recognized. Scientific progress consists in a progressive opening of those boxes” p. 10
General system theory p. 10 “A system is closed if no material enters or leaves it, it is open if there is import and export and, therefore, change of the components.”
Open system concepts & the field of organizational behavior & design. P. 11. “How odes a system interact with its environment? In human systems, how do people negotiate the boundaries between an organization and its environment in the presence of persistent uncertainty?” p. 11
Engineers embrace the principles of open systems- movement to create modular standards for materials in construction/building (1930s). P. 12
Open system is used to refer to a competitive & standardized industry (1966) “... anticipated that the fundamental traits of subsequent open system projects: the belief that standardization and competition in the face of technical and social complexity, and the historical tendency for closed systems to dominate industrial production.” p. 12
Coordination problem in early ICT standards efforts. Jack Houldsworth defined open working as “The ability of the user or program of any computer to communicate with the user or the program of any other.” 1977 p. 13
ISO creation of OSI; “the adjective open means to imply that all participants come to the system as equal partners;” acknowledgement of the political challenges of this openness. Open is a system that gets us out from underneath [IBM’s] thumb. Open systems are a critique of centralized control. P. 14
Open systems ideology of the 70s-90s embodied several assumptions from previous open systems thinking such as 1) an economic commitment to global markets 2) a moral support of international and multicultural ties 3) political opposition to centralized power - either in governments or in monopolies - that threaten individual autonomy, 4) a belief that technical professionals could achieve these economic, moral, and political aspirations through cooperation and standardization p. 15
“Although the exuberant rhetoric of openness often signifies a favorable set of political, cultural, economic, and technical values, open systems are neither inevitable nor, in some cases, even preferable.” closed systems can be easier to solve / manage. “Economists argue that the single-minded pursuit of openness can impede standardization and damage innovation, and legal scholars have shown how closed and hierarchical information systems can be more secure, more efficient, and more convenient for users.” p 15-16
***Open Standards.** “Standardization is a social process by which humans come to take things for granted.” “Standards are recipes for reality, whose black boxes are rarely opened and whose subjectivity and contingency are rarely revealed.” p. 16*
Nuanced distinction between standard and standardization p. 17
Most standards fall into three general categories: performance, measurement, compatibility (p. 17-18) Russells’ book focuses most on the last (compatibility) for communication networks. Viewed as infrastructure, platforms, network effects. P.18
Standardization as a power-laden process (varieties: de facto, de jure, voluntary consensus) p. 18
Voluntary consensus process is most complicated and least understood...consensus standardization is fundamentally political; standards committees do not make technology rather they make agreements about technology… consensus standardization, by definition, requires exclusion in order to define the scope of inclusion (p. 19)
“When widespread mistrust...combined the core practices of consensus standardization with their open systems ideology to create a hybrid - open standards - that became the predominant mode of standardization for the digital infrastructure of the open world.” p. 19

“Most definitions identify three categories of participants in the standards process - creators, implementers, and end users - and argue that more openness generally means a larger scope of inclusion for end users and a fourth constituency, the general public.” p. 20
1928 ASA declares that all proposals for standards must come from committees that could demonstrate a balance of interests (p 21)
“...it is possible to distill an ideology of open standards from the spectrum of open standards definitions that presently exist. First, open standards strive to honor the ideals of participatory democracy, including commitments to fairness, transparency, due process, and rights of appeal. Second, open estandards embrace the ideal of a vibrant market economy that has negligible barriers to entry and liberal terms for using standardized technologies. Third, proponents of open standards share the implicit conviction- which in some cases manifests itself as religious zeal - that their work is just and that the forces of technological and social progress are on their side. They share a common foe - namely, anyone who advocates closed or centralized control over the production and use of standards.” p. 21
“The creation of the digital infrastructure of the open world reflects the faith in market capitalism, reverence for technological expertise, and skepticism toward concentrated power that were defining characteristics of the late twentieth century.” p. 24

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