Software Technology and Social Development Policy:
Scenarios for Preventing Software Dependency and Encouraging Ingenuity[1]

[Draft 1.0]

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Abstract

I explore the relationship between software development policy and social development goals in countries where the immediate challenge is to improve the quality of life by meeting the most basic human needs. The choices we make today about how to structure technology policy will have important consequences for social development around the world. To inform choices and imagine consequences, I do three things in this article. First, I identify the two most important goals for any national software policy—avoiding software dependency and encouraging local technical ingenuity—and discuss the difference between the costs of acquisition and the costs of ownership. Second, I describe the different meanings of open source software. Third, I review developing world examples of the synergies between software technology policy and social development policy. Finally, I select a set of 'best of breed' practices that are most likely to create synergy between telecommunications and social development policy.

Liberation Technology Theology

Four-fifths of the world's population lives in developing countries, where many key political, economic and cultural institutions are not strong enough to help people meet their basic health and educational needs. There seems to be three kinds of arguments about why information communication technologies (ICTs) are important for these societies. Depending your perspective as a stakeholder, by improving infrastructure and clarifying telecommunications policy poor countries will improve the climate for discussion within civil society, create the right environment for an indigenous ICT industry, and improve the organizational reach and efficiency of government bureaucracies and international aid agencies.

Knowledge and information exchange is an increasingly important competitive factor for developing economies, so the donor community has conceived ICT as an engine for economic growth and social development. Despite the impressive penetration of internet and ICT-enabled services in past decade and the optimistic discourse to bridge the digital divide between the have and have nots most of the developing world remains in the

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second category. For example, in Latin America there are 15 million internet users, or 3% of the region's population, with most of those users living in Argentina, Brazil, and Mexico (Brod, 2003). In Africa, there are only 4 million internet users, mostly concentrated in metropolitan areas. The information infrastructures in developing and transition economies are about one-seventh the size of the average infrastructure of OECD member countries (Wellenius, Braga, & Qiang, 2000) However, these numbers are often seen as market potential – the rates of growth in the internet-using population are higher than in the developed world, such that Latin America will probably have more than 60 million users by the end of 2004.

Recognizing this potential, governments in many developing countries are enunciating an ICT strategy through policy instructions about the incubation, acquisition, and implementation of software systems. Governments in the developing world face the double challenge of designing public initiatives that bridge the digital divide within countries while at the same time addressing the competing challenges on the development agenda, such as poverty, environmental degradation, and social inequality. However, software is also the enabling technology for a host of important social programs, like distance learning, telemedicine, and financial transactions.

To help build these enabling technologies, some governments have created policy regimes that direct the ingenuity of the high-tech economy into solving social problems. There is little doubt that ICT has helped improve the logistical capacity and service delivery of aid agencies, from peacekeeping, disaster planning, and election observing, to human rights monitoring, food and health aid, and tracking environmental degradation. The counter argument is that the open market is really the best institution for communicating demands, and that such ingenuity will be channeled at social problems when the pricing point is right. Is any policy regime really needed, or will market institutions make sure that infrastructural needs are met by talented providers, at whatever price the market will tolerate? Alternatively, is government intervention required, to make sure that talented providers are given clear priorities and prices are subsidized?

One of the most contested areas regarding the open source software in developed and developing countries alike is the role that the government should play in promoting, either directly or indirectly, the adoption of open source software. Many governments in Africa, Asia, and Latin America are designing strategies to ensure the exploitation of the benefits of open source software, hoping to increase bureaucratic efficiency, to save foreign currency, and to stimulate local entrepreneurs with talent in technology development (GITOC, 2003).

Avoiding Software Dependency and Encouraging Local Ingenuity. A strategy for linking software choices with social development should have two overarching goals: policy-makers should avoid creating software dependency, and should do their best to foster the technical ingenuity of its own programmers and entrepreneurs. Dependency has come to mean several things in the context of developing economies, but it is also relevant in the context of open and proprietary software management. Software dependency

occurs when a government agency has become so invested in its software applications that sudden changes in market prices or software developments radically alter the total cost of ownership without allowing the agency reasonable alternatives.

Software dependency has already taken several forms in developing countries. Companies that donate software eventually decline to support the deployed software, forcing the recipient agency either to pay for the upgrade or hope for another donation. Many proprietary software systems require a fast computer with sufficient memory and hard drive space, which means that software choices may depend on equipment upgrades. Most proprietary software companies will not price their wares to compete with open source software, so government agencies must budget for upgrades and license renewals. As recently argued in Scientific American: "If the current stylistic distinctions between open-source and commercial software persist, an open software revolution could lead to yet another divide between haves and have-nots: those with the skills and connections to make use of free software, and those who must pay high prices for increasingly dated commercial offerings."

The other important policy challenge is to foster a local ICT industry capable of providing support for the software and hardware investments of government. These local entrepreneurs and consultants are needed whether the government invests in proprietary or open software. Since different countries seem to have different capacities to manage their software acquisitions. The commitment of senior bureaucrats, documentation about pervious software and hardware strategies, and the existence of a local community of coders and ICT experts affect a government agency's capacity to handle its software acquisitions well (Higgo, 2003; Tessler, Barr, & Hanna, 2003).

I argue that open source software is of most use at the confluence of both telecommunications *and* social development policy. The underlying motivation for those working in the open source movement is independence from foreign software companies, diminished software costs, and strong local ICT industries. With these objectives in mind, policy-makers need to assess both proprietary and open source software options, based on performance and long-term costs.

Acquisition Costs and Ownership Costs. Policy-makers in developing countries often have trouble calculating the total cost of ownership for a software system because they assume that the total cost of acquisition provides sufficient information about the impact of their decisions. Total cost of ownership calculations are a key component of any capital investment since it involves future cost and cash flows associated with the initial purchase.[2] Today, the single most important consideration is not to confuse the cost of licensing, sometimes called the total cost of acquisition, with the more holistic, long-term perspective of estimating the total cost of owning software. For policy-makers, the total cost of ownership should include:

[2] The official total cost of ownership model for distributed computing (non-centralized computing) was designed by Gartner and it is not optimized for open source software. Variability in open source software is so great that ownership calculations are especially difficult.

- The risks and benefits of software dependency
    - Risks of migrating to new platforms and applications
    - Software support and training
    - Market accountability
    - Patents and product lifecycle for new releases and upgrades
    - Testing for compatibility with other software and organizational habits
- The risks and benefits of a local source of technical ingenuity
    - Subsidies through preferential contracts
    - Sufficient training for ICT support and problem solving

Whether policy-makers are considering proprietary or open source software, it is crucial to conduct an analysis of the total cost of ownership, not just the total cost of acquiring the software. The government agencies of some developing countries have found that the total cost of ownership for an open software system can be 15 times less than that of a proprietary software solution. In many countries the total cost of ownership calculations will bring into sharp relief "the long known problem of human resources and learning: retraining users and ICT skilled people, which can increase in the long run, the costs of migrating to OSS" (Rajani, 2003). The total cost of ownership can be reduced by carefully selecting local vendors to supply the support and the 'best of breed' software, whether the license is open or proprietary.

Different Kinds of Openness

Open source software (OSS) refers to "access to the source code, written in a programming language, that constitutes a working software program. With open source software, users and others can read the code and change it to suit their needs" (Hahn, 2002)(p. 1). The OSS movement took form in the mid-eighties when Robert Stallman designed GNU, a compatible UNIX software that had the source code open for people to distribute and modify. However, the open source movement really took form after Linus Torvalds posted the first version of Linux on a website (Evans, 2002). The exponential growth of the internet in the mid-nineties further increased the possibilities for the open source movement to become a global phenomenon.

There are different kinds of openness when it comes to open source software, though all have "impacted the way in which information and communication technologies are conceptualized, used and developed" (Rajani, 2003)(p. 1). The phrase has come to mean voluntary cooperation, copyleft, equality, technological independence, and accessible price points.[3] It is important, at this point, to define what the word "free" means in the

[3] "The concept of copyleft is to put a program into the public domain and choose not to enforce any copyright on the program. Copyleft is a type of intellectual property protection. Those who use and distribute a software program that is protected by copyleft have the right to use, modify and redistribute the code and must give others that same right upon redistribution. The software is copyrighted, and then users must agree to the terms of a copyright license if they wish to use or

context of the OSS movement. "Free software is a matter of the users' freedom to run, copy, distribute, study, change and improve the software irrespective of the price aspect" (Stallman, 2003) . The use of the word free is problematic since it does not translate well in many languages. For example, in Spanish free is often translated as *gratis*, which entails that the costs of production are not passed on to the person obtaining the good – the price is zero.

Proprietary software is copyrighted under an end-user license agreement and prohibits any kind of distribution and modification. Consequently, open source software leverages the rhetoric of freedom to bring together coders to contribute to the program, release the improvements, and redistribute copies openly. Whoever participates in the coding carnival needs to comply with a *general public license* that explicitly grants the abovementioned freedoms and ensures that the code of the software is not redistributed with a proprietary scheme (Rajani, 2003). Along these same lines, any software derived from a general public licensed Linux "must be distributed with an accessible copy of the source code, and the rights to use any modifications in the source code must be free to all, thereby making it very difficult to profit from using Linux code as part of proprietary software" (Hahn, 2002)(p.4).

But within the OSS movement, there are two distinct initiatives. The Free Software Foundation bases its philosophy more on the grounds of participation and freedom in exchanging and distributing the code (philosophy that is epitomized by the distribution arrangements of the general public license). In contrast, the Open Source Initiative that has taken a different stand by conceiving the benefits of OSS in terms of the "of a superior model for developing software, which is based on the availability of the source code, combined with the rights to inspect, modify and distribute to everyone" (Rajani, 2003)(p. 10). Different from the general public license agreement which guides the distribution arrangements of the Free Software Foundation, the Open Source Initiative uses the Berkeley Software Distribution license which grants the same freedoms that general public license but does not require the licensees to share their entire code. The general public license remains the most popular distribution license for open source products.

Synergy Between ICT and Social Development Policy

The type, degree, and level of optimal policy intervention in markets has always perplexed economists and policy-makers alike. It still widely believed that government intervention in the economy endangers competition, causes market failures, and lessens product quality. For the most part, governments should only intervene in the economy when market institutions appear unable to produce the socially desirable allocation of goods and services. Such interventions, often in favor of an OSS, have created synergy between ICT and social development goals in a number of countries.

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modify the software." Retrieved from: http://www.cs.utexas.edu/users/almstrum/cs370/ctao/research/copyleft.htm.

Lowering the Costs of Software. Overall, government expenditures in ICT are high, ranging from 3.4 percent of the GDP in Mexico, to 8.3 percent in Brazil, and 7.9 percent in the United States (DDG, 2002).[4] In 2000, the United States government alone spent 3.7 billion USD in software (Evans, 2002). Thus, finding an alternative that can help lower the costs for software acquisition is always desirable. The lower entry cost of OSS derives from the fact that it does not require a government agency to pay for licenses. This also means that the agency can replicate the software and share it among different levels of administration.

Encouraging an Indigenous Software Industry. Local talent can create solutions that are more responsive to local needs. OSS permits local capacity building and knowledge transfer, which can translate into human capital for the national ICT industry (Rajani, 2003). Flexible OSS allows for the creation of software in different languages, making it more accessible to wider segments of the population. For example, Translate.org.za is completing the translation of all 11 official South African languages for the Linux operating system (Coetzee, 2002). By developing a national indigenous software industry, many countries expect to reduce the dependence from foreign companies' subsidiaries and to save in foreign currency. However, experience in Ireland, Israel and India suggests that this happens as an indirect effect of investing in telecommunications infrastructure and certified educational systems, not as a direct result of tax incentives, government decree, or nicely built technology parks.

Ensuring Universal Access. Governments in many developing countries are taking concerted efforts to implement market oriented reforms, privatizing and deregulating the telecommunications sector and setting up transparent regulatory frameworks triggering the participation of the private sector in the telecom market (Schware, 2003). As an integral part of the deregulation process, government agencies require that newly privatized telecom companies expand connectivity, usually in the form of infrastructure, to rural areas. Brazil, Mexico, Chile and Peru, have created regulatory bodies to ensure that privatized companies do not limit their service to more profitable urban areas (CISL, 2003).

Building Public Information Kiosks. The savings for keeping some of the foreign reserves at home can enable the governments to promote and invest in social projects. Commonly, governments will use funds from privatizing ICT infrastructure or taxing ICT services to build public internet access points or other kinds of telecenters. These public access points provide information and communication technologies as a tool to deliver a basket of services to underserved communities.

There are several examples of national software development policies that seem to be complimenting national development goals. In South Africa, the government encourages the use of open source software as long as its agencies can meet three fundamental tests: the implementation of OSS should produce clear value, the agency should have the capacity to implement and maintain the OSS, and all the stakeholders to the agency's

[4] The percentages refer to the overall expenditure in ICT and not exclusively in software.

work must support the OSS initiative. These goals certainly sound intuitive but the South African example is noteworthy not only for enunciating these tests but also for enforcing them in a context of limited state resources.

Brazil has established a "Free Software Technical Implementation Chamber." This independent agency within an office of strategic planning has several policy goals. The conducts research into the OSS options available to other government agencies, helping those other agencies calculate the total costs of ownership, manage service priorities, and think about multi-platform applications. The agency also tries to popularize the use of free software, to expand the network of services to the citizen through free software, and to ensure to every citizen the right of access to public services without requiring them to use specific platforms.

One of Brazil's state governments recently completed an assessment of how OSS was used in its distance education project, *Rede Excolar Livre*. Sponsored by the government of Rio Grande so Sul, the project included a set of tools for distance education, web presence, computer learning, and a customized LINUX that eases the adoption and learning of free software tools by teachers and students. The study claims that the government has saved 20 million dollars and made investments in training programs and support staff (Brod, 2003). Another innovative example comes from India, where n-logue has built information kiosks that use a WiFi technology, corDECT to provide access and connectivity to remote villages. This technology was developed by the IIT in Madras (governmental institution) and it is offering through their information kiosks a wide range of e-government services, in addition to access, connectivity, and ICT Training.

Regardless of the intricacies of each distribution license, the impact of the OSS movement is already significant. According the Netcraft, roughly 60% of the internet is hosted on the Apache Web Server Platform, one of the most important open source software applications. Apache market share on web servers is two times larger that Microsoft, the "closed source" rival (Comino & Manenti, 2003). Modzilla, Red Hat, and other OSS-based software are also gaining an important, although still small, market share. There are many challenges to find reliable statistics regarding the presence of OSS-related products in the developing world. However, Coetzee calculates that about 180,000 internet hosts in Africa are running some form of OSS (Coetzee, 2002). In India, for example, local entrepreneurs developed an OSS for their low-cost computer the Simputer. Pakistan is crafting a policy initiative to encourage OSS adoption and decrease dependence on proprietary software (Noronha, 2003). Brazil and Peru have designed a national strategy mandating the use of open source software in all public agencies, including government offices, universities and hospitals.

Conclusion: 'Best of Breed' OSS Policy for the 'Liberation Technology'

Governments in many countries are considering the migration from proprietary software to open source software, hoping that this switch will lower expenses. In turn, this

software migration should make ICT more accessible for a wider segment of society and, probably most importantly, leverage the expertise of a local open source community onto local needs. Comino and Manenti distinguish three types of policy interventions: mandatory adoption, subsidization, and information campaigns (Comino & Manenti, 2003).

Mandatory Adoption Policy. These policy options usually take the form of legislation that mandates all public agencies to migrate or favor open source software solutions. In Latin America, this is the case of Brazil where OSS is being given preference over proprietary software in municipal governments of Recife, Campinas, Solonopole, Amparo, Sao Carlos, and Porto Alegre (Hahn, 2002)(p. 2). In 2002, Peru enacted a legislation to favor the adoption of OSS in all governmental offices (Hahn, 2002)(p. 5).

National Subsidization Policy. This is a similarly aggressive government intervention and refers to the use of subsidies by the government to compensate companies using OSS through subsidies or tax breaks. This is the case of Singapore which offered "tax reductions and financial grants to fund Linux-related projects" (Hahn, 2002)(p. 5). But direct subsidization seems the least effective and most risky. Governments should probably choose software based on its merits and costs rather than just favoring open source software as a matter of policy (Evans, 2002). Furthermore, Comino and Maneti argue that providing subsidies to support OSS initiatives in developing countries can decrease social welfare (Comino & Manenti, 2003). Some agencies take funds from social aid projects and offer corporate subsidies for the use or production of open source rather than proprietary software.

National Information Campaigns. This is probably the least invasive policy intervention of the three mentioned since it entails promoting campaigns to inform users (experts and non experts) about the possibilities of open source software. An information campaign must provide the knowledge to users so they can choose which platform to use. It also can help to overcome the "technological shock" for those users who can't take advantage of the fact that the code is open for them to review, but can benefit from having software available in their local language.

Neither unfettered markets nor direct government intervention seem to be the 'best of breed' strategies. I have two recommendations for policy makers. First, governments should not promote OSS through direct intervention in the form of subsides or tax breaks for companies that are migrating or using an OSS component. Singapore is taking this approach and it has being widely criticized. Some authors argue that direct intervention can create market distortions. Governments must guide their decision based on the business value that OSS and proprietary software provides. It is important that governments considered not only the initial entry cost of OSS, which definitely is lower than that of proprietary software, but also the total cost of ownership which includes the total cost of migration, training, support and updates. The decisions need to be made based on the merits of the software—including reliability, accessibility, and security—rather than on the implied savings of avoiding a license fee.

Second, governments should support research, cooperation, and dialogue to inform civil servants and citizenry the risks and benefits of an OSS. The United Nations Development Program has created an agency, the International Open Source Network where experts in many areas come together to promote a wider understanding of the possibilities that OSS can have for developing countries. If an OSS strategy is developed, governments need to create a local champion, an agency that is responsible for implementing, monitoring, and providing constant support to the government body. Creating a culture where policy makers and the public can make informed decisions is crucial. Similarly, sharing knowledge and experience at different levels of governance is key to developing best practices and making the needs of public bureaucracies clear to local entrepreneurs.

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phil. thanks for sending the paper. I'm definitely happy that we've got a paper that focuses on open source, obviously. But I have a few questions (that maybe apply to various of the papers) in terms of the conference. First, most of the people are pretty savvy, definitely way beyond me. So various parts of the paper are things that might be taken for granted by them. But more important, it is not very clear how you are pitching the relationship between open source and "standards," which is the point of the conference. of course, this may my ignorance. But the paper doesn't integrate with the function of the confernece unless--as you shape it--it is more about using standard setting, or using groups involved in the process of standard setting, or using government control or influence over standard setting to establish the kind of programming that becomes or remains dominant. Or it could be a variation: the use of standard setting and domination of standard setting debate to make entry of open source less prevalent. The focus can be on the developing world, and the premise can be that open source is a more important strategy for the reasons that you give, but that--i.e.that open source is good or helps developing countries--shouldn't be the main force of the paper.
i hope this is helpful and not too late.

Also

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