A Brief Review of Studies on Open Source Software in Developing Countries in Peer-Reviewed Journals

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Abstract
There has been much attention given to the promising benefits of open source software (OSS) for the development of the domestic software industries of developing countries. **This study attempts to build a base for scholarly research on the subject of OSS in developing countries by reviewing the work that has been published in peer-reviewed academic journals**. Major sub-streams of research include applications of OSS in developing countries, and the analysis and recommendations of government policies. This review also details the geographical regions covered by the scholarly research, extensions of the open source model to applications of open content, and theoretical approaches that have been adopted in the scholarly literature.

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1. Introduction
The emergence of open source software (OSS) has radically changed the technological landscape of the computing industry, affecting the strategic dynamics involved in various commercial enterprises, including proprietary software developers, hardware manufacturers, and makers of network products alike.

OSS can be defined as "software that is made freely available to all" [1], and that is developed and maintained by numerous contributors who are scattered around the world, but who interact through

a virtual community on the Internet. The majority of these public-good producers contribute freely to the provision of the project in return for only intangible rewards. However, it is important to note that "freedom" has a particular meaning in open source contexts: "Free [open source] software is a matter of the users' freedom to run, copy, distribute, study, change and improve the software" [2]. This is quite distinct from freeware, which is software provided at no price. In contrast, open source software licenses often permit sale of the products at any price, with the caveat that the buyer be informed of their right to full access to the source code at no charge.

It has normally been believed that high management control is necessary to ensure the quality of a software or information product project [3]. However, through flagship products such as the Linux operating system, the Apache Web server, and the Firefox Web browser, the open source model has demonstrated convincingly that the apparently anarchistic process of open source development can yield products of high quality [4]. This is partially explained by the famous quote attributed to Linus Torvalds (of Linux fame), "Given enough eyeballs, all bugs are shallow". That is, with thousands of contributors, any buggy or inefficient code is fixed, and only the best quality code is left, and is continuously improved upon.

Although OSS has arisen in developed nations, as have virtually all information technologies, there has been much attention given to its promising benefits for the development of the domestic software industries of developing countries. A number of reports have been commissioned by governmental and non-governmental agencies on the general subject of information and communication technology (ICT) for development; many of these mention the role of open source software. By far the most comprehensive of these has been Weerawarana and Weeratunga's [5] report for the Swedish International Development Cooperation Agency (Sida). Another important report was conducted by Bannerman [6] for the International Development Research Centre, which broadly presented how intellectual property issues relate to the use of OSS for development in developing countries. Key advantages of OSS that she highlighted are that it facilitates the localization of software; builds domestic knowledge and skills; assures governments of security concerns with foreign software, and independence from foreign control; and can lead to considerable cost savings. However, she detailed various issues and problems, including lack of user-friendliness in most OSS; the insufficient incentives for innovation; and the hazards of international software patents. Specifically focusing on Brazil, Stefunato and Salles-Filho's [7] thorough survey and review on the OSS industry in Brazil is an invaluable source that reported on the state, as of 2005, of OSS usage and local development.

Most of these reports and recommendations have been mostly descriptive, and lack thoroughly researched theoretical bases. However, **more recently, the use and development of OSS in developing countries has begun to attract the attention of scholars who have attempted to more rigorously study this phenomenon from many different angles. This study attempts to build a base for scholarly research on the subject of OSS in developing countries by reviewing most of the important scholarly work that has been done thus far. Because the focus here is on high-quality scholarly work, the studies reviewed here are mainly limited to those that have been published in peer-reviewed journals.** Thus, work that has been published in conference proceedings is not included, nor has other work that has not passed through scholarly peer review, with a few notable exceptions.

This review begins with studies on applications of OSS in developing countries, involving Linux, digital libraries and education, and geographical information systems. Next, it covers the bulk of work in this area, involving the analysis and recommendations of government policies concerning OSS in developing countries and regions. It follows by listing the geographical regions that have

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been covered in the current scholarly journal literature. Next, it discusses extensions of the open source model in developing country to applications of open content. Finally, before the conclusion, it highlights the few theoretical approaches that have been adopted in the scholarly study of OSS in developing countries.

3.2. Brazil

In a massive treatment of over 300 pages, Kogan [22] argued that the Brazil's recent promotion of what they call an "open source" or "universal access" intellectual property regime is ill-founded. He strongly argued the need for intellectual property rights to maintain and nurture an economy based on innovation, contrary to what he called the socialist views of those campaigning to nullify or greatly reduce intellectual property rights in Brazil or other countries. He argued that such moves would greatly hamper the development of Brazil's local and international competitiveness. In fact, the open source philosophy is firmly based on a regime of strong intellectual property rights— the legal basis for all open source licenses is standard copyright, without which such licenses would have no legal force; this is particularly the case with licenses such as the GNU General Public License that have a "copyleft" provision that requires those who modify open source code to share their modifications with others. Without strong copyright laws, any company could take incorporate open source code into their own proprietary software without returning anything to the community, hence mooching of the efforts of others. Thus, far from promoting open source, the position of the Brazilian government as Kogan has presented is inimical to the very concept.
(pp. 3-4)

…Only two peer-reviewed journal articles have thus far been published concerning OSS in Latin America, both focusing on Brazil, though there have been several very thorough reports on this country's thriving OSS industry, and on its government's strong support for OSS: Câmara and Fonseca [18] and Kogan [22].
(p. 4)

[22] Lawrence A. Kogan, "Rediscovering the Value of Intellectual Property Rights: How Brazil's Recognition and Protection of Foreign IPRs Can Stimulate Domestic Innovation and Generate Economic Growth," *International Journal of Economic Development*, vol. 8, 2006, pp. 17-307.
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