



OPEN STANDARDS, OPEN SOURCE, AND OPEN INNOVATION: Harnessing the Benefits of Openness

**A REPORT BY THE
DIGITAL CONNECTIONS
COUNCIL OF THE
COMMITTEE FOR
ECONOMIC
DEVELOPMENT**

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Each statement is preceded by extensive discussions, meetings, and exchange of memoranda. The research is undertaken by a subcommittee, assisted by advisors chosen for their competence in the field under study.

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PREFACE

BY THE CED RESEARCH AND POLICY COMMITTEE

CED's Digital Connections Council (DCC), a group of information technology experts from CED trustee-affiliated companies, was established to advise CED on the policy issues associated with cutting-edge technologies. This report, concerning "openness" in the digital economy, is the second of its products. CED appreciates greatly the efforts of the members of the Council, and in particular, the work of Paul Horn, Senior Vice President for Research of IBM Corporation and Chair of the DCC, for his leadership in bringing this report to completion. Special thanks are also due to Elliot Maxwell, CED's project director and consultant, and to Carolyn Cadei for assistance with research, editing, and publication.

This report is the work of the DCC and is endorsed by CED's Research and Policy Committee. We welcome this report and recommend it to readers as an excellent analysis of how the U.S. economy can benefit from greater openness in technological standards, software development, and innovation.

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EXECUTIVE SUMMARY

In its most recent report, the Digital Connections Council examined the digital economy and the special case of digital intellectual property. That report highlighted the benefits of making information widely available through the Internet for the encouragement of innovation and the stimulation of economic growth. The Council recognized the importance of protecting the interests of initial creators—authors, songwriters, inventors—but also saw a critical role in the historically balanced intellectual property scheme for the vast number of potential “follow-on innovators,” who build upon earlier innovation by standing on the “shoulders of giants.”

In this report, the Council further explores this theme by examining the phenomenon of “openness,” which the Organisation for Economic Co-operation and Development (OECD) calls “an underlying technical and philosophical tenet of the expansion of electronic commerce” that will “cause transformations, for better (e.g. increased transparency, competition) or worse (e.g. potential invasion of privacy), in the economy and society.”

But what is “openness” in the context of today’s digital economy? There are many potential definitions. Works and processes are usually neither open nor closed but somewhere on a spectrum between the two. One key attribute of openness is accessibility. The more accessible a work is to anyone, the more open it is. Another attribute of openness involves responsiveness—as the degree to which a work can be modified by anyone increases, so too does the work’s level of openness.

Intellectual property law in the United States has provided a means by which the holder of intellectual property rights may “close” off an information product, controlling access to it and charging for the rights to

copy, distribute, or modify it. This right to “exclude” fit neatly into an economic framework where it was difficult and costly to create and distribute a physical good, such as a book or a recording on a physical medium, such as vinyl, tape, or compact disc, and where allowing one person to have access and control of that good precluded others from having the same rights at the same time. Just as with a physical space, only one person could use it at any given point in time. The legal regime was also consistent with the centralized economic processes that had emerged from the Industrial Revolution.

But this model is under considerable pressure. Digital works require no less creativity than non-digital works but are dramatically easier to copy, modify, and distribute. At the same time, these works can be shared by millions of users without any other potential user being prevented access; they are, as economists say, non-rivalrous. These characteristics are creating opportunities for different models of production and distribution that are decentralized, collaborative, and global. Digitization of information and the Internet have profoundly expanded the capacity for openness, and the Council sought to understand the consequences of these changes.

The Council examined three areas—open standards, open-source software, and open innovation—to study the impact of openness in specific circumstances, to gauge its importance, and to determine whether public policy should encourage it, restrict it, or be neutral.

OPEN STANDARDS

The very best example of open standards is the Internet itself. Built on a set of standards available to anyone, that were created in a process that allowed participation by anyone, the Internet’s open standards enable any network to interconnect and any applica-

tion to be made available to everyone. At the same time, the very connectivity that the Internet provides has become the vehicle for the expansion of “open innovation”—the collaboration of parties separated in time and distance but united through their contributions to projects as diverse as mapping the human genome and building new on-line encyclopedias.

Proprietary standards—those controlled by a particular party—can provide substantial benefits, as anyone knows who has ever been prevented from sharing an electronic document with an individual using different software. Moreover, such standards have the advantage of being validated by the marketplace. But open standards prevent a single, self-interested party from controlling a standard, facilitate competition by lowering the cost of entry, and stimulate innovation beyond the standard by companies that seek to differentiate themselves. Customers value the interoperability that open standards provide and generally benefit from not being locked into a particular supplier. *Because of the advantages of open standards, the Council recommends that governments encourage the development and use of open standards through processes as open to participation and contribution as possible. The Council believes that the participation of civil society would be beneficial in the formation of standards with important social consequences. The Council also recommends that the results of government-supported research be readily available for inclusion in open standards, as they have been in areas such as grid computing.*

Support for open standards has grown dramatically in recent years. But as the National Innovation Initiative has pointed out, issues surrounding intellectual property claims threaten the development of open standards. Companies involved in standards development that believe their technology to be essential for the implementation of an open standard may insist on licensing terms that inhibit broad adoption. Even providing for “reasonable and non-discriminatory licensing” (RAND) may, according to groups such as the World Wide Web Consortium

(W3C), inhibit the process of developing standards.

Providing technology essential for the implementation of a standard under a royalty-free (RF) license may prevent a company from maximizing its royalty revenues, but it does not eliminate the benefits the company may obtain. The more the standard draws on a company’s technology, the more likely it is the standard will validate the technology, expand the market for it, and provide advantages to the firm that created the technology and, thus, knows it best.

However, RF licensing by firms involved in the development of an open standard does not preclude a firm that has not participated in the process from asserting an intellectual property claim after the standard has been adopted and implemented. Perversely, there is even an incentive for such a firm to wait until the standard is widely utilized before challenging it, so as to maximize revenues from licensing or from damages. *The Council, therefore, recommends that incentives be created to induce the early disclosure of intellectual property claims and that consideration be given to progressively limiting recovery by a firm asserting infringement, as time elapses from the adoption of a standard.*

OPEN-SOURCE SOFTWARE

The second form of openness examined was open-source software. In proprietary software, the “source code” comprehensible by a programmer is not “open” and available for study, modification, and redistribution; the software is licensed for use under conditions set by the rights holder. In contrast, open-source software is governed by a license under which anyone can access, modify, and further distribute the source code. It is the mirror image of the manner in which intellectual property law has operated in the physical world; rather than excluding others and seeking compensation for creative activity through licensing access, open source uses intellectual property law to guarantee the widest possible distribution of the source

code in order to stimulate its improvement and to add value.

As Steven Weber points out in *The Success of Open Source*, unrestricted distribution and modification are central to the open-source software system, as development requires a programming task be separated into small modules. These modules encourage contributions by interested parties but, at the same time, do not overwhelm the individual participants with the enormity of the entire project. Among the many who can access the code because of the broad distribution, there is a smaller group who self-select to take part in any given open-source project; within this group, there is likely to be at least one individual with the skill, experience, insight, and interest to improve the software.

This model of sharing is not new. It is key to the practice of science and is rooted in the academic system of creating and sharing.

Although the open software model is vastly different from the dominant model of proprietary software based on controlling access, it is becoming increasingly important in today's environment. The Internet itself runs on open-source software, and a growing number of large commercial firms are supporting open-source software as part of their commercial strategies. Just as the Internet has facilitated the development of global open standards, it has also made global collaboration on open software development possible.

Some proprietary software firms have criticized open-source software by suggesting that it undercuts, or even destroys, the economic incentives necessary for the software industry to continue to create quality products by making them compete with "free" software. Supporters of open software point to its role in competitive markets such as Web-server technology (Apache) or database systems (MySQL), and its growing strength in markets with dominant players such as Web browsers (Mozilla's Firefox) and operating systems (Linux).

Critics of open software also argue that the open-source model is unsustainable, as it

does not provide the economic incentives necessary for someone to choose to devote his or her time and effort to solving a particular problem. But there are many reasons why programmers contribute to open-source efforts—the culture of sharing, the desire to contribute to a communal effort, the sheer joy of creation, the feeling of accomplishment for solving a difficult problem, the reputational gains from a highly regarded piece of work, and the expectation of reciprocity from helping those who might later help you. Complementing these incentives, major players in the information technology industry are paying for software development that is, at least in part, contributed to the open-source "commons."

There have been initiatives in a number of countries, particularly in the developing world, to mandate that governments purchase only open-source software. Proponents of such a requirement argue that it would save much-needed governmental funds, encourage the development of local programming resources, and reduce dependence on foreign software firms.

The Council believes that, rather than replacing one another, proprietary software and open-source software will co-exist, with each playing an appropriate role in the information and communication technologies (ICT) environment. The Council opposes any requirement forcing governments to make purchasing decisions based on the licensing system used. It recommends that the U.S. government not advocate purchases based on any particular licensing scheme—proprietary or open.

But the debate over such mandates has highlighted the importance of interoperability and the negative impacts that result when it is not achieved. In a striking example, survivors of Hurricane Katrina could only apply to the Federal Emergency Management Agency (FEMA) using a particular vendor's proprietary browser—another burden on those already battered by the storm. In its 2004 report calling for an interoperable system of health care records, the Bush Administration recognized the power of interoperability and made it a centerpiece of

the Administration's efforts to reduce the cost and improve the provision of medical care in the United States. *The Council believes there are certain critical functions of government that should be conducted solely with interoperable technology; in these critical areas, no citizen should be required to use the hardware or software of any particular vendor.* This does not mean that only open-source software would be available. Proprietary software vendors choosing to sell in these markets, however, would be required to provide sufficiently open interfaces, so as to allow others to interoperate with their product. The use of open standards and royalty-free licensing are particularly important in these areas. *The Council recommends that the United States support such interoperability requirements in international procurement as well. The Council also recommends that international agreements entered into by the United States regarding intellectual property should reflect the nation's historically balanced intellectual property regime reflecting the interests of both first and follow on innovators.*

OPEN INNOVATION

The combination of the Internet and the growing importance of digital information products is changing even the organization of creative enterprises and enabling new processes of innovation. The firm, as an economic unit, was, in part, a response to the problems of organizing work by dispersed parties. Information was difficult and expensive to gather and share, and coordination of diverse efforts was hard to achieve. But the Internet is changing these conditions, as it has changed so many other areas. Communication is cheaper, and coordination far easier than in the past. Rather than seeing the firm as the only model for organizing innovation and production, we are seeing new collaborative models of open innovation. The emerging result is what Tim O'Reilly has called an "architecture of participation."

Open-source software is only one example of the open innovation model. It is open because the source code is broadly available

and subject to successive modification, but it is not completely open, as there are evaluative mechanisms in place to ensure the stability and quality of the product (mechanisms that have also been adopted in many other forms of open innovation).

It is relatively easy to see how software could be developed collaboratively, and why more and more producers of physical goods are seeking improvements through collaborative efforts. Open innovation can be seen in the growing use of digital software tools tied to computer-controlled fabrication devices that allow users to design an object and then produce it physically. As the costs of these digital design tools decrease, users are able to innovate, breaking the model of manufacturers being the source of innovation and customers simply consuming them. The openness model, the antithesis of a "not invented here" attitude, encompasses not only manufacturers and users, but suppliers whose innovations should be welcomed by the companies they supply.

Perhaps most striking is the extraordinary increase in "peer production" of digital information products. Many, if not most, of the pages accessible on the World Wide Web are posted by individuals with no expectation of monetary gain. Similarly, the on-line encyclopedia Wikipedia is the result of contributions from thousands of individuals, as are the buyer's recommendations on Amazon.com, and the buyer and seller reviews on eBay.

Just as major information technology (IT) companies see benefits in seeding the open-source commons, sophisticated commercial firms are harvesting the benefits of openness. The podcasting capability of Apple's iPod was developed by users, who function as an external research and development unit; Eli Lilly's e-research subsidiary turns to a network of thousands of independent researchers for assistance in solving pharmaceutical problems.

"Open science" is making scientific information available well beyond the subscribers of traditional scientific journals. The National Institutes of Health (NIH) are encouraging widespread publication within

12 months of the results of the research that they fund. Open courseware is providing self-directed students around the world with the syllabi and course readings of great university teachers. All of these efforts rest on the assumption that society benefits by increasing access to information and allowing more people to contribute their special skills and experiences. Advocates for more openness contend that openness will result in greater innovation than would be achieved by restricting access to information or allowing first creators to exert greater control over it. Such a belief in the value of tapping the collective wisdom is profoundly democratic.

In order to foster open innovation, the Council recommends not only that the NIH should continue their efforts to expand the dissemination of the research they support, but also that other federally

funded, unclassified research should be made broadly available. Consistent with the position it has taken in its earlier reports, the Council recommends that any legislation or regulation regarding intellectual property rights be weighed with a presumption against the granting of new rights. The burden of proof should be on proponents of new rights to demonstrate with rigorous analysis the necessity of such an extension, because of the benefits to society of further innovation through greater access to technology. Finally, the Council suggests that the National Science Foundation (NSF) fund research into alternative compensation methods, similar to those created to facilitate the growth of radio, to reward creators of digital information products and accommodate the changes brought about by the digitization and growth of the Internet.