

Open Standards and their Early Adoption: Implications for the Government Policy.

Literature review

Vladislav Fomin <wlad@cbs.dk>

&

Mogens Kühn Pedersen <kyhn@cbs.dk>

OStEA deliverable #2 (www.cbs.dk/ostea).

Draft v.093. June 2006

Table of Contents

Introduction.....	2
The scope of the project on open standards and government policy.....	4
Definition and concept of open standards.....	4
Boundaries of the work.....	5
The literature review.....	8
The many dimensions of interoperability.....	8
Economics.....	8
Public good and compliance.....	10
Syntax and semantics.....	11
One-stop service experience.....	11
Timing and maturity of standards.....	12
Future-proofness.....	12
Goals of participation.....	12
End-user perspective (accessibility, user-friendliness, etc.).....	13
IPRs.....	14
Implications for policymakers.....	14
Analysis and contribution.....	17
References.....	18
Appendix 1. Problem classification scheme.....	20
Appendix 2. Identification of relevant issues.....	21
Appendix 3. The future of standardization research.....	22

Introduction

OStEA (Open Standards and their Early Adoption) is a public university research project sponsored by the Danish Ministry of Science, Technology, and Innovation. The aim of the project is to identify issues related to government policy with regard to open standards. E-government implementations and development of Information and Communications Technology (ICT) solutions are focal points of the project within the overall idea of a governance framework for open standards and their early adoption.

Some of the research questions we pursue answering are:

- *The viable/plausible scope of open standards as pertaining to the government ICT policy.*
- *Identification of relevant standards pool and the relevant ongoing standardization in various fora.*
- *Identification of perceived needs for open standards and the reasons and opportunities in government adopting an open standards governance policy.*
- *Government's participation in standardization.*
- *Timing of open standard development and adoption*
- *Conformance to standards in public procurement/ discrimination against non-compliant standards.*

The importance and currency of the project are prompted by the growing trend toward open ICT systems and standard as seen through policy actions of national governments, corporate statements of leading global ICT vendors, and consumer demands.

While the global trends and the currency of this work are clearly the drivers for research, there are numerous barriers that we are facing. Those barriers are mostly attributable to the novelty of the topic (open standards and government policy), scarcity of available literature focused on the very research questions we are pursuing answering, while, on the other hand, availability of broad and unsystematized literature on standards and standardization in general.

Standards and their adoption can be studied, for example, from the perspective of timing, the degree of openness, the level of compatibility, the economic and market effects, among others. When it comes to the studies of standards in relation to government policy, the issues of timing, openness, interoperability, and economic effects become the most relevant ones.

In terms of standardization timing, one can distinguish anticipatory standards, participatory, and responsive ones. Anticipatory standards, as the term suggests, are developed ahead of the mainstream market acceptance of the standard-based innovation. Participatory standards are co-developed by the developer and user, and the term implies early post-market implementation phase. Responsive standards are created, as the term suggests, in a response to the technology introduction to the market, when there is a number of

competing implementations and standardization is needed to narrow down the innovation space or reduce investment uncertainty for manufacturers and/or end users (Blind 2004. p.187).

Economic implications for policy formation with respect to standards are partially stemming from commonly argued fact that the standardization process and the innovation process are linearly related (Blind 2004. p.188). When combined with the issue of timing, significance of research can be easily noted: wrong timing in standardization process can lead to economic inefficiencies. So, for example, premature standardization can lead to adoption of sub-optimal technology as a standard. A late standardization may result in switching costs for adopters of non-standard solution to the newly standardized one being too high (Blind 2004. p.188). On the macro scale of a long term nation-state's development, such theoretically predictable inefficiencies can result in losing a leading position in the world rankings of global ICT leaders, not mentioning the negative economic effects on business and consumers.

However, assessing the economic benefits of standardization is a difficult task even on the company level, let alone on the country level. Reasons for that stem from several implications. First, the technical change which is to be measured as an “economic outcome” of standardization process is difficult to quantify. Second reason lies in the complexity of standardization processes – it is difficult to operationalize them for empirical analysis (Blind 2004. p.193). There is also a third reason for difficulty to assess economic benefits of standardization. As West (2006 (forthcoming)) eloquently formulated, while for many corporate and individual users of ICT, open standards have long been promoted as a universally good thing, for many ICT vendors, nirvana is in having their proprietary standard win a wide adoption.

Even such global ICT giants as IBM, which explicitly direct corporate policy towards “openness”¹, have to operate with “many shades of gray”, due to economic realities of modern ICT and business world (West 2006 (forthcoming)). This contradiction in many ways is prompted and sustained by the mundane question “who pays?”² – switching costs and other lock-ins created by the use of proprietary standards provide an ongoing stream of revenues to pay ICT vendors' shareholders, employees, and their executive bonuses.

In the backdrop of the aforesaid, the aim of this work is to obtain insights on the *governance and policy issues stemming from or related to the adoption of open standards in the public ICT sector.*

However ambivalent the relationship between the standards and technical change is, standards are necessary for innovation in network industries (Blind 2004. p.215), e-Government service industry being one of them.

1 See, e.g., <http://www.ibm.com/ibm/responsibility/world/government/opencomputing.shtml>

2 See also response by Carl Cargill in Appendix 3.

In the light of the aforesaid ambivalence, in this report we attempt to clarify the role of open standards in technology innovation by reviewing a broad and ripe stream of literature on standardization, and specifically, on open standards. The aim of this work is to develop a foundation for subsequent topic-specific and more focused investigations. Due to the relative novelty of the topic, open standards we can not claim, nor do we attempt to produce an exhaustive assessment of economic (or other) impacts of open standards on the (government's) innovation policy. Merely, we provide an overview of existing literature and draw our conclusions from an analysis.

This work is also intended to inform our questionnaires for a Delphi-method based expert survey on the role of open standards in the government policy formation, and the survey of the public sector ICT professionals on the adoption of the Danish ICT standard's catalog (so called OIO Catalog³) – a standards reference catalog for the Danish Interoperability Framework.

Writing a literature review is useful when embarking on a new project, which has to tackle an emerging issue (Webster and Watson 2002, p.xiv). In this regard, we find it very appropriate to write a literature review at an early stage of our research project on open standards – an emerging issue in government policy studies. While we are not aiming at proposing novel theoretical foundations or conceptual models for the topic, we are aiming to develop a concept-centric review of (a part of) existing literature (Webster and Watson 2002, p.xvii).

The scope of the project on open standards and government policy

Definition and concept of open standards

A partnership of European standardization bodies have defined an **open standard** as one (ICT Standards Board 2005, p.10)⁴:

- developed and/or affirmed in a transparent process open⁵ to all relevant players, including industry, consumers and regulatory authorities, as indicated above;
- either free of IPR concerns, or licensable on a (fair), reasonable and non-discriminatory ((F)RAND) basis^{6,7};
- driven by stakeholders, and user requirements must be fully reflected;
- publicly available;
- maintained.

³ <http://standarder.oio.dk/English/>

⁴ Loosely based on EU/ISTAG.

⁵ Open does not necessarily mean free.

⁶ “FRAND” and “RAND” are often used inter-changeably.

⁷ W3C will not issue a Web standard if it is aware that Essential Claims exist which are not available on Royalty-Free terms. Refer to the W3C Patent Policy at <http://w3.org/Consortium/Patent-Policy/>.

In contrast, the same document defines **proprietary standard** as “a set of requirements and specifications that are established and asserted through a closed process, typically performed by a single company or closed consortium rather than an open standards body” (ICT Standards Board 2005, p.9).

Finally, as West (2006 (forthcoming)) boldly notes, openness is not a static construct, but instead a complex dynamic one.

Boundaries of the work

In this study we are primarily focusing on the country-level of analysis, i.e., while the concept of open standard is the object of the study, the Danish ICT government policy is the study subject.

In selecting literature sources for this review we were guided by certain temporal and contextual limitations. The temporal scope of the study is two-dimensional. On the one hand, the temporal scope is set by the available literature on open standards – a relatively novel and still emerging and widely disputed concept. On the other hand, having policy formulation in mind, we were seeking literature which focuses on possible short- and long-term impacts stemming from the adoption and /or use of open standards in ICT and e-government policy formulation.

Given the open-ended scope of the project, we had to discuss the possible / relevant topics of interest during the project meetings. Delimitation of the scope of the project and identification of relevant topics was done in several steps.

First, we consulted the IDABC database⁸ publications for the period of 2003-2005. Inquiry using a search key “open standard” returned 75 publications, which were subsequently analyzed. The review of IDABC publications is provided in Table 1. IDABC stands for Interoperable Delivery of European eGovernment Services to public Administrations, Businesses and Citizens. IDABC issues recommendations, develops solutions and provides services that enable national and European administrations to communicate electronically while offering modern public services to businesses and citizens in Europe. Thus, IDABC being focused on such issues as interoperability, e-government services, and communications, becomes a valid and viable input in determining the scope of research problems.

Second, we made an inquiry about existence of related projects into the SIIT standardization-related mailing list (see Appendix 2 for the responses), which lists 272⁹ participants from academia, industry, government organizations,

8 <http://europa.eu.int/idabc/>. IDABC uses the opportunities offered by information and communication technologies to encourage and support the delivery of cross-border public sector services to citizens and enterprises in Europe, to improve efficiency and collaboration between European public administrations.

9 As for March 29, 2006. From email communication with the moderator of the SIIT list.

and SDOs¹⁰.

Third, we analyzed the SIIT-mailing list discussion spurred by moderator's open question on the "Future of standardization research." The online discussion took place in February 2006, and generated responses from different experts in the field of standardization (see Appendix 3).

Fourth, we engaged in discussions during the project meetings.

As a result of the aforementioned steps, we have developed the problem classification presented in Table 4 in Appendix 1.

We followed recommendations of Webster and Watson (2002, p.xvii) to compile a concept matrix derived from the IDABC publications analysis.

¹⁰Standard Setting Organizations.

Table 1: Concept matrix. For the legend, see Table 4 in Appendix 1.

Source	LoA	Topic	Impact	Concept											
				DE	GP	EA	CP	DA	IO	GI					
										L	M	F	E		
IDABC 03001	EU	Search services interoperability	A+			PS					PS				
IDABC 03002	EU, DK	Microsoft opens XML schemas, DK is the first to adopt in InfoStructureBase	T+			+				+					
IDABC 03003	DK	Danish Digital Signature	S+ E+			+									XS, PR V
IDABC 03004	EU	E-procurement data standard – in UK, based on eBIS-XML open standard	E+				+			+					
IDABC 05001	DK	E-government DK strategy	A+							+					
BSA 05002	EU	BSA statement on technology standards	E+ /- T- S-	XS, ES	+					XS, ES					
IDABC 05003	EU	Microsoft to open Office formats: ECMA prepares, ISO approves	T+							XS, ES					
IDABC 04001	DK	Danish government defines “open standards”		+						+					
IDABC 04002	EU	Belgium: directives and recommendations on the use of open standards		+											
IDABC 04003	EU	City of Stockholm gearing up to e-congestion charge trial	E+ S+			XS									
IDABC 04004	EU	US government approves e-authentication architecture	E+							XS					XS
ETSI 05004	EU	GSC#10 Joint GRSC/GTSC meeting. Resolution GSC-10/04: Open Standards		+											
IDABC 04005	DK	Danish government adopts universal business language (UBL) for e-procurement	T+ E+			XS	XS			XS					XS
IDABC 05005	DK, EU	Denmark pioneers adoption of UBL-based standard	T+ E+			XS	XS			XS					XS
IDABC 05006	DK	Danish Government tackles administrative burdens and barriers to digitization	S- E-								NS				

This literature review is intended be used as a foundation for subsequent and more focused studies of the role of open standards in the government policy formation, as mentioned above. It is also a sense-making or orientation report for the government employees and decision makers involved in the county's ICT policy formulation.

We believe that the report will be of great interest to the academic community. Due to the novelty of topic, literature analysis and synthesis becomes a valuable guide for scholars entering the field of standards and standardization. We can also see the rising interest of professional communities in the topic of standards and standardization, and the move towards “openness”, as e.g., postulated in “corporate responsibility” statements of such leading global ICT vendors and business consultants as

IBM¹¹.

The literature review

There are two mainstream themes in works concerned with standards and standardization – that of (network) economics and interoperability.

Product compatibility and interoperability in the ICT domain has always been a central issue in discussions on the impacts and effects of standards and standardization. Not surprisingly, we started the work on literature review by looking through recent IDABC publications.

One of the reasons for embarking on writing this report, was to find out what are the other important dimensions of standards, and what implications are of those other dimensions in regard to openness and policy.

The many dimensions of interoperability

There are different aspects of interoperability that need to be considered in the context of policy formulation. Before we proceed to analysis, the concept of interoperability has to be defined. European Interoperability Framework (IDABC 2004) distinguishes between three types of interoperability:

- Organizational interoperability “is concerned with defining business goals, modeling business processes and bringing about the collaboration of administrations that wish to exchange information and may have different internal structures and processes” (IDABC 2004).
- Semantic interoperability is a prerequisite for the front-end multilingual delivery of services to the user. Semantic interoperability “is concerned with ensuring that the precise meaning of exchanged information is understandable by any other application that was not initially developed for this purpose. Semantic interoperability enables systems to combine received information with other information resources and to process it in a meaningful manner” (IDABC 2004).
- Technical interoperability “covers the technical issues of linking computer systems and services. It includes key aspects such as open interfaces, interconnection services, data integration and middle-ware, data presentation and exchange, accessibility and security services” (IDABC 2004).

Economics

After reviewing theoretical and empirical work on standardization and its relation to technical change, Blind concludes, that standardization can trigger not only positive, but also negative effects for overall economic development (Blind 2004. p.193). Whether the economic effect of standardization will be positive or negative can depend on a number of factors, such as timing, interface compatibilities, variety-reducing effects, cost-cutting rationalization,

¹¹ See, e.g., <http://www.ibm.com/ibm/responsibility/world/government/opencomputing.shtml>

etc., – too many to make a sensible theoretical prediction. However, the uncertainty of the problem can be reduced if the economic considerations are analyzed in the context of technical interoperability.

ICT products derive much or all of their utility from the interoperability obtained by implementing compatibility standards. In his review of economic realities of open standards, West (2006 (forthcoming)), summarizes on the economic effects of interoperability. Those, according to West, include:

- direct network effects, where increasing adoption by other users of a given standard increases the utility of that standard to the focal user;
- specialized complementary assets¹², where popular standard attracts a larger supply of complementary products, which in turn increases the attractiveness of the standard (this positive feedback model provides “demand side economies of scale”¹³);
- switching costs and lock-in effects, which are created by users' investments in specialized assets (i.e., the standard), such that users tend to keep the same standard once adopted;
- up-front research and development (R&D) costs¹⁴, which are necessary to create both the standard and its implementation.

Given these factors, ICT vendors seek wide adoption of their respective proprietary standards to provide an ongoing stream of rents, while ICT buyers seek out less proprietary alternatives. Thus, West (2006 (forthcoming)) argues that while open standards have long been considered the universal good for technology users, in real business life different stakeholders assign different priorities to various dimensions of openness. Some stakeholders do not prefer the most open alternative for varying reasons.

However, for ICT vendors/ suppliers there are also positive economic effects stemming from open standards. Open standards help consolidate a larger customer base (as opposed to offering products/ support based on disparate proprietary technologies). The same effect occurs to end-users – vendors are pooled together, which increases competition and drives the prices down, producing better quantity and quality of vendor options (Sliman 2002).

It is also generally accepted, that availability of (open) standard reduces the risk of investment through obtaining a durable solution¹⁵.

The reduction of risk stems from the lower probability for the adopter to

12 Teece, D. "Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy." *Research Policy*, Volume 15, Number 6, 1986, pp. 285- 305 ..

13 Katz, M. L., and Shapiro, C. "Network Externalities, Competition and Compatibility." *American Economic Review*, Volume 75, Number 3, 1985, pp. 424- 440 ..

14 Where such R&D costs are high, they combine with network effects and switching costs to create a barrier to potential competitors through increased returns to scale; thus, the most popular standard tends to gain increasing advantage over second-tier rivals. West, J. "The Economic Realities of Open Standards: Black, White and Many shades of Gray." In *Standards and Public Policy*, ed. Shane Greenstein and Victor Stango. Cambridge: Cambridge University Press, 2006 (forthcoming).

15 This idea is closely related to that of future-proofness of open standards based solutions (see page 12).

become “angry orphans” - to become users of abandoned technology/platform. Another type of risk reduced – that of running into interoperability problems, which in economic terms translates to reduced transaction cost for negotiating interoperability agreements.

The tension between the push for proprietary by vendors and demand of open by end-users is further complicated by existence of competing standards. In their work on transaction cost theory of standardization, Reimers and Li (2006, p.303) argue that existing economic theories (based on the concept of positive network externalities) can either not explain the phenomenon of colliding standards initiatives (if prospective network participants base their decisions on existing network sizes / structures) or they cannot explain successful standards initiatives (if prospective participants base their decisions on expected network sizes / structures) except on rather restrictive assumptions. This has a direct implication for policy formulation, when policymakers are attempting to “bet” on one standard over another in defining it as mandatory (de jure) standard.

Another important implication for standards policy that Reimers and Li (Reimers and Li 2006, p.308) allude to, is that when standards initiatives are supported by more than one SDO or trade association representing overlapping business networks, adoption of those standards can be slowed down or even blocked.

Public good and compliance

There are other dimensions of product interoperability pertaining to standardization processes. One of those – the role of standards in vertical industry business transactions. In a recent special issue of Electronic Markets journal, Wigand, Markus, and Steinfield (2006) introduce the focus theme of the vertical industry standards by stressing the role of open standards in the emergence and adoption of XML-based EDI standards in different industries.

While the firm- or industry-level unit of analysis per se is outside the focus of our analysis, there are several important lessons we learn from the work of Wigand et al. (2006). Specifically, that vertical standards development, while so crucial for industry-wide interoperability of ICT applications, has a public good problem – the standards development process is often (if not always) driven by large companies, while the adopters are small companies. It does not take a huge leap of imagination to substitute the “industry” concept with that of “country” and look at the problem through the prism of public sector agencies as “adopters.” As an example for this case, one can think of a municipality being an adopter of a W3C standards on Web accessibility – a municipality may lack resources for assuring appropriate testing and/or acquisition of development tools to comply with the standard's specifications. Another example would be reluctance of a company providing web hosting service to the municipality to embark on compliance testing, and the lack of the municipality's economic and/or political power to force the supplier act otherwise.

<i>Table 2: 2x2 compliance matrix</i>		End-user (e.g., municipality)	
Developer/ web hosting firm	<i>Compliance</i>	1	2
	<i>Non-compliance</i>	3	4
		<i>Compliance</i>	<i>Non-compliance</i>

All-in-all, the compliance-non-compliance issue can become quite complex, with 4 different scenarios presented in the classical 2-by-2 matrix (Table 2). A policy issue becomes whether the degree to which the standards implementations deliver the promised interoperability can or should be mandated.

Syntax and semantics

Disproportionate sizes of developers and adopters, as well as varying sizes of adopters, not only may cause compliance problems, but also create a risk of encountering functional and/or semantic problems when establishing interoperability processes based on common standards (Wigand, Markus, and Steinfield 2006, p.286).

Zhao et al. (2006) point at the apparent lack of standards for syntax and semantics for existing Internet-based (interoperability) standards. “Even though the proliferation of new technologies, especially the XML, has laid the foundation for firms to facilitate information sharing, standards are needed to define the syntax and semantics of information sharing” (Zhao, Xia, and Shaw 2006, p.289). Further, they stress that the role of standards in, and the importance of information sharing has been recognized by many industries as the foremost issue to tackle in order to increase efficiency of electronic communications and business. Zhao et al. (2006, p.290) also note that vertical industry standards are different from traditional IT standards in that there is a more significant role of user groups and less fierce competition among standard adopters in the standard development and adoption processes.

One-stop service experience

While the term “e-business standard” intuitively may seem irrelevant in the context of public sector, the actual definition of the term proves contrary: “standards that entail inter-organizational web-based communications, transactions, and business processes” (Zhao, Xia, and Shaw 2006, p.290). Thus, a simple substitute of e-business for e-service, for example, brings the arguments of Zhao et al. (2006) to the heart of polemic on Danish public sector's service digitization. Indeed, the demands that end-users of e-business systems place on systems providing different commercial services, and the demands and expectations of citizens in advanced information society are no different – a real-time integration of information across horizontal and vertical layers of public sector's agencies for a one-stop service “shopping”

experience.

The acceptance and adoption of open standards by major global vendors such as IBM, HP, and Oracle have created a growing assortment of open-standard-enabled products and services (Simon 2005, p.228). This accelerated the adoption of open-standard-based products by governments, which are under constant pressure to provide more efficient and reliable services. Specifically, there is an increasing demand for vertically and horizontally integrated services, spanning organizational, administrative, and even national boundaries (Simon 2005, p.228). The use and reuse of data across public digital registers is another important requirement for the contemporary policy, realization of which requires the use of open standards (Denmark 2005).

Timing and maturity of standards

Another important issue in development of vertical industry standards (or for that matter vertical public sector standards) is that of technical maturity of underlying technologies, as emphasized by (Zhao, Xia, and Shaw 2006, p.296). When systems in use (that have to be interoperable) are based on different ICT technologies, different strategies for pursuing choice of interoperability standards should be taken. So, for mature systems, the emphasis should be on resolving interconnection problems, and different stakeholders' conflicting interests. In the case of emerging technologies, however, the standards setting work should be focused on emerging or anticipatory standards.

Another aspect of time and maturity is that of evolution of standards. As there is a shift from interoperability in vertical markets to interoperability in horizontal markets, this calls for open standards developed in open environments that allows for the evolution of specifications (Schoechle 2005).

Future-proofness

Open standards, such as the Structured Query Language (SQL), have proven to have higher durability over time than proprietary solutions (Sliman 2002). When no single proprietary vendor has a control over the standard's specifications, i.e., not having enough power to force the adopters replace/upgrade (as it is common with e.g., new versions of Microsoft Office Suite) the standard-based product, the end user can continue to use the standard-based technology until something else has proven to meet her requirements better (Sliman 2002).

Goals of participation

Drawing on their study of the emerging open standard for financial statements and reporting – XBRL – Chang and Jarvenpaa (Chang and Jarvenpaa 2006, p.366) argue that in the case when stakeholders of standardization process are not only user organizations and SDOs, but

government / regulatory agencies themselves, the regulators must closely collaborate with the standards organizations to ensure that emerging standard specifications (software code) and regulations (law) work together rather than against each other. In other words, here is a case for early action on behalf of a government.

The decision process and the barriers to participation—whether direct or indirect—have a major impact on whose goals are served in standardization. These goals might include the following:

Matching existing implementations. One concern is to make standards consistent with existing investments—particularly when standardization is used to codify and harmonize existing implementations. In such post hoc standardization, users and complementors want new standards upwardly compatible with the standards they have already adopted. Vendors want the formal standard to closely match their existing de facto implementations.

Alignment of technology. Beyond patents, potential implementers have varied technological expertise, and thus seek to influence the standard in a direction that will give them a (often transient) competitive advantage in implementation. Such tensions are rarely documented outside the SSO; a rare exception is Bekkers' (2001) account of the French and German goals in GSM standardization.

Attempts to make SDOs more open can destroy the revenue model that allows the organizations to operate (West 2006 (forthcoming)). Not having a model how to finance standardization with low cost barriers to participation jeopardizes standard's initiatives from user associations and others not in a position to capitalize directly from a new standard. High cost standardization processes tend favoring vendors excluding other stakeholders.

End-user perspective (accessibility, user-friendliness, etc.)

In the context of public sector services, there are different types of communication taking place. Communications between an administration and an enterprise or citizen (G2C)¹⁶ could be of both 1-to-1 type, and many-to-many, where multiple transactions are possible, services are integrated and transactions between administrations and enterprises and citizens are fully automated (IDABC 2004). Establishing this type of communication would mean connecting applications which belong to different administrations and which are located in different locales of administration – e.g., in different communes or even Member States. In this complex setup, only by building on universally agreed open standards and specifications a meaningful interoperability can be achieved.

Moving towards simple, transparent, and user-friendly services is important, as users value less complexity. End-user's access to different kind of services through single device can not be made possible without technology

¹⁶ Government-to-citizens.

convergence, which in turn requires open standards (Schoechle 2005).

IPRs

The increasing need for interoperability of systems and services drives technology convergence, which in turn drives standards convergence. Increasing demand for interoperability emphasizes the need to collect standards and IP requirements into system specifications that allow products to interoperate. Just as standards of technology are important, a standard for IP is also important to foster interoperability (Schoechle 2005).

IPR issues also affect collaboration among SDOs. IP terms and conditions in one body may not apply to another. Openness of standardization process becomes a cornerstone for collaboration – collaboration is not possible if documents are not available to SDOs involved in a standards project (Schoechle 2005).

Implications for policymakers

It seems that at this time, there are more questions about policy implication of open standards than answers. One is definite, however – openness of standards has direct policy implications (West 2006 (forthcoming)), as exemplified by e.g., the E.U. antitrust lawsuits against Microsoft.

The first group of policy questions pertains to standards' **compliance** issue:

- When defining policies for interoperability, should the target groups (government agencies and private enterprises which provide public services) be mandated to adhere to the interoperability framework, or merely “invited” to do so (IDABC 2004)?

The second group of questions pertains to the **definition of openness**:

- Should “Open standard” be defined by the degrees of openness across multiple dimensions, or by the organizational form or even (solely) by the standardization process used (West 2006 (forthcoming))?

The third group of questions addresses the aspects of **competition**:

- Should governments' striving for openness override other goals of cost or performance (West 2006 (forthcoming))?
- How do policymakers distinguish between the inherent advantages that accrue to standards creators from anti-competitive behavior creating an illegal cartel (West 2006 (forthcoming))?
- Should the policy promote competition through support of multivendor standards? If so, what makes a multivendor standard¹⁷ (West 2006

¹⁷ In posing this question, West (West, J. "The Economic Realities of Open Standards: Black, White and Many shades of Gray." In *Standards and Public Policy*, ed. Shane Greenstein and Victor Stango. Cambridge: Cambridge University Press, 2006 (forthcoming)) is juxtaposing UNIX with multiple implementations running on proprietary hardware to the Wintel standard with a single processor and operating system supplier but multiple competing

(forthcoming))?

The fourth set of questions deals with issues of **competing rationalities**:

- How to strike a balance between different interests and values of democratic, administrative, and professional rationalities (Lines 2005, p.111)?
- How to strike a balance between national and European interests, e.g., in the case of procurement policies, where most of Danish regulations are based on European laws (Henriksen and Mahnke 2005)?

Besides unanswered questions, there is criticism of existing approaches adopted by policymakers towards public sector services and ICT systems. So, for example, Ilshammar et al. (2005, pp.35-36) stress that the contemporary debate on e-government is much concerned with interoperability issues, often discussed in terms of Enterprise Architecture. For ICT policy to be successful, it should go beyond the technical interoperability rationale, and have a long-term perspective and focus on strategic problem areas in society.

Another point of criticism is that the political focus is almost always on the producers of ICT systems and services, and on the administrations, but not on the citizens or end-users (Ilshammar, Bjurström, and Grönlund 2005, p.36).

Related to the criticism of lack of focus on citizens, is the discrepancy between the official rhetorics of the degree of advancement of ICT infrastructure and service development on a national or international level, and the actual degree to which the infrastructure and the services are used by citizens (Flak, Olsen, and Wolcott 2005). While Denmark is a recognized leader in ranks of developed Information Societies, the actual uses of such “successful” policy implementations as e.g., digital signature or e-procurement portal are actually below any expectations (Fomin 2006; Henriksen and Mahnke 2005). This discrepancy is a result of lack of proper measurement methods – all rankings exclusively focus on the supply of services, and fail to look at the demand side of services, as well as ignore the governance issues (Andersen and others 2005).

Table 3: New concept matrix

Article	LoA	Concept	Impact
(National Science Foundation 2005), (IDABC 2004)	EU	The role of standards in the development of national infrastructure is that of providing users with access to tools and services. Communications between an administration and an enterprise or citizen .	T+ S+
(Wigand, Markus, and Steinfield 2006)	CO, EU	Public good problem – large firms develop standards, while small firms adopt them.	E
(Zhao, Xia, and Shaw 2006)	CO, EU	Lack of standards for syntax and semantics	T-
(Zhao, Xia, and Shaw 2006)	CO, EU	Different and significant role of user groups and less fierce competition among standard adopters in the case of vertical industry standards.	E, S
(Zhao, Xia, and Shaw 2006)	EU	End-user's expectation of a real-time integration of information across horizontal and vertical layers of public sector's agencies for a one-stop service "shopping" experience.	T, E, S
(Zhao, Xia, and Shaw 2006)	EU	Technical maturity of underlying technology standards in creating and adopting vertical integration standards.	T
(Reimers and Li 2006)	CO	Inadequacy of network externalities theories for predicting success of standards initiatives.	E
(Chang and Jarvenpaa 2006)	EU	Regulators must collaborate with SDO when they are have a dual role of adopter and regulator. This is needed to ensure that emerging standard specifications (software code) and regulations (law) work together rather than against each other.	S, E
(West 2006 (forthcoming))	CO, EU	The tension between perceptions of open standards as "universally good" for users and widely-adopted proprietary standards as "nirvana" for ICT vendors.	E
(West 2006 (forthcoming))	EU	Different stakeholders assign different priorities to various dimensions of openness . Some stakeholders do not prefer the most open alternative.	E
(West 2006 (forthcoming))	EU	Should the definition of "open standard" be based on the degree of openness across multiple dimensions, or by the organizational form or even (solely) by the standardization process used?	T, S
(West 2006 (forthcoming))		Contradictions between openness, cost, and performance in policy formulation.	E
(Lines 2005)	DK	Contradictions between democratic, administrative, and professional rationalities in policy making and implementation.	S, E
(Henriksen and Mahnke 2005)	DK	Competition between national and international international policy interests	E
(Sliman 2002)	CO	Open standards help consolidate a larger customer and supplier base , which increases competition and drives the prices down, producing better quantity and quality of vendor options.	E+
(Sliman 2002)	CO, EU	Open standards have higher durability over time than proprietary solutions.	E+, T+
(IDABC 2004)	EU	What are the target groups in formulating policy for interoperability?	S, T
(IDABC 2004)	EU	Mandatory vs. voluntary compliance with the interoperability framework's standards.	T, S
(Ilshammar, Bjurström, and Grönlund 2005)	DK	A need for long-term perspective and focus on strategic problem areas in society in policy formulation.	E, S, T
(Ilshammar, Bjurström, and Grönlund 2005)	DK	Lack of focus on citizens/ end-users in policymaking	S, E
(Flak, Olsen, and Wolcott 2005)	DK	Lack of tools to measure performance of public sector's services.	E, S
(Andersen and others 2005)	DK	Discrepancy between rhetoric and reality in measuring success of ICT service offerings – all rankings exclusively focus on the supply of services, and fail to look at the demand side of services, as well as ignore the governance issues.	E, S
(Simon 2005)	EU	The acceptance and adoption of open standards by major global vendors such as IBM, HP, and Oracle have created a growing assortment of open-standard-enabled products and services.	E+, T+
(Schoechle 2005)	EU	There is a need for a standard for IP requirements in standards setting process.	E
(Schoechle 2005)	EU	Requirement for openness in SDOs collaboration .	T, E, S

Analysis and contribution

The primary contribution of this report is in bringing together previously-disparate streams of literature to help shed light on the issue of open standards in government ICT policy formulation (Webster and Watson 2002, p.xv).

Keeping in mind that writing a literature review is about making a chart for future research (Webster and Watson 2002, p.xix), we find it appropriate to look at future-defining policy statements from agencies at the forefront of ICT revolution. In this respect, we find that several principles charted in the report of the U.S. National Science Foundation on the future of Cyberinfrastructure can be appropriated for the government policy on open standards. Specifically, the NFS report (National Science Foundation 2005) emphasizes the importance of such concepts as **access** (of communities to tools, services, and data), **promotion** (of the policy by the government to broaden participation and strengthen the workforce in the field. Also, some agency must take a leadership role), **sustainability** (of the national infrastructure, i.e., it must be secure, efficient, reliable, accessible, usable, and interoperable), **integration** (of infrastructure between different levels of national government structures, as well as internationally, with the aim of creating a comprehensive **ecosystem** suited for meeting future needs). Embarking on implementing those concepts in the government policy, as well as their realization, would require **national and international partnership**. In short, the policy on open standards in the context of national ICT innovation and development, must be aimed at creating ICT infrastructure that is **interoperable, flexible, efficient, evolving, and broadly accessible**.

The importance of open standards in fulfilling on the above mentioned goals is emphasized by the variety of computer systems currently in use in the e-government domain in Denmark (and elsewhere in Europe and worldwide).

Existence of gate-keepers professing proprietary data formats in government interchange acting as barriers to open standard adoption due to a lack of perceptive new ventures that can be realized with new standards (in e-business or e-services). Showing vendors' future business opportunities derived from standard adoption in government would facilitate an early adoption of open standards.

The importance of the role of government is emphasized by the continuous need to provide the system vendors with insights into the major concerns and needs of the national ICT infrastructure (development).

Robert Sutor, VP of Standards of IBM, argued that there are four innovation accelerators: open standards, new IP practices, open-source software, and processes standardization (Schoechle 2005). How to spur innovation with open standards evolution is a core challenge both for government and vendors.

References

Andersen, K. V., Grönlund, Å., Moe, C. E., and Sein, M. K. "Introduction to the Special Issue: E-Government in Scandinavia." *Scandinavian Journal of Information Systems*, Volume 17, Number 2, 2005, pp. 3-10.

Blind, K. *The Economics of Standards. Theory, Evidence, Policy*. Cheltenham, UK: Edward Elgar, 2004.

Chang, C., and Jarvenpaa, S. "Pace of Information Systems Standards Development and Implementation: The Case of XBRL." *Electronic Markets*, Volume 15, Number 4, 2006, pp. 365-377.

Denmark. "ICA Country Report from Denmark." A paper delivered at the International Council for Information Technology in Government Administration (ICA), Salzburg, 13-15 September 2005.

Flak, L. S., Olsen, D. H., and Wolcott, P. "Local E-Government in Norway: Current Status and Emerging Issues." *Scandinavian Journal of Information Systems*, Volume 17, Number 2, 2005, pp. 41-84.

Fomin, V. V. "Snow, buses, and mobile data services." A paper delivered at the Fifth Global Mobility Roundtable: Wireless Value - from Business or Pleasure? Helsinki, 1-2 June 2006.

Henriksen, H. Z., and Mahnke, V. "E-Procurement Adoption in the Danish Public Sector." *Scandinavian Journal of Information Systems*, Volume 17, Number 2, 2005, pp. 5-26.

ICT Standards Board. *Critical Issues in ICT Standardization*. Information & Communication Technologies Standards Board, April 27 2005. Accessed March 30 2006. WWW/PDF. Available from http://www.ictsb.org/ictsfg/ictsfg_report_2005-04-27.pdf.

IDABC. *European Interoperability Framework for Pan-European eGovernment Services*. European Communities, 2004. Accessed March 30 2006. WWW/PDF.

Ilshammar, L., Bjurström, A., and Grönlund, Å. "Public E-Services in Sweden: Old Wine in New Bottles?" *Scandinavian Journal of Information Systems*, Volume 17, Number 2, 2005, pp. 11-40.

Katz, M. L., and Shapiro, C. "Network Externalities, Comapanition and Compatibility." *American Economic Review*, Volume 75, Number 3, 1985, pp. 424-440.

Lines, K. "MIS and the Problem of Decoupling in E-Government Reforms." *Scandinavian Journal of Information Systems*, Volume 17, Number 2, 2005, pp. 107-132.

National Science Foundation. *NFS's Cyberinfrastructure Vision for the 21st*

Century Discovery. NSF, September 26, 2005 2005. Accessed March 20 2006. WWW. Available from <http://www.itr.nsf.gov/>.

Reimers, K., and Li, M. "Antecedents of a transaction Cost Theory of Vertical IS Standardization Process." *Electronic Markets*, Volume 15, Number 4, 2006, pp. 301-312.

Schoechle, T. D. *Standards for Global Business: The European conference on Collaborative Trends in Europe and Global Standardization*. Munich: IEEE Standards Association, 2005. Executive Summary.

Simon, K. D. "The value of open standards and open-source software in government environments." *IBM Systems Journal*, Volume 44, Number 2, 2005, pp. 227-238.

Sliman, E. *Business Case for Open Standards*. OpenStandards.net, May 9, 2002 2002. Accessed March 20 2006. WWW. Available from www.openstandards.net.

Teece, D. "Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy." *Research Policy*, Volume 15, Number 6, 1986, pp. 285-305.

Webster, J., and Watson, R. T. "Analyzing the Past to Prepare for the Future: Writing a Literature Review." *MIS Quarterly*, Volume 26, Number 2, 2002, pp. xiii-xxiii.

West, J. "The Economic Realities of Open Standards: Black, White and Many shades of Gray." In *Standards and Public Policy*, ed. Shane Greenstein and Victor Stango. Cambridge: Cambridge University Press, 2006 (forthcoming).

Wigand, R. T., Markus, M. L., and Steinfield, C. W. "Preface to the Focus Theme Section: 'Vertical Industry Information Technology Standards and Standardization'." *Electronic Markets*, Volume 15, Number 4, 2006, pp. 285-288.

Zhao, K., Xia, M., and Shaw, M. "Vertical E-Business Standards and Standards Developing Organizations: A Conceptual Framework." *Electronic Markets*, Volume 15, Number 4, 2006, pp. 289-300.

Appendix 1. Problem classification scheme

Table 4: OStEA problem classification scheme

Unit of analysis	Abbreviation
Company / firm	CO
Denmark / country	DK
EU or Global	EU
Problem / concept	
Definition of "open standard"	DE
Government's participation	GP
Early adoption	EA
Conformance in public procurement	CP
Discrimination against	DA
Inter-Operability	IO
Governmental issues: Lack of coherent approach to standardization Monopolistic position in service provision Future proofness of data Enforcement of Open Standards by the government	GI- -L -M -F -E
Sub-problem	
Existing standard	XS
Emerging standard	ES
Potential standard	PS
Disappearing standard	DS
Non-existent standard	NS
All categories of standards.	AS
Domain	
IPRs	<i>IPR</i>
DRM	<i>DRM</i>
Privacy	<i>PRV</i>
Impact	
Social	S+/-
Economic/ institutional	E+/-
Technological	T+/-
All kind of impacts	A+/-

Appendix 2. Identification of relevant issues

Table 5: Summary of responses to the inquiry to identify open standards-related projects. Source: SIIT mailing list, February 2006.

Author	Topic
Rusi Bekkers, Professor	Although I never got into studying OSSOS in detail, I know that their approach is rather controversial. The EU adopted their ideas about the definition of openness into their EIF (European Interoperability Framework) and the effect might very well be that all software companies will simply stop to work for the field of publicly procured systems. Reason is that they impose that all stuff must be royalty-free (a rather unrealistic approach given reality: no matter how much one may be critical towards the effect of the patent system this is something unrealistic).
Kai Jakobs, PhD, SIIT mailing list moderator	<p>No-Rest has terminated (well, almost, I guess). We had the final review last week, and are now awaiting the evaluators' final comments (and the associated workload). The accepted deliverables should be on the website www.no-rest.org, as well as the newsletters.</p> <p>On the Interest web site www.interest-fp6.org you will find the newsletters, the slides from our first workshop, and the first deliverable, a lit rev. We are currently working on the next deliverable, which will report on findings from case studies and a survey of FP5/6 project co-ordinators.</p> <p>There was Maxiquest <http://www.maxiquest.net/>, and there is Copras <http://www.w3.org/2004/copras/>. Both were/are related to Interest in that they also look(ed) at the interface between standardisation and innovation.</p> <p>A project studying European standards policy will soon be launched, but nothing so far. The same holds for a project on standards in public procurement.</p> <p>The Asia-Link project aims to develop a curriculum for standardization in companies and markets <http://www.asia-link-standardisation.de/>.</p>
Yves Chauvel, ETSI	This may be interesting to you: http://www.etsi.org/sos_interoperability/
Geneviève Feyt, CENELEC	<p>From your message, we assume that your definition of "Open standards" includes the aspect "free of charge" and "freely available". If so, we have no such standards in the e-Government field but our sister organisation CEN and ETSI would be able to help you (especially as your query relates to the ICT field).</p> <p>We would advise you to contact CEN that is dealing with e-Government issues.</p> <p>ETSI also devotes its work to the definition of open standards.</p> <p>As a final remark, please note that "open standards" in the ESO field of standardisation does not necessarily include the aspect "freely available".</p>
Tineke Egyedi, Professor	Then there is the NO-REST project . http://www.no-rest.org I'm not sure how useful it is to you. Possibly the impact part (Knut just presented a final draft to the EU on this). My part on standards dynamics is perhaps less immediately relevant (also final draft stage, waiting for EU reviewer written comments).
L-F Pau, Professor	<p>I sit or have sat on decision boards for standards at IEEE, OMG , RapidIO, JavaC, ECMA and others so there is a lot to say about your project; but restriction in project scope to DK turns the research question into a "non IBM / non Microsoft " debate, and about Danish unconscious support to these parties' non-conformance to open standardsGovernmental non compliance: just look at privacy issues in DK. Smart cards is also a red zone in DK.</p> <p>You may find a lot of directly relevant data, cases and processes in the recent book: P.A. Dargan, Open systems and standards for software product development, ARTECH house, 2005, 89 USD, ISBN 1580537499</p>
Robin Williams, Professor	Do you know about the project on Collective Intellectual Property Rights that Andrea Bonaccorsi is running under the PRIME Network of Excellence, which looks at Open Source (and IP sharing in biotechnology)?
Cristina Rossi, Professor	<p>The CIPR project deals with collective management of intellectual property rights and aims at comparing two main phenomena, Open Source and Biotech. I am involved in the OS part that has produced a large scale survey on 918 European firms that provide to their customers OSS-based products and services (OSS firms). In short, we address the supply side of the OSS market and analyse firms' entrance in the OSS field.</p> <p>In our opinion the analysis of relationships between the commercial world and the OSS community is an intriguing issue for economic scholars. You could find our papers at http://papers.ssrn.com/sol3/results.cfm.</p>

Appendix 3. The future of standardization research

Table 6: Topics identified as "the future of standardization research". Source: SIIT mailing list online discussion, February 2006.

Author	Topic
Cornelia Storz, Professor	<p>The problem of detection and dilution in the case of quality standards.</p> <p>The setting of quality standards by international organizations.</p> <p>Delegating former state (monopoly) competences to private organizations.</p> <p>Adequate monitoring and control mechanisms for quality of standards and standard setting processes.</p>
Kai Jakobs, PhD, SIIT mailing list moderator	<p>The relevance of (national, international) policy for standards, and what exactly establishes the "open standard".</p> <p>Enterprise interoperability.</p> <p>How can a complex standard setting environment be made more efficient?</p>
James Issak, Professor, IEEE Board of Directors 2003/4, computer Society Board of Governors	<p>The leading role of industry in standards setting.</p>
Timothy Schoechle, Fellow PhD,	<p>The interplay between standardization and innovation.</p> <p>The growing clash between innovation & standardization and the intellectual property rights (IPRs) in the global economy.</p> <p>The IPR-based innovation in the developed world vs. the need for standardization and innovation in the developing economies.</p>
Michael Spring, Professor	<p>The balance between the private and the public in the standards setting process.</p>
Ken Krechmer, Lecturer, University of Colorado	<p>The roots and values of the European (de jure) and the U.S. (market, de-facto) approaches to standardization.</p>
Carl Cargill, Director of Standards at Sun Microsystems	<p>Where do standards belong in the interconnected society?</p> <p>What is the nature of standard setting?</p> <p>Who gets to do it, for what reason, and when?</p> <p>Do standards and standardization act as a leading indicators of success?</p> <p>Why do people/ companies/ countries do it?</p> <p>Who cares enough to pay to find it out?</p>
Kees van de Meer, Professor	<p>The durability of standards as investment.</p> <p>The inheritance of properties of a new child standard replacing the obsolete parent one.</p>

Appendix 4. Consulted literature

Ahrne, G., and Brunsson, N., "Organizing the World," Working Paper Stockholm University, June 2005.

Bannister, F., and Remenyi, D., "Acts of faith: instinct, value and IT investment decisions," *Journal of Information Technology*, Volume 15, 2000, pp. 231-241.

Bolin, S., "The Nature and Future of ICT Standardization," Report The Bolin Group, 2004.

Chaminade, C., and Edquist, C., "From theory to practice: the use of systems of innovation approach in innovation policy," Research Paper 2005/02, Lund University, 2005.

Dedrick, J., and West, J., "Adoption of Open Source Platforms: An Exploratory Study," Proceedings of the HBS - MIT Sloan Open Source Software Conference, 2003, pp. 27p.

Glott, R., and Ghosh, R. A., "Free/Libre and Open Source Software: Policy Support," Government survey report MERIT, University of Maastricht, March 2005.

Goode, S., "Something for nothing: management rejection of open source software in Australia's top firms," *Inf. Manage.*, Volume 42, Number 5, 2005, pp. 669-681.

Krechmer, K., "Open Standards Requirements," working Paper 2006.

Ministry of Economic Affairs and Communication, "Estonian IT Policy: Towards a More Service-Centred and Citizen-Friendly State," Ministry of Economic Affairs and Communication, 2004.

Ministry of Economic Affairs and Communication, "Information Technology in Public Administration of Estonia, 2004," Ministry of Economic Affairs and Communication, 2005.

Ministry of Science Technology and Innovation, "The Danish eGovernment Strategy 2004-06," PDF Ministry of Science Technology and Innovation, Feb. 2004.

National Office for the Information Economy, "Interoperability Technical Framework for the Australian Government," National Office for the Information Economy, June 2003.

OECD, "OECD e-Government Studies. Denmark," Country Report OECD, 2006.

Information Management Office, "A Guide to ICT Sourcing for Australian Government Agencies. Developing and executing an ICT Sourcing Strategy," The Australian Government Information Management Office (AMIGO), 2005.

Open ePolicy Group, "Roadmap for Open ICT Ecosystems," Report Berkman Center for Internet Society, 2005.

Shen, X., "Developing Country Perspectives on Software: Intellectual Property and Open Sources - A Case Study of Microsoft and Linux in China," *Journal of*

Information Technology Standards & Standardization Research, Volume 3, Number 1, 2005, pp. 21-43.

Spring, M. B., "Creating Better Standards More Efficiently," Report University of Pittsburgh, 2/9 2006.

The Danish XML Committee "Handbook for Standardization," Copenhagen, (2006:Feb. 28), 2003.

West, J., "How Open is Open Enough? Melding Proprietary and Open Source Strategies," Research Policy, Volume 32, Number 7, 2003, pp. 1259-1285.

West, J., and Dedrick, J., "Scope and Timing of Deployment: Moderators of Organizational Adoption of the Linux Server Platform," International Journal of IT Standards & Standardization Research, Volume 4, Number 2, 2006.

Wilson Research Strategies, "Massachusetts Information Technology Policy: A Study of the Economic Impact of the Enterprise Open Standards and Open Source Policy on the Commonwealth of Massachusetts," Wilson Research Strategies, March 2004.