

# **Adoption and Use of Open Source Software: Preliminary Literature Review**

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## Executive Summary

This paper presents the preliminary findings from a literature review focusing on opportunities and barriers to open source adoption and use. Rather than present a comprehensive overview of scholarship on the subject, this review highlights work that is representative of deeper literatures of given subjects. Each of the articles cited here provides an entrée into more literature on that subject. The key pertinent areas include:

- Technology adoption at national level
- Public policy issues and adoption *within* public sector
- Private Sector Adoption and Use
- Developer Roles in Adoption and Use
- Economic issues pertaining to Open Source Software

## Introduction

This paper presents the preliminary findings of a literature review and annotated bibliography on open source software, with a particular emphasis on themes that are applicable to the creation of open source potential indices (OSPIS). In that regard, this literature review highlights themes related to the adoption and use of open source software, with the nation, type of user, or sector as the unit of analysis. The literature review also addresses broader methodological issues concerned with the formation of such indices, as well as the data sources used by researchers.

In addition to a brief analysis, this literature review presents relevant articles, arranged by theme, and presented in the form of a matrix. An annotated bibliography is also provided. The current iteration of this literature reviews draws upon the scholarly literature on open source software using databases such as EBSCO, EconLit, Academic Search Premier, ProQuest Research Library, and JSTOR. This means that certain useful sources pertaining to open source software, including such books as Steven Weber's *The Success of Open Source* (Cambridge: Harvard University Press, 2005) and Joseph Feller *et al.*'s (eds.) *Perspectives on Free and Open Source Software* (Cambridge: MIT Press, 2007) have not yet been integrated within this review. These lengthier sources will receive consideration in the final version.

## What the Academic Literature Tells Us about Open Source Research

At the forefront of much research into open source software has been the work done by economists, most of whom are intrigued by what appears to be a distinct mode of technological development, innovation, and, especially, distribution. Lerner and Tirole (2005b) suggest four questions/issues of interest to scholars studying open source software: 1) technological characteristics conducive to smooth open source development, 2) optimal licensing of open source, 3) the coexistence of open source and proprietary software, and 4) the potential for the open source model to be carried over to other industries (i.e. the portability of the “open source” concept). While technological issues are germane to the adoption of open source, just as important are social issues. In his examination of the Linux operating system, Weber (2000) identifies three key issues for social scientists to ponder: 1) motivation of individuals who develop open source; 2) coordination of activities in the supposed absence of a hierarchical structure, and 3) growing complexity in open source projects and its management.

Questions such as these can only be answered with the gathering of reliable data. And a number of social scientists have emphasized a need for empirical data in order to substantiate some of the claims made about open source software. Ghosh, in Feller *et al.*, (2007) explains why little empirical evidence exists for explaining why or how the open source model works. Hard data on the monetary value of OSS collaborative development is almost non-existent. Most models for economic evaluation and measurement require the use of money, and noneconomic activity such as the creation and development of free software is hard to measure in any quantifiable sense. (There are studies for nonpriced goods, e.g. knowledge, and these are useful in judging influence of such goods in organizations, markets, and other socioeconomic structures dominated by monetary indicators. But measurement is more complex and ambiguous in a context where the primary economic activity - the generation of free software through collaborative networks - is unusual in its avoidance of the use of money as a mode of exchange.) Ghosh contends, therefore, that the lack of objective, "census-type" sources means that many indicators, quantitative and qualitative, may require the use of surveys.

He identifies two problems with such surveys, however:

1. Who can we survey? There is no universal, clearly recognized objective data on the population to be surveyed.
2. Issues of Secondary Sources: Empirical data on FLOSS developers is not only hard to collect, but once collected, might be somewhat unreliable. So, there is a reason to use secondary sources to match subjective empirical data, and methods of validating them (a "handy excuse for papers that do not cite empirical data")

Other critics have argued that no empirical evidence exists to substantiate the claims that have been made about open source software.

Contra such critics, Lerner and Tirole emphasize that aspects of open source software appear initially puzzling to an economist. But scholars' ability to answer confidently many of the issues raised here questions is likely to increase as the open source movement itself grows and evolves. At the same time, they believe much of open source activities can be understood within existing economic frameworks, despite the presence of claims to the contrary. One such demonstration is their empirical analysis of the determinants of license choice using the **SourceForge** database<sup>1</sup>, a compilation of nearly 40,000 open source projects.

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<sup>1</sup> <http://sourceforge.net/>

## Themes

When considering opportunities and barriers to the adoption and use of open source software, particularly non-technological factors, a number of themes are emergent in the literature:

**Adoption at national level:** Scholars have examined the adoption of open source by national governments, via policy mechanism/regulatory approaches. By 2001, Peru, Brazil, Argentina, France, and Mexico all had measures pending that would mandate the use of free software on government computers. Other national and local-level efforts were also taken up in such countries as Germany, Spain, Italy, and Vietnam to establish official alternatives to the use of closed, proprietary software by government. For many free software practitioners, it was the seemingly uncontrollable momentum of their movement and the sheer technical strength of free software itself—more than any particular local actions or activities—that were to credit for its global successes. However, Chan (2006) argues that Peru provides an alternative case to this free market explanation. The Peruvian national government became directly invested in the issue, and free software in that nation became an instrument to directly address limitations of the state and its relation to global markets. Through free software, stakeholders sought to refashion the state as a strengthened entity that could act independently from or in challenge to transnational corporate interests. Chan argues that if free software in other nations had frequently expressed a confidence that it would and should spread without government's intervention, Peru's legislative developments signaled a departure from such free market logics and signaled that something other than free software's technological spread were of most concern to its advocates. When considering open source adoption at the national level, one key issue is the government's interests in pursuing this option versus those of other stakeholders who stand to benefit from such a decision.

Chae and McHaney (2006) examined an initiative announced by China, Japan, and South Korea in 2003 to promote open source software and platforms that favored non-Microsoft products such as Linux. When considering the reasons for this partnership and the nations' rationales for pursuing open source, the authors focused on, 1) geography, 2) similar languages and traditions, 3) security, 4) political and economic forces (e.g., alternative vs. Microsoft), and 5) technological self-reliance. Particularly germane are East Asian countries where e-government initiatives are underway, as well as concern about the security and vulnerability of commercial software (e.g. South Korea's experience with the 2003 "SQL Slammer" worm). Related to such rationales for national adoptions is May's (2006) analysis, arguing that open source software adoption in sub-Saharan African nations can help curtail the costs and problems associated with closed software licenses and intellectual property rights issues.

**Public Sector Adoption and Public Policy Issues:** An issue distinct from direct national adoption involves parsing the role public policy should (or even can) play in open source decisions. Whereas some governments have begun to *procure* open source software, others have actually channeled public funds to large-scale open source development projects. The distinction here, as made by Lee (2006), is that a nation that "considers" OSS signifies its desire to establish a level playing field within the public sector's IT procurement policies—such policy is not actually pro-OSS policy because it neither constitutes a government preference for OSS or

means the government will choose it. However, when policy makers decide to “prefer” OSS over proprietary software, the decision is likely to be criticized as procurement discrimination by proprietary software developers. Lee argues that when making public policy decisions on open source, government users should taking into account society’s long term interests, not just its interests as a consumer.

Other issues germane for policy makers include OSS’s impact on e-government initiatives. While official discourse and government policy for non-proprietary software suggests that its introduction into government will bring more 'politics as usual' rather than democratization, Berry and Moss (2006) discuss circumstances in which the discourse and practice of non-proprietary software contribute to opening-up and democratizing e-government. OSS can protect and extend transparency and accountability in e-governments and offer scope for technology to be socially shaped by citizens and associations as well as by administrators and private interests. Simon (2005) and Seiferth (1999) also bring attention to political issues such as standards settings and open licensing that impact the public policy of open source.

**Private Sector Adoption and Use:** Even within national contexts, the private sector remains an important factor when considering the opportunities and barriers to the adoption of open source. In her discussion of IBM’s embrace of open source, Samuelson (2006) draws attention to several developments: 1) an anti-Microsoft strategy among firms; 2) consequence of changed business models in the software industry; and 3) manifestation of an open innovation strategy for promoting faster and more robust technical advances. Meanwhile, Bonaccorsi and Rossi (2006) call attention to the larger issues surrounding the private sectors’ decisions whether to embrace open source, including economic (price/license policy independence), social (conforming to values of OS community), and technological (exploiting feedback and contributions from developers, promoting standardization, security issues) motivations.

**Role of Developers in Adoption and Use Decisions:** A growing body of literature has also emerged to query the role that OSS developers themselves may play in the adoption and use of open source in both the public and private sectors. The motivations of open source developers in the literature have generally been described by a taxonomy that considers two components of motivation—intrinsic (e.g., fun, flow, learning, community) and extrinsic (e.g., financial rewards, improving future job prospects, signaling quality). Krishnamurthy (2006) makes a case for incorporating both elements in developing an integrative theory about developer motivation. Three elements are identified as being unique to open source development: 1) diversity of project structures, 2) co-existence of companies and communities and, 3) co-existence of creative and commercial elements. Four factors are identified by the author as important mitigating and moderating factors in the conversation surrounding developer motivation: 1) financial incentives, 2) nature of task, 3) group size, and 4) group structure. Such issues are important because the motivations of open source developers shape socially the adoption of these systems by firms and governmental agencies.

In that vein, Bonaccorsi and Rossi (2006) provide empirical evidence on the incentives of the firms that engage in OS activities. Findings on firms' motivations were compared with the results of surveys on individual programmers in order to analyze the role played by different classes of incentives (social, economic and technological) in determining the involvement in the movement of different typologies of agents (individual vs. organizations). In conclusion, the different ways in which individual developers and companies approach open source can impact

its adoption within private and public sectors. Unlike innovation based on a strong professional culture involving close collaboration between professionals in academia and/or corporations, Lin (2006) argues that open source development entails a global knowledge network, which consists of: 1) a heterogeneous community of individuals and organizations who do not necessarily have professional backgrounds in computer science but have developed the competency to understand programming and working in a public domain; and 2) corporations, which results in a hybrid form of software development.

**Economic Issues Pertaining to Open Source Software:** As previously noted, economists have shown a great deal of interest in the issues posed by open source software. While some have argued that open source is incongruous with existing theoretical models, many economists have followed Lerner and Tirole's lead in attempting to use existing models to better understand the phenomenon. An especially important issue has been the relationship between open source software and the software market in general. Regarding the propensity of would-be users to adopt open source, Comino and Manenti (2005) contend that mass-market consumers can be divided between those who are informed about the existence of OSS and those who are uninformed. Since OSS producers have little incentive to advertise, there may be a substantial mass of uninformed consumers, leading to market failures that may justify government intervention. Related to this assertion is Forge's (2006) analysis of the packaged software industry. Contra monopolistic trends related to the packaged software industry in the U.S., Forge finds that the way forward in economic terms for Europe may well be to follow and encourage open source software for reasons of creating a strong software industry and for a counterbalance to current monopolistic trends. The paper's findings emphasize the need for investment, education and encouragement in open source software, by both the public and private sectors, to build a strong knowledge-based society in Europe. Other related issues discussed in this literature review concern open source licensing and responses by open source developers to market externalities.

### Methods and Sources

The scholarship on the adoption and use factors for open source may be categorized into the types of research. Most prevalent is research that tends to be theoretical or presents a given model to explain a particular set of barriers and opportunities. These generally draw upon secondary sources. Next, case studies are common for building on or contributing to much of the theoretical research. Much of these have relied upon primary sources such as newspapers and government documents, though a few have also gathered information from correspondence or interviews. Finally, empirical research is the least common, but perhaps most useful means for gathering data. Studies such as these often draw upon survey data.

Issue	Study	Focus	Findings	Method	Data Source
Adoption of open source at national (governmental) level	Vaism an (2007)	Open source in Iran, Middle East/role of women	Three years ago, Iran decided to run its government computer system on open-source software. The Islamic Republic had long relied on pirated copies of Microsoft's software, a result of the US embargo that forbids American companies from providing technical support to Iran. A recent European Union survey found that only 1.5% of European open-source coders are female. Not so in Iran, where, by some estimates, half of all software engineers coming out of the country's universities are women. Of the three coders who developed Iran's first official open-source project, two were women. Similar patterns are now emerging elsewhere in the Middle East. In Syria, which is also under a US embargo, women are estimated to make up at least 50% of the coding workforce.	Report	Media sources
	Chae and McHorney (2006)	Collaborative open source initiative by Japan, China, and Korea	Factors involving geography, politics, economics, and security motivated CJK's open source-based software initiative	Case study/Analysis	News media sources
	May (2006)	Open source adoption in sub-Saharan Africa	Argues that opens source software can ameliorate many of the problems associated with intellectual property rights from closed source software	Policy analysis	Government documents; media sources
	Xiaobai (2005)	Open source vs. proprietary software in China	This paper looks at implications of the emerging global Intellectual Property (IP) regime for Developing Countries (DC) and their attempts to improve their technological capabilities. It further highlights the new perspectives for DCs opened by the emergence of non-proprietary (open source/free) software, such as Linux. A case study of the battle between Microsoft and Linux in China is used to explore the dilemmas faced by China in determining what IP regime (strict or weak) to adopt, and the threats and opportunities that either may pose for indigenous technology development. Based on the case analysis, the paper criticizes the simplistic polarized views that have been presented of the implications of the global IP regime and of the potential of non-proprietary software. It explores some of the complex considerations about the interplay between technology strategy and IP protection for China and discusses the policy implications for China and other DCs.	Case study	Government documents; media publications
	Alonso et	Open source	Alonso et al analyze the impact of a decision by the regional government in Extremadura, Spain to	Case study	Government

	<i>al.</i> (2004)	adoption in Spain	support development of free and open source software during the early 2000s. They do it against a background of political philosophical concerns for the loss of community in a high-tech and scientific society. Following through, they argue that a technoscientific policy may be judged on grounds other than straightforward economic benefit, for which case, benefits of a particular policy have included communitarian development.		documents; media sources
	Chan (2004)	Open source adoption in Peru	Peru's practices departed from language of technical and economic rationality repeatedly invoked to explain free software's adoption in other nations. Insisted instead on a new framing of free software as necessarily engaged and invested in processes of governance and political reform	Case study	Government documents; interviews; media sources
Public sector adoption of open source (public policy)	Berry and Moss (2006)	Open source software's impact on e-government initiatives	Analysis of official discourse and government policy for non-proprietary software suggests that its introduction into government will bring more 'politics as usual' rather than democratization; the authors of this paper envisage circumstances in which the discourse and practice of non-proprietary software contribute to opening-up and democratizing e-government, by protecting and extending transparency and accountability in e-governments and by offering scope for technology to be shaped by citizens and associations as well as by administrators and private interests.	Theoretical / Model	Secondary source literature; case studies
	Lee (2006)	Benefits and risks of government policy favoring open source	When making public policy decisions on open source, government users should taking into account society's long term interests; not just its interests as a consumer	Policy analysis	Secondary source literature; government documents
	Michler (2005)	Procurement decisions by national governments	Merits of open source software, particularly in the context of Australian Government procurement, have been the subject of considerable debate in recent times. Considers the merits of open source software through an examination of both the legal and technical risks associated with the product In concluding, it is determined that there is a positive argument for mandating open source software as a viable alternative to its closed source counterpart.	Legal analysis/case study	Government documents; Australian case law
	Simon (2005)	Convergence by governments worldwide to open standards and the	Given the equally rapid changes in the information technology marketplace, the successful adoption of these new technologies by governments will depend on how well the strengths of proprietary software and OSS are understood and applied--especially with respect to the use of open standards to speed deployments of integrated capabilities that respond to emerging	Analysis	Secondary literature; case study

		ways in which open source embraces this convergence	challenges.		
	Seifert h (1999)	Open licensing in the United States	Open source licensing plays important role in releasing source codes; Use of open content licensing to release the associated electronic information; Adoption of open licensed systems by the Department of Defense.	Case study	Government documents
Private sector adoption/use of open source	Bonaccorsi and Rossi (2006)	Examination of incentives of the firms that engage in OS activities	Firms' motivation for open source may be understood as economic (price/license policy independence), social (conforming to values of OS community), and technological (exploiting feedback and contributions from developers, promoting standardization, security issues)	Model/theoretical	Survey (146 Italian open source firms)
	Miralles, Sieber, and Valor (2006)	OSS Adoption by IT Departments	In this paper, authors propose that due to the particularities of the Open Source Software (OSS) development process and its perceived "social" connotations, traditional ways of explaining IT adoption are insufficient to understand the case of OSS diffusion. Evidence shows that OSS fails in many cases to displace dominant market leaders even in the case of user's unhappiness with the prevalent solution, while in some others OSS is adopted without a clear advantage. Using a qualitative research approach, authors highlight the existence of a new context, in which the adoption of Linux-based OSS platforms by companies is not led only by traditional drivers. User communities and broader social responsibility considerations have been found to exert some degrees of pressure on the IT decision maker. Through the analysis of some significant cases authors propose a framework that helps to depict under which conditions significant OSS adoption may unfold.	Theoretical / Comparative case study	11 firms in France: interviews and company documents
	Samuelson (2006)	Discusses IBM Corp.'s adoption of an open source software model	IBM's embrace of open source may be understood in three ways: 1) an anti-Microsoft strategy; 2) consequence of changed business models in the software industry; and 3) manifestation of an open innovation strategy for promoting faster and more robust technical advances.	Legal analysis	IBM publications; secondary literature
	West and Dedrick (2006)	OSS Adoption	Authors present a qualitative study of how organizations do (or do not) adopt a new computer server platform standard; namely, Linux using PC-compatible hardware. While discussions of Linux typically focus on its open source origins, our respondents were interested primarily in low price. Despite this relative advantage in	Comparative case study; Interviews	4 MIS departments in U.S.; Interviews with CIOs of companies.

			price, incumbent standards enjoyed other advantages identified by prior theory; namely, network effects and switching costs. Authors show when, how, and why such incumbent advantages are overcome by a new standard. They find that Linux adoption within organizations began for uses with a comparatively limited scope of deployment, thus minimizing network effect and switching costs disadvantages. Authors identify four attributes of information systems that potentially limit the scope of deployment: few links of the system to organizational processes, special-purpose computer systems, new uses, and replacement of obsolete systems. Authors also identify an organizational level variable-internal standardization-which increases scope of deployment and, thus, the attractiveness of the incumbent standard.		
	Gosain (2003)	Culture of OSS developers via Slashdot	Slashdot is a major virtual meeting ground for the Open Source development community. The discourse at Slashdot is interpreted in this study, and in combination with primary interviews and secondary archival analysis, yields rich insights about the signifying practices, contradictions, norms, incentive structures and values systems that characterize the community that it supports. The characteristics of the site such as the emphasis on collaboration to manage information, its distinctive interpolation, the reputation-maintenance mechanisms, use of Open Source tools, and adoption of norms such as "release early, release often" reflect the broader Open Source ideals. Using an ethnomethodology perspective, this study provides clear examples to recover what reflective members 'know' from their practical mastery in everyday affairs of the community. We find that the site taps into the emergent social construction of the community and effectively mediates that construction.	Ethnographic study	Interviews, Slashdot archives
	West and Dedrick (2001)	Standards adoption	Firms that sponsor proprietary de facto compatibility standards must trade off control of the standard against the imperative for adoption. For example, Microsoft and Intel in turn gained pervasive adoption of their technologies by appropriating only a single layer of the standards architecture and encouraging competition in other layers. In reaction to such proprietary strategies, the open source movement relinquished control to maximize adoption.	Case study	Secondary literature
Adoption of open source by educational institutions	Churney and Zhou (2008)	MIT's Open Course Ware initiative	This paper discusses the open source movement as it relates to educational platforms. It begins with examining the value of information in the American economy and reviewing the legal mechanism which primarily affords protection to information in our legal system, namely copyright	Case study	Media sources

			law. The impact of the Internet on both information and education is studied. The culmination of stringent copyright laws and the ubiquity of the Internet are put forth as the impetus for the modern open source movement and the open education movement. The view of "education as a good" is posited as well as the impact of the Internet on education. The philosophy and impact of the open source education movement are also studied, with particular attention paid to MIT's Open Knowledge Initiative (OKI) and OpenCourseWare (OCW) Project. Some obstacles to MIT's initiatives are reviewed. Finally, the information is examined and a conclusion put forth about the efficacy and future of open source education software.		
	Van Rooij (2007)	Perceptions of technology and academic decision-makers about open source benefits and risks versus commercial software applications	Interviews revealed perceived barriers to open source adoption and the extent to which the outsourcing concept could alleviate risks. Recommendations for overcoming adoption barriers are offered.	Survey	Telephone survey
	Waters (2007)	Benefits derived by U.S. schools from open source software	Growing number of K-12 districts are converting to open source software, both to cope with tight budgets and to escape proprietary vendor lock-in and expensive upgrade cycles	Survey/analysis	Interviews with education leaders (K-12 Open Technologies Leadership Initiative)
Role of OSS developers in public and private sector adoption	Duenas <i>et al.</i> (2007)	Comparison of open source project incubators	Open source development is often regarded as a chaotic environment where new initiatives' success or failure just happens by chance. However, successful open source communities are applying incubation processes for managing the risks associated with creating new projects. This article analyzes the qualitative and quantitative aspects of the incubation process, focusing on the Apache and Eclipse communities. After performing a quantitative and qualitative comparative analysis of these communities, the authors identified aspects that affect the incubation period's duration and community size.	Comparative case study	Governance documents and other project documents from Apache and Eclipse

			The similarities led them to propose a two-stage model for the incubation process, which might facilitate its applicability to other open source or industrial organizations.		
	Krishnamurthy (2006)	Trends in the research on motivation in open source	Current literature favors a taxonomy that considers two components of motivation— intrinsic and extrinsic. Author makes a case for incorporating both elements in developing an integrative theory about developer motivation. Three elements are identified as being unique to FLOSS development: diversity of project structures, co-existence of companies and communities, and co-existence of creative and commercial elements	Model	Interviews and surveys based off of Sourceforge ; Slashdot discussion groups; survey of 141 Linux developers, etc. (metadata, mostly)
	Lin (2006)	Dynamics of collaboration between open source community and corporations	Current open source development entails a global knowledge network, which consists of 1) a heterogeneous community of individuals and organizations who do not necessarily have professional backgrounds in computer science but have developed the competency to understand programming and working in a public domain; and 2) corporations	Policy analysis	Interviews (fieldwork undertaken at European FLOSS conferences ; 10 semi-structured interviews with developers from EU)
Legal aspects of open source	McGhee (2007)	Legal analysis of open source licensing	McGhee discusses the rise of free and open source software (FOSS) as an alternative to traditional commercial software products and how this new software brings a host of unique legal issues that must be evaluated before any gains may be realized. Mr. McGhee reviews the case law and explains when companies should be aware of the particular situations that emphasize FOSS licensing compliance. The author concludes that free and open source software can be either a tremendous boon to companies that use it intentionally or a potential logistic, economic, and legal nightmare for those that do not. In any event, he believes that FOSS compliance should no longer be ignored.	Legal analysis	Court cases involving OSS
	McGowan, Stephens, & Gruber (2007)	Attitudes toward intellectual property	This article helps to clarify and articulate the ideological, legal, and ethical attitudes regarding software as intellectual property (IP). Computer software can be viewed as IP from both ethical and legal perspectives. The size and growth of the software industry suggest that large profits are possible through the development and sale of software. The rapid growth of the open source movement, fueled by the development of the Linux operating system, suggests another model is possible. The large number of unauthorized	Comparative case studies/legal analysis	Court documents/ media sources

			copies of software programs suggests that many people do not believe in laws regarding software copyright. There are many and varied views of software as IP, even within the information systems (IS) profession. In this article, four distinct subgroups of IS professionals are identified. The article describes the four subgroups and their respective ideological views on software ownership; it explores the subgroups' attitudes regarding software laws; and finally, it explains the ethical positions embraced by each subgroup.		
Economic aspects of open source	Gaudul (2007)	OSS developers' consideration of the market	Paper traces the history of TEX, the open source typesetting program. TEX was an early and very successful open source project that imposed its standards in a particularly competitive environment and inspired many advances in the typesetting industry. Developed over three decades, TEX came into competition with a variety of open source and proprietary alternatives. Argue from this case study that open source developers derive direct and indirect network externalities from the use of their software by others and must therefore consider non-developers' needs to make their software more attractive to a broader audience and more competitive with proprietary alternatives. Counters Raymond (2001) about "bazaar"; sees OSS as hierarchical and highly structured.	Case study	TEX newsgroup
	Bonaccorsi, Giannangeli, and Rossi (2006)	OSS business models	The paper analyzes the strategies of software firms that have entered the open source (OS) field. The notion of the OS business model is discussed in the light of a substantial body of theoretical literature concerning strategic management and the economics of innovation, as well as specialized literature on OS. Empirical evidence based on a survey of 146 Italian software firms shows that firms have adapted to an environment dominated by incumbent standards by combining the offering of proprietary and OS software under different licensing schemes, thus choosing a hybrid business model. The paper examines the determinants of the degree of openness toward OS and discusses the stability of hybrid models in the evolution of the industry.	Survey	Survey of 146 Italian software firms.
	Forge (2006)	Impact of OSS on packaged software industry	The paper briefly traces the economic significance of the software industry and the dominance in packaged software of the large US publishers, the phenomena of natural monopolies building in software packages, and the need for different industry structure for Europe, as it exhibits a small to medium-sized enterprise (SME) and system integrator structure. It then examines the balancing affects of OSS. The paper	Theoretical	Secondary (government) data sets from E.U. and U.S.

			also addresses the role that poor software plays in creating new costs or externalities for its users when it fails, contrasting the robustness of open source in defect repair. The paper finds that the way forward in economic terms for Europe may well be to follow and encourage OSS for reasons of creating a strong software industry and for a counterbalance to current monopolistic trends. The paper's findings emphasise the need for investment, education and encouragement in OSS, by both the public and private sectors, to build a strong knowledge-based society in Europe. The paper introduces the ideas of the basic economic mechanisms of volume sales of software as a good, with analysis of the industry impacts of confluence of the network effect coupled with the law of increasing returns with volume to drive monopolistic positions in the proprietary software package industry.		
	Gehring (2006)	Economic analysis of open source	The institutional framework of open source, not merely the low cost of open source software, makes it an attractive alternative mode of organizing the production and distribution of software and software-related services. Alternative organizations will be formed and existing organizations will be transformed to take advantage of its opportunities	Economic analysis	Secondary literature
	Comino and Manenti (2005)	Impact on social welfare of government policies supporting OSS	Mass-market consumers can be divided between those who are informed about the existence of OSS and those who are uninformed. Since OSS producers have little incentive to advertise, there may be a substantial mass of uninformed consumers, leading to market failures that may justify government intervention. Authors study three government policies: (a) mandated adoption, whereby the government forces public agencies, schools, and universities to adopt OSS, (b) information provision, whereby the government informs the uninformed users about the existence and the characteristics of OSS, and (c) subsidy, whereby the government makes a payment to consumers if they adopt OSS. They show that mandated adoption and information provision may increase social welfare, but the subsidy always reduces it. When network externalities are added to the model, we show that mandated adoption and information provision may increase social welfare if they help the market to tip towards standardization.	Economic analysis	Theoretical models
	Dahlander and McKelvey (2005)	Probing differences between OSS users and non-users	Explores three issues, which have not been extensively explored in the literature, namely, (1) how frequently a group of skilled people use OSS, (2) reasons for differences among users and non-users in terms of use and attitudes, and (3) how frequently, and why, some users contribute	Survey/ Questionnaire	Surveys of students/graduates at Linkoping University (Sweden)

			<p>to OSS projects (and thereby become developers). In doing so, authors consider the opportunity costs of use and development of OSS, which has been largely neglected in the literature. Authors find that the individuals have a rather pragmatic attitude to firms and that many are active in both firms and OSS community, which raises many questions for future research about the role and influence of firms on the development and diffusion of OSS.</p> <p>Main reasons not to develop: 1) Lack of time; 2) not necessary; 3) not used enough; 4) other</p>		and Rice University (N=75; 62, effectively, 50; 60)
	Lerner and Tirole (2005a)	How OSS activities may be understood in economic frameworks	Aspects of open source software appear initially puzzling to an economist. As authors have acknowledged, our ability to answer confidently many of the issues raised here questions is likely to increase as the open source movement itself grows and evolves. At the same time, authors believe much of open source activities can be understood within existing economic frameworks, despite the presence of claims to the contrary. The labor and industrial organization literatures provide lenses through which the structure of open source projects, the role of contributors, and the movement's ongoing evolution can be viewed.	Economic analysis	Literature review
	Lerner and Tirole (2005b)	Open source licensing	This article is an initial exploration of the determinants of open source license choice. It first highlights how the decision is shaped not just by the preferences of the licensor itself, but also by that of the community of developers. The article then presents an empirical analysis of the determinants of license choice using the SourceForge database, a compilation of nearly 40,000 open source projects. Projects geared toward end-users tend to have restrictive licenses, while those oriented toward developers are less likely to do so. Projects that are designed to run on commercial operating systems and whose primary language is English are less likely to have restrictive licenses. Projects that are likely to be attractive to consumers--such as games--and software developed in a corporate setting are more likely to have restrictive licenses. Projects with unrestricted licenses attract more contributors. These findings are broadly consistent with theoretical predictions.	Survey	SourceForge
	Gallaway and Kinnear (2004)	Legal analysis of copyright law	As digitized information becomes an increasingly large part of the economy, new realities are challenging the very nature of our past-binding, coal-and-steel era conceptions of scarcity, property, consumption, and production and of profit as the unchallenged engine of the economy. Institutionalists have a hundred-year history of skeptical scrutiny of these very same notions. At	Legal analysis	Secondary literature

			<p>the same time, institutionalists understand that in any age there is no greater obstacle to a clear analysis of contemporary challenges than a culture's own habits of thought. It seems clear that in the area of copyrights (at the very least) Congress and the Supreme Court are headed in exactly the wrong direction. It is also clear that much of this can be explained by their clinging to a mythical ideal of an industrial economy rife with competition but devoid of power and strategic behavior. If the full promise of the digital revolution is to be realized, institutionalists must do their part in speaking out against the ceremonial adherence to old-economy ideals and outdated institutions.</p>		
	Hawkins (2004)	Cost-benefit analysis of OSS vs. proprietary software	<p>Large quantities of software, ranging from operating systems to web servers to games, are now available as "open source software" or "free software". In many cases, this software is backed by large profit seeking corporations such as IBM. Traditional economic analysis is used to identify the costs and benefits to firms of using open source rather than proprietary solutions, particularly in the case of the firm releasing code to the world when not obliged to do so. Examples of large companies backing open source are examined in light of the profit motive. Additionally, open source is also analyzed as a quasi-public good.</p>	Economic analysis	Theoretical models based on secondary literature
Miscellaneous	Ebert (2007)	Open source and its relation to innovation	<p>Engineers using free and open source software created many of today's most innovative products and solutions. FOSS also changed the way we develop software. IEEE Software's Open Source column first appeared in this magazine in July 2004. In this last column, the editor revisits what we've learned over the past three years as 17 articles from 11 different authors (and companies) examined a dedicated FOSS component, tool, or product and reported lessons learned in selecting, implementing, and maintaining it.</p>	Literature review	Secondary literature
	Coleman (2004)	Political meanings of open source	<p>Open source is one local instantiation of liberal values--rearticulation centered on reposing the relationship between intellectual property and free speech law by redirecting the use of licenses to protect expressive activity. Through open source's visibility, circulation, and use, the juridical understanding of free speech is shifting while some of the ingrained assumptions of intellectual property law have already been partially destabilized, the wider effect of which has been to open up a social space for new legal possibilities.</p>	Theoretical	Secondary literature

### **Annotated Bibliography (arranged in alphabetical order)**

Alonso, Andoni, Luis Casas, Carlos Castro, and Fernando Solis, "Research, Development, and Innovation in Extremadura: A GNU/Linux Case Study," *Philosophy Today* 48 (2004): 16-22.

Alonso et al analyze the impact of a decision by the regional government in Extremadura, Spain to support development of free and open source software during the early 2000s. They do it against a background of political philosophical concerns for the loss of community in a high-tech and scientific society. Following through, they argue that a technoscientific policy may be judged on grounds other than straightforward economic benefit, for which case, benefits of a particular policy have included communitarian development.

Berry, David and Giles Moss, "Free and Open-Source Software: Opening and Democratizing E-Government's Black Box," *Information Polity: The International Journal of Government and Democracy in the Information Age* 11, no. 1 (2006): 21-34.

This article considers the implications that the use of free and open-source software in government might have for democracy and public participation. From a constructionist perspective, the democratic 'effects' of non-proprietary software are contingent on how the practice of free and open-source software is discursively represented and constituted as it is translated into new e-government systems. On these premises, an analysis of official discourse and government policy for non-proprietary software suggests that its introduction into government will bring more 'politics as usual' rather than democratization. Nevertheless, on the basis of an alternative discourse of ethics and freedom evident in the Free Software and Open Source communities, the authors of this paper envisage circumstances in which the discourse and practice of non-proprietary software contribute to opening-up and democratizing e-government, by protecting and extending transparency and accountability in e-governments and by offering scope for technology to be shaped by citizens and associations as well as by administrators and private interests.

Bonaccorsi, Andrea and Cristina Rossi, "Comparing Motivations of Individual Programmers and Firms to Take Part in the Open Source Movement: From Community to Business," *Knowledge, Technology & Policy* 18, no. 4 (Winter 2006): 40-64.

The first urgent question for any scholar willing to study the Open Source (OS) movement has been clearly put by Glass (1999, 104): I don't know who these crazy people are who want to write, read and even revise all that code without being paid anything for it at all. A growing body of economic literature has been addressing the motivations at the basis of the participation in the OS movement since when the new paradigm has become successful and triggered the entrance on the market of firms offering Open Source based products and services (Open Source firms). However, most of the empirical analyses focus on individual developers and neglect companies that adopt Open Source business models. This paper contributes to the literature by providing empirical evidence on the incentives of the firms that engage in OS activities. Findings on firms' motivations are compared with the results of the surveys on individual programmers aiming at analyzing the role played by different classes of incentives (social, economic and technological)

in determining the involvement in the movement of different typologies of agents (individual vs. organizations).

Bonaccorsi, Andrea, Silvia Giannangeli, and Cristina Rossi, “Entry Strategies Under Competing Strategies: Hybrid Business Models in the Open Source Industry,” *Management Science* 52, no. 7 (July 2006): 1085-1093.

The paper analyzes the strategies of software firms that have entered the open source (OS) field. The notion of the OS business model is discussed in the light of a substantial body of theoretical literature concerning strategic management and the economics of innovation, as well as specialized literature on OS. Empirical evidence based on a survey of 146 Italian software firms shows that firms have adapted to an environment dominated by incumbent standards by combining the offering of proprietary and OS software under different licensing schemes, thus choosing a hybrid business model. The paper examines the determinants of the degree of openness toward OS and discusses the stability of hybrid models in the evolution of the industry.

Chae, Bongsug (Kevin) and Roger McHaney, “Asian Trio’s Adoption of Linux-Based Open Source Development,” *Communications of the ACM* 49, no. 9 (September 2006): 95-99.

This article discusses China, Japan, and South Korea joining forces for an initiative to promote open source software and platforms that favor non-Microsoft products such as Linux. The countries have further promised to jointly develop a Linux-based open source operating system and promote open source development through active government- and private-level R&D activities and information sharing. The countries have also promised to collaborate in covering the 2008 Summer Olympics in Beijing, China.

Numerous factors involving geography, politics, economics, and security motivated CJK’s open source-based software initiative. Most importantly, the three countries are geographically close and have maintained relationships over thousands of years. The countries share Chinese characters and similar traditions, offering an ideal basis for developing regional standards for new computer software, hardware, and electronic devices. Security concerns seem to be another important driving force. Today, government services and administration rely heavily on technology. Thus, governments are concerned about information security and tend to be cautious about storing data in the proprietary formats of commercial software vendors. This concern seems to be higher in East Asian countries where e-government initiatives are picking up.

Chan, Anita. “Coding Free Software, Coding Free States: Free Software Legislation and the Politics of Code in Peru,” *Anthropological Quarterly* 77, no. 3 (Summer 2004):

In December 2001, a legislative proposal was introduced to the Peruvian Congress that would have mandated the use of free software on government computers. The introduction of the bill, dubbed the Law for the Use of Free Software in Government Agencies, or Proposition 1609, added Peru to a growing list of countries pursuing legal measures for the adoption of free software by government. Similar measures had begun in Brazil, Argentina, France, and Mexico—and within a year, they would be joined by dozens of other national- and local-level efforts in Germany, Spain, Italy, and Vietnam—all seeking to establish official alternatives to the use of

closed, proprietary software by government. But it was Peru alone that uniquely managed to capture international public attention in the work surrounding its legislative efforts.

For many free software practitioners, it was the seemingly uncontrollable momentum of their movement and the sheer technical strength of free software itself—more than any particular local actions or activities—that were to credit for its global successes. Yet a closer examination of the practices that surround the emergence of free software legislation in Peru reveals a distinctly different account. Far from presuming free software's steady advancement, the proponents of Peru's free software legislation undertook various forms of local and non-local work, advocacy, and activism to propel the visibility of their movement. Further, their practices departed from the language of technical and economic rationality that had been repeatedly invoked to explain free software's adoption. They insisted instead on a new framing of free software as necessarily engaged and invested in processes of governance and political reform. If free software had frequently expressed a confidence that it would and should spread without government's intervention, Peru's legislative developments signaled a departure from such free market logics and signaled that something other than free software's technological spread were of most concern to its advocates.

Chumney, Wade M., and Zehai Zhou, "Legal and Business Perspectives of Open Source Education Software," *Journal of American Academy of Business* 13, no. 1 (2008): 208-214.

This paper discusses the open source movement as it relates to educational platforms. It begins with examining the value of information in the American economy and reviewing the legal mechanism which primarily affords protection to information in our legal system, namely copyright law. The impact of the Internet on both information and education is studied. The culmination of stringent copyright laws and the ubiquity of the Internet are put forth as the impetus for the modern open source movement and the open education movement. The view of "education as a good" is posited as well as the impact of the Internet on education. The philosophy and impact of the open source education movement are also studied, with particular attention paid to MIT's Open Knowledge Initiative (OKI) and OpenCourseWare (OCW) Project. Some obstacles to MIT's initiatives are reviewed. Finally, the information is examined and a conclusion put forth about the efficacy and future of open source education software.

Coleman, Gabriella. "The Political Agnosticism of Free and Open Source Software and the Inadvertent Politics of Contrast." *Anthropological Quarterly* 77, no. 3 (Summer 2004): 507-519.

Free and open source software (FOSS) is one local instantiation of liberal values, a rearticulation centered on reposing the relationship between intellectual property and free speech law by redirecting the use of licenses to protect expressive activity. FOSS sensibilities of freedom and the growing hacker assertion that source code is speech, largely regimented as politically neutral through liberal values, are also rooted in methodologies, values, and techniques constituted around the act of writing code and expressed visibly in a wider public social sphere of hacking. Through FOSS' visibility, circulation, and use, the juridical understanding of free speech is shifting while some of the ingrained assumptions of intellectual property law have already been partially destabilized, the wider effect of which has been to open up a social space for new legal possibilities.

Comino, Stefano, and Fabio M. Manenti, "Government Policies Supporting Open Source Software for the Mass Market," *Review of Industrial Organization* 26, no. 2 (March 2005): 217-240.

This paper analyzes the impact on social welfare of government policies supporting open source software (OSS). Mass-market consumers can be divided between those who are informed about the existence of OSS and those who are uninformed. Since OSS producers have little incentive to advertise, there may be a substantial mass of uninformed consumers, leading to market failures that may justify government intervention. The authors study three government policies: (a) mandated adoption, whereby the government forces public agencies, schools, and universities to adopt OSS, (b) information provision, whereby the government informs the uninformed users about the existence and the characteristics of OSS, and (c) subsidy, whereby the government makes a payment to consumers if they adopt OSS. They show that mandated adoption and information provision may increase social welfare, but the subsidy always reduces it. When network externalities are added to the model, we show that mandated adoption and information provision may increase social welfare if they help the market to tip towards standardization.

Dahlander, Linus, and Maureen McKelvey, "Who Is Not Developing Open Source Software? Non-users, Users, and Developers," *Economics of Innovation and New Technology* 14, no. 7 (October 2005): 617-635.

The development of knowledge requires investment, which may be made in terms of financial resources or time. OSS has challenged much of the traditional reasoning by suggesting that individuals behave altruistically and contribute to a public good, despite the opportunity to free-ride. The lion's share of the existing literature on OSS examines communities, that is, those individuals whom are already part of the OSS community. In contrast, this paper starts from users with the requisite skill to use and develop OSS. This group of skilled individuals could potentially invest into the development of OSS knowledge, but they may or may not do so in actuality. This paper, therefore, explores three issues, which have not been extensively explored in the literature, namely, (1) how frequently a group of skilled people use OSS, (2) reasons for differences among users and non-users in terms of use and attitudes, and (3) how frequently, and why, some users contribute to OSS projects (and thereby become developers). In doing so, authors consider the opportunity costs of use and development of OSS, which has been largely neglected in the literature. Authors find that the individuals have a rather pragmatic attitude to firms and that many are active in both firms and OSS community, which raises many questions for future research about the role and influence of firms on the development and diffusion of OSS.

Duenas, Jose *et al.* "Apache and Eclipse: Comparing Open Source Project Incubators," *IEEE Software* 24, no. 6 (November/December 2007): 90-99.

Open source development is often regarded as a chaotic environment where new initiatives' success or failure just happens by chance. However, successful open source communities are applying incubation processes for managing the risks associated with creating new projects. This article analyzes the qualitative and quantitative aspects of the incubation process, focusing on the

Apache and Eclipse communities. After performing a quantitative and qualitative comparative analysis of these communities, the authors identified aspects that affect the incubation period's duration and community size. The similarities led them to propose a two-stage model for the incubation process, which might facilitate its applicability to other open source or industrial organizations.

Ebert, Christof, "Open Source Drives Innovation," *IEEE Software* 27, no. 3 (May/June 2007): 105-109.

Engineers using free and open source software created many of today's most innovative products and solutions. FOSS also changed the way we develop software. IEEE Software's Open Source column first appeared in this magazine in July 2004. In this last column, the editor revisits what we've learned over the past three years as 17 articles from 11 different authors (and companies) examined a dedicated FOSS component, tool, or product and reported lessons learned in selecting, implementing, and maintaining it.

Forge, Simon, "The Rain Forest and the Rock Garden: The Economic Impacts of Open Source Software," *Info: The Journal of Policy, Regulation and Strategy for Telecommunications, Information, and Media* 8, no. 3 (2006): 12-31.

The software industry is rapidly being reformed by the collective development of open, common software - open source software (OSS) - sometimes being free at no charge, but always with the source code revealed for changing, testing and improvement. The purpose here is to examine the role and power of software in the economy and review the economic impacts of the trend to OSS on the software industry, largely from a European industrial and social perspective. The paper briefly traces the economic significance of the software industry and the dominance in packaged software of the large US publishers, the phenomena of natural monopolies building in software packages, and the need for different industry structure for Europe, as it exhibits a small to medium-sized enterprise (SME) and system integrator structure. It then examines the balancing affects of OSS. The paper also addresses the role that poor software plays in creating new costs or externalities for its users when it fails, contrasting the robustness of open source in defect repair. The paper finds that the way forward in economic terms for Europe may well be to follow and encourage OSS for reasons of creating a strong software industry and for a counterbalance to current monopolistic trends. The paper's findings emphasise the need for investment, education and encouragement in OSS, by both the public and private sectors, to build a strong knowledge-based society in Europe. The paper introduces the ideas of the basic economic mechanisms of volume sales of software as a good, with analysis of the industry impacts of confluence of the network effect coupled with the law of increasing returns with volume to drive monopolistic positions in the proprietary software package industry.

Gallaway, Terrel, and Douglas Kinnear, "Open Source Software, The Wrongs of Copyright, and the Rise of Technology," *Journal of Economic Issues*, 38, no. 2 (June 2004): 467-74.

As digitized information becomes an increasingly large part of the economy, new realities are challenging the very nature of our past-binding, coal-and-steel era conceptions of scarcity, property, consumption, and production and of profit as the unchallenged engine of the economy.

Institutionalists have a hundred-year history of skeptical scrutiny of these very same notions. At the same time, institutionalists understand that in any age there is no greater obstacle to a clear analysis of contemporary challenges than a culture's own habits of thought. It seems clear that in the area of copyrights (at the very least) Congress and the Supreme Court are headed in exactly the wrong direction. It is also clear that much of this can be explained by their clinging to a mythical ideal of an industrial economy rife with competition but devoid of power and strategic behavior. If the full promise of the digital revolution is to be realized, institutionalists must do their part in speaking out against the ceremonial adherence to old-economy ideals and outdated institutions.

Gaudeul, Alex. "Do Open Source Developers Respond to Competition? The (L)A)TEX Case Study," *Review of Network Economics* 6, no. 2 (June 2007): 239-263.

This paper traces the history of TEX, the open source typesetting program. TEX was an early and very successful open source project that imposed its standards in a particularly competitive environment and inspired many advances in the typesetting industry. Developed over three decades, TEX came into competition with a variety of open source and proprietary alternatives. I argue from this case study that open source developers derive direct and indirect network externalities from the use of their software by others and must therefore consider non-developers' needs to make their software more attractive to a broader audience and more competitive with proprietary alternatives. While OS developers improve open source software (OSS) for their own purposes, in order to better fulfill their needs, they also derive benefits from the use of their software by others (network externalities). This encourages them to broaden the software's user base by providing features that may be of no direct use to themselves or that may be low on their own priority lists.

Gehring, Robert, "The Institutionalization of Open Source," *Poiesis & Praxis* 4, no. 1 (March 2006): 54-73.

Using concepts of neoinstitutional economics, such as transaction cost economics, institutional economics, property rights theory, and information economics, the development of the Open Source movement is investigated. Following the evolution of institutions in Open Source, it is discussed what the comparative institutional advantages of this model are. The conclusion is that it is the institutional framework of Open Source, not merely the low cost of Open Source software that makes it an attractive alternative mode of organizing the production and distribution of software and software-related services. Alternative organizations will be formed and existing organizations will be transformed to take advantage of its opportunities.

Gosain, Sanjay, "Looking Through a Window on Open Source Culture: Lessons for Community Infrastructure Design," *Systemes d'Information et Management* 8, no. 1 (2003): 11-42.

Slashdot is a major virtual meeting ground for the Open Source development community. The discourse at Slashdot is interpreted in this study, and in combination with primary interviews and secondary archival analysis, yields rich insights about the signifying practices, contradictions, norms, incentive structures and values systems that characterize the community that it supports. The characteristics of the site such as the emphasis on collaboration to manage information, its distinctive interpolation, the reputation-maintenance mechanisms, use of Open Source tools, and adoption of norms such as "release early, release often" reflect the broader Open Source ideals. Using an ethnomethodology perspective, this study provides clear examples to recover what reflective members 'know' from their practical mastery in everyday affairs of the community. We find that the site taps into the emergent social construction of the community and effectively mediates that construction.

Gruen, Nicholas, "Geeks Bearing Gifts: Open Source Software and Its Enemies," *Policy* 21, no. 2 (Winter 2005): 39-44.

This article presents information on the economic aspects of open source software (OSS). OSS is the brainchild of MIT programmer Richard M. Stallman who saw the academic culture of sharing and peer review from whence he came as a powerful solution to these dilemmas. This "viral" quality distinguishes OSS as a new economic form. OSS has been an inspiration behind a growing enthusiasm for "sharing as a modality of economic production often assisted by the internet." As production becomes more knowledge intensive and the division of labor more complex both within and between firms, hierarchical production systems of command and control are increasingly disadvantaged. Feedback between users and producers at each stage of production becomes increasingly important.

Hawkins, Richard E. "The Economics of Open Source for a Competitive Firm: Why Give It Away for Free?" *Netnomics: Economic Research and Electronic Networking* 6, no. 2 (August 2004): 103-117.

Large quantities of software, ranging from operating systems to web servers to games, are now available as "open source software" or "free software". In many cases, this software is backed by large profit seeking corporations such as IBM. Traditional economic analysis is used to identify the costs and benefits to firms of using open source rather than proprietary solutions, particularly in the case of the firm releasing code to the world when not obliged to do so. Examples of large companies backing open source are examined in light of the profit motive. Additionally, open source is also analyzed as a quasi-public good.

Krishnamurthy, Sandeep, "On the Intrinsic and Extrinsic Motivation of Free/Libre/Open Source (FLOSS) Developers," *Knowledge, Technology & Policy* 18, no. 4 (Winter 2006): 17-39.

Motivation in the context of open source software may be seen as fundamentally different due to the presence of unpaid programmers, implicit rather than explicit forms of control and a different methodology for software development. Since software development is a creative task, the motivation of open source programmers can be compared to individuals in creative industries (Caves 2002). This paper summarizes the important trends in the research on motivation in open source and identifies variables that should be included in future research. Specifically, the

current literature favors a taxonomy that considers two components of motivation—intrinsic (e.g., fun, flow, learning, community) and extrinsic (e.g., financial rewards, improving future job prospects, signaling quality). Author makes a case for incorporating both elements in developing an integrative theory about developer motivation. Three elements are identified as being unique to FLOSS development- diversity of project structures, co-existence of companies and communities and co-existence of creative and commercial elements. The important empirical evidence on FLOSS developer motivation is presented and analyzed. Four factors are identified as important mitigating and moderating factors in the conversation surrounding developer motivation- financial incentives, nature of task, group size and group structure. The role of these factors on developer motivation is discussed.

Lee, Jyh-An, “Government Policy toward Open Source Software: The Puzzles of Neutrality and Competition,” *Knowledge, Technology & Policy* 18, no. 4 (Winter 2006): 113-141.

For a variety of policy reasons, governments throughout the world are now adopting different legislative and administrative strategies that support the development of FLOSS. Some governments have actually begun to procure FLOSS, whereas others have channeled public funds to large-scale FLOSS projects. This study demonstrates both the benefits and the risks of government policy favoring FLOSS from the perspective of economics, technology, and politics, and to further analyze whether these same policy goals can be achieved through government support of FLOSS. The most fundamental argument of the study is that, in lending its support to FLOSS, the difference between a government user and a business user is that the government should take into account society's long-term interests, not merely its own interests as a consumer.

Lerner, Josh, and Jean Tirole, “The Scope of Open Source Licensing,” *Journal of Law Economics & Organization* 21, no. 1 (April 2005): 20-56

This article is an initial exploration of the determinants of open source license choice. It first highlights how the decision is shaped not just by the preferences of the licensor itself, but also by that of the community of developers. The article then presents an empirical analysis of the determinants of license choice using the SourceForge database, a compilation of nearly 40,000 open source projects. Projects geared toward end-users tend to have restrictive licenses, while those oriented toward developers are less likely to do so. Projects that are designed to run on commercial operating systems and whose primary language is English are less likely to have restrictive licenses. Projects that are likely to be attractive to consumers--such as games--and software developed in a corporate setting are more likely to have restrictive licenses. Projects with unrestricted licenses attract more contributors. These findings are broadly consistent with theoretical predictions.

Lerner, Josh, and Jean Tirole, “The Economics of Technology Sharing: Open Source and Beyond,” *Journal of Economic Perspectives* 19, no. 2 (Spring 2005): 99-120.

This paper reviews the authors' understanding of the growing open source movement. They highlight how many aspects of open source software appear initially puzzling to an economist. The authors' ability answer confidently many of the issues raised here questions is likely to increase as the open source movement itself grows and evolves. At the same time, they observe

how much of open source activities can be understood within existing economic frameworks, despite the presence of claims to the contrary. The labor and industrial organization literatures provide lenses through which the structure of open source projects, the role of contributors, and the movement's ongoing evolution can be viewed.

Lin, Yuwei, "Hybrid Innovation: The Dynamics of Collaboration between the FLOSS Community and Corporations," *Knowledge, Technology & Policy* 18, no. 4 (Winter 2006): 86-100.

Unlike innovation based on a strong professional culture involving close collaboration between professionals in academia and/or corporations, the current Free/ Libre Open Source Software (FLOSS) development entails a global knowledge network, which consists of 1) a heterogeneous community of individuals and organizations who do not necessarily have professional backgrounds in computer science but have developed the competency to understand programming and working in a public domain; 2) corporations. This paper describes the operation of the hybrid form of developing and implementing software, and also identifies several key factors shaping the collaboration between FLOSS firms and the community.

May, Christopher, "Escaping the TRIPs' Trap: The Political Economy of Free and Open Source Software in Africa," *Political Studies* 54, no. 1 (March 2006): 123-146.

Across sub-Saharan Africa, the promise of 'informational development' is proclaimed. The global governance of intellectual property rights (IPRs), however, currently structured through the Trade-Related Aspects of Intellectual Property Rights (TRIPs) agreement and overseen by the World Trade Organisation (WTO), makes much software expensive to deploy. There is an alternative: open-source and/or free software ameliorates many of the cost problems countries in Africa have anticipated as they have changed their laws to protect IPRs; using non-proprietary software will enable them to deploy extensive computerization without making large payments to suppliers from the developed countries. By escaping the TRIPs' trap, many Africans will be better able to enjoy the potential benefits of 'informational development'.

McGhee, Douglas, "Free and Open Source Licenses: Benefits, Risks, and Steps toward Ensuring Compliance," *Intellectual Property & Technology Law Journal* 19, no. 11 (November 2007): 5-10.

McGhee discusses the rise of free and open source software (FOSS) as an alternative to traditional commercial software products and how this new software brings a host of unique legal issues that must be evaluated before any gains may be realized. Mr. McGhee reviews the case law and explains when companies should be aware of the particular situations that emphasize FOSS licensing compliance. The author concludes that free and open source software can be either a tremendous boon to companies that use it intentionally or a potential logistic, economic, and legal nightmare for those that do not. In any event, he believes that FOSS compliance should no longer be ignored.

McGowan, Matthew K., Paul Stephens, and Dexter Gruber, "An Exploration of the Ideologies of Software Intellectual Property: The Impact on Ethical Decision Making," *Journal of Business Ethics* 73, no. 4 (July 2007): 409-424.

This article helps to clarify and articulate the ideological, legal, and ethical attitudes regarding software as intellectual property (IP). Computer software can be viewed as IP from both ethical and legal perspectives. The size and growth of the software industry suggest that large profits are possible through the development and sale of software. The rapid growth of the open source movement, fueled by the development of the Linux operating system, suggests another model is possible. The large number of unauthorized copies of software programs suggests that many people do not believe in laws regarding software copyright. There are many and varied views of software as IP, even within the information systems (IS) profession. In this article, four distinct subgroups of IS professionals are identified. The article describes the four subgroups and their respective ideological views on software ownership; it explores the subgroups' attitudes regarding software laws; and finally, it explains the ethical positions embraced by each subgroup.

Michler, Carla, "The Procurement Decision – 'Open' or 'Closed' Source Software?" *Deakin Law Review* 10, no. 1 (2005): 261-269.

The merits of open source software, particularly in the context of Australian Government procurement, have been the subject of considerable debate in recent times. This paper provides an overview of the distinguishing features of open source software and considers the terms of the license under which open source software is distributed. Consideration is also given to the merits of open source software through an examination of both the legal and technical risks associated with the product. In concluding, it is determined that there is a positive argument for mandating open source software as a viable alternative to its closed source counterpart.

Miralles, Francesc, Sandra Sieber, and Josep Valor, "An Exploratory Framework for Assessing Open Source Software Adoption," *Systemes d'Information et Management* 11, no. 1 (March 2006): 85-105.

In this paper we propose that due to the particularities of the Open Source Software (OSS) development process and its perceived "social" connotations, traditional ways of explaining IT adoption are insufficient to understand the case of OSS diffusion. Evidence shows that OSS fails in many cases to displace dominant market leaders even in the case of user's unhappiness with the prevalent solution, while in some others OSS is adopted without a clear advantage. Using a qualitative research approach, we highlight the existence of a new context, in which the adoption of Linux-based OSS platforms by companies is not led only by traditional drivers. User communities and broader social responsibility considerations have been found to exert some degrees of pressure on the IT decision maker. Through the analysis of some significant cases we propose a framework that helps to depict under which conditions significant OSS adoption may unfold.

Samuelson, Paula, "IBM's Pragmatic Embrace of Open Source," *Communications of the ACM* 49, no. 10 (October 2006): 21-25.

The article discusses IBM Corp.'s adoption of an open source software model. Though IBM began as a strong advocate of intellectual property rights for computer programs, the company has embraced open source software under the General Public License in the 2000s. The company is showing its dedication to the open source movement by contributing \$100 million a year to the development of Linux and other open source projects, as well as donating some of its proprietary software to strengthen Linux's ability to provide enterprise-level capabilities.

Samuelson argues that IBM's embrace of open source may be understood in three ways: 1) an anti-Microsoft strategy; 2) consequence of changed business models in the software industry; and 3) manifestation of an open innovation strategy for promoting faster and more robust technical advances.

Seiferth, C. Justin, "Open Source and These United States," *Knowledge, Technology & Policy* 12, no. 3 (Fall 1999): 50-79.

Focuses on the development of open licensing in the United States. Role of open source licensing in releasing source codes; Use of open content licensing to release the associated electronic information; Adoption of open licensed systems by the Department of Defense. (GOOD PLACE TO START)

Simon, K. D. "The Value of Open Standards and Open-Source Software in Government Environments," *IBM Systems Journal* 44, no. 2 (2005): 227-238.

Among the most noteworthy topics surrounding the recent widespread adoption of open-source software (OSS) are the convergence by governments worldwide to open standards and the ways in which open source embraces this convergence. There are continuing debates over the future of software and, in particular, the competition between OSS and proprietary software. Many studies by governments and by information technology analysts suggest that OSS and open standards are intimately connected and that the inherent value of open-source adoption may be attributable in large part to the embodiment of open standards in OSS. The government environment is changing rapidly in areas as diverse as homeland security and social services. Given the equally rapid changes in the information technology marketplace, the successful adoption of these new technologies by governments will depend on how well the strengths of proprietary software and OSS are understood and applied--especially with respect to the use of open standards to speed deployments of integrated capabilities that respond to emerging challenges. This paper evaluates the relative strengths of proprietary software and OSS as development techniques that embrace the open standards valued by governments.

Vaisman, Daria, "Coding a Revolution," *Foreign Policy* 159 (March/April 2007): 93.

Three years ago, Iran decided to run its government computer system on open-source software. The Islamic Republic had long relied on pirated copies of Microsoft's software, a result of the U.S. embargo that forbids American companies from providing technical support to Iran. Officials in Tehran said the switch would free them from another form of U.S. hegemony. But

they probably never guessed it would also give Iran one of the most advanced corps of female coders anywhere in the world. A recent European Union survey found that only 1.5 percent of European open-source coders are female. Not so in Iran, where, by some estimates, half of all software engineers coming out of the country's universities are women. Of the three coders who developed Iran's first official open-source project, two were women. What's behind the rise of women in Iran's open source movement? With the restrictions put on women in the Middle East, technology is an attractive option for those who want a career. Technological work, and coding in particular, can be done from home, allowing ambitious women to become well-known within their industry without becoming taboo in their communities. Similar patterns are now emerging elsewhere in the Middle East. In Syria, which is also under a U.S. embargo, women are estimated to make up at least 50 percent of the coding workforce.

Van Rooij, Shahron. "Perceptions of Open Source Versus Commercial Software: Is Higher Education Still on the Fence?" *Journal of Research of Technology in Education* 39, no. 4 (Summer 2007): 433-453.

Exploratory study investigated the perceptions of technology and academic decision-makers about open source benefits and risks versus commercial software applications. The study also explored reactions to a concept for outsourcing campus-wide deployment and maintenance of open source. Data collected from telephone interviews were analyzed, emergent themes identified, and a model of differentiators of open source versus commercial software was created, which was then used to evaluate reactions to the outsourcing concept. Interviews revealed perceived barriers to open source adoption and the extent to which the outsourcing concept could alleviate risks. Recommendations for overcoming adoption barriers are offered and future research opportunities identified to ensure that open source software applications are both technically efficient and supportive of engaged learning.

Van Wendel de Joode, Ruben, Yuwei Lin, and Shay David, "Rethinking Free, Libre, and Open Source Software," *Knowledge, Technology & Policy* 18, no. 4 (Winter 2006): 5-16.

This special issue includes seven articles that make significant contribution to the literature pertaining to knowledge and public policy around Free, Libre and Open Source Software (FLOSS). Focusing on questions in two themes (i) motivation and organization and (ii) public policy, the articles in this volume develop new analytic models and report on new empirical findings, as an important step in bridging the wide gap that exists in public policy literature around FLOSS. Warning against rhetorical pitfalls that have been prevalent in FLOSS research, this introduction starts with a short history of FLOSS development, continues with a brief thematic literature review and review of the misconceptions surrounding FLOSS, and concludes with a first introduction of the articles that follow.

Waters, John, "Opening a New Door," *T H E Journal* 34, no. 8 (August 2007): 30-35.

The article explores the benefits derived by U.S. schools from open source software. A growing number of K-12 districts are converting to open source software, both to cope with tight budgets and to escape proprietary vendor lock-in and expensive upgrade cycles. According to Steve Hargadon, founder of K12 Computers and project leader of the K-12 Open Technologies

Leadership Initiative, the accelerating adoption rate is also being fueled, at least in part, by the arrival of a growing list of solid open source desktop applications for K-12 education. Although cost concerns are moving an increasing number of schools to consider open technologies, the force that may ultimately push K-12 to a tipping point in its slowly evolving relationship with open source software is peer pressure.

West, Joel, and Jason Dedrick, "Open Source Standardization: The Rise of Linux in the Network Era," *Knowledge, Technology & Policy* 14, no. 2 (Summer 2001): 88-112.

To attract complementary assets, firms that sponsor proprietary de facto compatibility standards must trade off control of the standard against the imperative for adoption. For example, Microsoft and Intel in turn gained pervasive adoption of their technologies by appropriating only a single layer of the standards architecture and encouraging competition in other layers. In reaction to such proprietary strategies, the open source movement relinquished control to maximize adoption. To illustrate this, authors examine the rise of the Linux operating system from 1995-2001, particularly the motivations of organizational buyers and suppliers of complementary assets, and Microsoft's reaction to its success.

West, Joel and Jason Dedrick, "Scope and Timing of Deployment: Moderators of Organizational Adoption of the Linux Server Platform," *International Journal of IT Standards and Standardization Research* 4, no. 2 (July-December 2006): 1-21.

Authors present a qualitative study of how organizations do (or do not) adopt a new computer server platform standard; namely, Linux using PC-compatible hardware. While discussions of Linux typically focus on its open source origins, our respondents were interested primarily in low price. Despite this relative advantage in price, incumbent standards enjoyed other advantages identified by prior theory; namely, network effects and switching costs. Authors show when, how, and why such incumbent advantages are overcome by a new standard. They find that Linux adoption within organizations began for uses with a comparatively limited scope of deployment, thus minimizing network effect and switching costs disadvantages. Authors identify four attributes of information systems that potentially limit the scope of deployment: few links of the system to organizational processes, special-purpose computer systems, new uses, and replacement of obsolete systems. Authors also identify an organizational level variable-internal standardization-which increases scope of deployment and, thus, the attractiveness of the incumbent standard.

Xiaobai, Shen, "Developing Country Perspectives of Software: Intellectual Property and Open Source—A Case Study of Microsoft and Linux in China," *International Journal of IT Standards & Standardization Research* 3, no. 1 (January-June 2005): 21-43.

This paper looks at implications of the emerging global Intellectual Property (IP) regime for Developing Countries (DC) and their attempts to improve their technological capabilities. It further highlights the new perspectives for DCs opened by the emergence of non-proprietary (open source/free) software, such as Linux. A case study of the battle between Microsoft and Linux in China is used to explore the dilemmas faced by China in determining what IP regime (strict or weak) to adopt, and the threats and opportunities that either may pose for indigenous

technology development. Based on the case analysis, the paper criticizes the simplistic polarized views that have been presented of the implications of the global IP regime and of the potential of non-proprietary software. It explores some of the complex considerations about the interplay between technology strategy and IP protection for China and discusses the policy implications for China and other DCs.