

## Research Article

# Imperatives of Free and Open Source Software in Cuban Development

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### Abstract

*Many developing countries around the world are frequently confronted with a dual challenge of simultaneously developing IT infrastructure and implementing software solutions. Some countries have successfully created extensive information technology infrastructures, yet software use continues to be reliant on pirated sources. The experiences of licensing regulation violations and increasing virus attacks indicate that part of the problem is a consequence of dependencies created by the use of proprietary software within resource-scarce economies. Recent growth in the use of free and open-source software (FOSS) by various public- and private-sector agencies suggests an alternative path to software self-sufficiency for a resource-scarce country like Cuba. There is, however, an interesting background to current software use within Cuba that makes it unique among several less-developed countries. Apart from the well-known advantages, FOSS use could be essential to shape the future scenario of Cuba. The present paper first delineates some of the Cuban background, basically characterized by lack of freedom in technology ownership and access to external information. The potential of FOSS use within existing conditions in Cuba is then analyzed. Finally, conclusions are provided on the basis of a survey carried out in Cuba, arguing that there needs to be stronger political will to reduce gaps between goals and implementation reality to achieve intrinsic advantages of FOSS use successfully.*

## Introduction

Exponential advances in information technology (IT) over the past decade have made maintenance of old and traditional IT infrastructure of a business, school, or university substantially expensive. Although such an increase in maintenance costs has affected public sector bodies globally, economic and social progress of less-developed countries seem to be affected relatively more severely by such rising costs. Along with prohibitive costs of hardware, proprietary software is also a major expense. In an attempt to address the disadvantages of proprietary software purchases, there seems to be the emergence of a new and alternative worldwide community dependent on free and open source software (FOSS). According to Câmara (2004) there are various advantages of FOSS use. Some of these include the feasibility to develop bespoke products in keeping with local conditions and users within different countries and organizations. Independence from stipulations of proprietary software, as well as opportunities of sharing and modifying code as and when necessary, are other advantages of FOSS pointed out by Câmara (2002).

In light of these characteristics of FOSS, it seems evident that integra-

tion of FOSS into software development and application creation strategies for developing countries should be considered more seriously. After the dissolution of the Soviet Union in the early 1990s, several countries that were dependent on it for infrastructure and technology transfer have been negatively affected. Cuba, being such a country, is worthy of further research. Traditionally access to IT facilities in general and software in particular has been problematic within Cuba. However, the information and communications technology (ICT)—using community of Cuba has made various attempts to integrate and design solutions to reduce costs and optimize advantages during the past decade.

With such a background, FOSS seems the only legal mechanism for a country like Cuba to acquire parity in any kind of IT exchange with the rest of the world. FOSS can play a key role as a solution to the information and computer technologies (ICT) crisis inherent to the current socioeconomic and political conditions. Such a crisis is the result of decades of economic embargo imposed by the U.S. government as well as existing national ICT policies.

During the past decade many attempts to integrate FOSS into day-to-day software-related work have been made by Cuban IT professionals. Most of these efforts, however, have been sporadic and have lacked correspondence to progress achieved internationally. It seems logical, therefore, that a greater use of FOSS within Cuba is likely to encourage development of reliable standards that would bring parity between international and local advances. More important, such a development will also have a significant impact in a future scenario, where both the embargo and current policies are unlikely to co-exist. The present paper looks at prevalent conditions within an ICT-using environment of two Cuban organizations within which some attempts to integrate FOSS have been made. As a result of the research, the authors argue that there needs to be a greater impetus on the part of Cuban officials to reduce gaps between goals and implementation of a FOSS strategy within the national context.

### Background to the Cuban Context

In a world where Internet access is taken to be akin to breathing, Cuba seems to have evaded any debate on virtual or Web-based freedom by restricting free access to the internet (Swartz 2004). At a time

when participation is universally accepted as a cornerstone of successful Web-based enterprise, under current law Cuban citizens are not permitted to access Web resources outside their own country. After 1959, revolutionary changes to the prevailing political, economic and social conditions led to the emergence of a unique context within Cuba. In response to nationalization of U.S. enterprises within Cuba, the U.S. government at the time imposed a trade embargo. The consequences of this embargo have been severe for Cuba. The embargo—though with some exemptions for medicine, food, and now in the energy sectors—continues to be in place and has had crippling socioeconomic effects (cf. Spadoni 2002, Brenner, Harvey, and Vanderbush 2002; Spadoni 2002).

The effects of such an embargo continue to be debilitating, because no products, technology, or services may be exported from the United States to Cuba either directly or through third countries (U.S. Department of Treasury 2004). The trade embargo made it illegal for Cuba to buy computers manufactured anywhere in the world containing even a single U.S. component. Almost filling a vacuum left by the U.S. embargo, the USSR and its allies quickly became primary suppliers of products, services, and technologies needed by Cuba.

In line with these developments, various institutes and centers were created in Cuba to assemble the first local computers. These computers were to be built without any US made components as well as be run by software manufactured within Cuba. In 1969 the Central Institute of Digital Research (ICID, from its name in Spanish) was founded (Valdes 1999). A year later the first computer (named CID 201) was designed and the first prototype was built. By 1972 a large number of CID 201s had been manufactured by the embryonic Cuban IT industry with the aim of using them within the sugar industry in both control of processes in the sugar mill and planning and control of cane transportation by railroad and trucks (Cuban Chamber of Commerce 2002). Supported by resources of former socialist community, in 1986 Cuba managed to develop an IBM-compatible microcomputer, calling it CID 1417.

In early 1990s, without the support from the Soviet Union that had existed in earlier decades, Cuba lost a major part of its imports (about \$4 billion–\$5 billion in aid and subsidies), including technologies. Such a crisis made it impossible to renovate or even

maintain Cuba's telephone infrastructure. Consequently, indigenous trends in growth in ICT production were no longer effective. Once again, the U.S. embargo proved problematic for the Cuban ICT industry.

It took nearly a decade before Cuba would begin to overcome such a crisis. By the late 1990s, the Company for Information Technologies and Advanced Telematics Services (CITMATEL) was created and another company, Copextel, started a production line in information systems and software. CITMATEL and Copextel have been in charge of assembling hardware and implementing software for the Cuban education system and industry. By November 2003, 46,000 computers had been installed in primary, secondary, and preuniversity schools in Cuba, and 12,800 had been installed in different universities ("Digitisation and Internet Access" 2003). By May 2004, there were an additional 1,700 computers, including some with Internet access, though only for sites within Cuba, through an important project addressed to teach IT-related issues to children and young people in their spare time ("¿Como multiplicar?" 2004). Meanwhile, several other sectors also introduced IT in their day-to-day activities.

Imports of computers components through non-U.S. routes have transformed the local manufacture of hardware from production to assembly. To service in-country hardware demands, these components are both sold in IT shops and assembled in the form of clones or in similar configurations. Although both costs and governmental policies make IT unavailable to ordinary people in Cuba, there are computer shops selling a variety of hardware- and software-based technologies. These technologies are sold either to organizations under the control of the government or to foreign enterprises and their representatives resident in Cuba.

### ***Breaking the Embargo***

To maintain a network of dozens of thousands of personal computers (PCs) in schools and colleges throughout the country, with some of them accessing the Internet, a substantial sum needs to be spent on hardware and software. The problem becomes bigger when software, like most operating systems, are produced by U.S.-based companies, consequently making them unavailable to the Cuban market. First, it is necessary to have scientifically

competent ICT professionals to be able to produce appropriate software for the country. Preparing such professionals in the use of technologies, however, requires technologies, and this is then a cyclical problem for the country. Traipsing through trade barriers, computers are acquired through non-U.S. sources and are being used to prepare new professionals with suitable levels of understanding of ICT issues within different fields, including specific ICT subjects such as computer sciences, informatics, and telecommunications. Despite all of these efforts, computers are assembled on the Intel microprocessor range of chips. Most of these PCs use illegally obtained copies of Microsoft Windows and Office software. Viral protection, which is a major concern in pirated software, is ensured through another range of illegal products. In a strange juxtaposition of increasing popularity and imposed trade restrictions in use of products manufactured by U.S. companies, the illegal use of software legitimizes an enforced immunity of control by Cuban industry.

### ***Effective Reality of the Cuban ICT Industry***

Cuba is buying computer hardware components from third countries that absorb any consequent risks of violating the U.S. embargo. Further, these components are assembled in Cuba in the form of clones or in similar configurations. In the case of software, a Cuban professional who attends a conference abroad or who flies to any country on behalf of his organization usually brings, if possible, a legal copy of any software. This copy can then be shared and reproduced, within the community of IT managers in Cuban organizations. As long as computers work to expectations, most organizations do not interfere in day-to-day activities. In a similar vein, professionals from different countries—including the United States—who travel to Cuba to attend conferences, bring at least a copy of any useful software to "donate" it to the Cuban organization hosting the conference. This does not, however, imply that valid copies of software are nonexistent in Cuba. There are projects involving people and organizations from countries that provide copyrighted versions of software required by them. There are also many local organizations running their IT infrastructure with legal copies of all software.

In 2003, an estimated 1,529 Internet hosts existed throughout the country, and there were

**IMPERATIVES OF FREE AND OPEN SOURCE SOFTWARE IN CUBAN DEVELOPMENT**

*Table 1. Evolution in Number of Personal Computers and Internet Users in Cuba Between 1995 and 2002*

	<b>1995</b>	<b>1997</b>	<b>1999</b>	<b>2001</b>	<b>2002</b>
Personal Computers (per 1000 persons)	Not available	5.70	9.9	19.6	31.8
Internet Users (thousands)	0	0.1	35	120	121

*Sources: Development Data Group, World Bank; Computers: Economic Eye on Cuba, September 1, 1997 (Press, 1997)*

around 120,000 Internet users (CIA 2006). Private citizens are prohibited from accessing the Internet without special authorization (Swartz 2004). Foreigners can access the Internet in large hotels. Some Cubans buy illegal passwords on the black market or take advantage of public outlets to access limited e-mail and the government-controlled “intranet” (CIA 2006). Such an Intranet means a “filtered” access to the World Wide Web, where Web sites containing any information “irrelevant or counter-revolutionary” in the government’s view is blocked. In any case, both Cubans and foreigners who browse the World Wide Web or use any other Internet service do so subject to firewalls. So far, Cuban Internet policy has been one that has been heavily regulated by the state. Somehow the Cuban state is convinced that it can control both the flow of information from outside as well as that from within. The effectiveness of such a control ideology, however, is hindered by the emergence of a number of dimensions, including growing awareness of dynamic Web access among citizens and rapidly proliferating IT capability. According to the Global Internet Freedom Act (2003), the government of Cuba, among others, is taking active measures to keep its citizens from freely accessing the Internet and obtaining international political, religious, and economic news and information. Despite the efforts of the government and resources put in obstructing any flow of foreign information, more and more Cubans are managing to access information—sometimes about Cuba—from sources outside the country. They do so for curiosity, entertainment purposes, or looking for news about the outside world and also about their own country not provided by the local media.

To corroborate the growth of Internet and computer usage, we have created several tables consist-

ing of figures published by the Cuban government. Table 1 refers to computers per 1,000 persons and Internet users, and table 2 shows the number of computers and software available in one of the schools of a Cuban university, covering the period between September 1996 and September 2002.

Table 1 shows the growth in the number of computers available in Cuba, which in 2002 (the last point at which information was available) was three times the quantity of 1999. Internet access also rose nearly four times in 3 years. Table 2 demonstrates the growth over time of availability of hardware and software in a higher educational institution in Cuba.

Thus, finding alternatives to avoid restrictions imposed by U.S. sanctions seems to be a panacea to all Cuban ICT problems; however, such a solution—though seemingly definitive—is an oversimplification of the Cuban ICT situation. This is underscored more by the fact that even when the U.S. embargo ceases to exist, Cuba is likely to continue to be a developing country, where acquisition of hardware and software will continue to be a problem, requiring urgent attention by both the Cuban government and IT trading companies.

Although one could argue that hardware and software are two sides of the same problem, some interesting differences between them led us to undertake the following analysis. While a piece of hardware can be used for years without need for upgrading, having a single copy—legally or otherwise—of any software that suits the organization’s needs can never be enough. The organization will not be able to avoid the need to upgrade it, even if there is no internal reason or interest in doing so. File formats keep changing with the emergence of new ones, and the organization is at risk of not being able to process new documents, even those created through newer versions of the same

Table 2. *IT Availability in One of the Schools of a Cuban University, 1996–2002*

Year	Number of Computers	Operating System	Main Application Software Available	IT-Based Information Services
1996	2	MS-Windows v.3.1 running on top of MS-DOS.	MS Office and mail programs.	One single e-mail address for official issues.
1997	6 4 second-hand PCs. (interconnected)	MS-Windows 95	Microsoft Office, Norton Antivirus.	Still a single e-mail address.
1998	11 5 new computers with Pentium microprocessors.	MS Windows NT v.4.0	Microsoft Office, Norton Antivirus, Microsoft Visual Studio.	Still a single e-mail address.
1999	35 24 new interconnected computers Celeron; CD-Writer, printers, scan- ners.	MS Windows NT version 4.0. Linux in the servers.	Microsoft Office, Norton Antivirus, Microsoft Visual Studio; SPSS and several appli- cation software.	Internet access in 10 com- puters: 5 for students and 5 for staff; e-mail service for staff; One e-mail ad- dress per team of 5 stu- dents; 3 computers in the library to browse the Internet.
2002	> 40 Digital cameras, scan- ners, etc. Wireless con- nection to Internet.	MS Windows XP Professional; Linux in the servers.	All latest version of the software available.	Same as before plus: Web site and Intranet running with access to the library.

Source: *Experiences of Alexeis Garcia-Perez.*

Table chronologically demonstrates the growth of availability of hardware and software in a higher educational institution in Cuba.

application. In such a context, and comparing it with other resource scarce regional exemplars, such as Brazil and India, it is appropriate to assume that the situation with software could be alleviated (if not resolved) by support from the local IT community. Encouraging advances in modern Web-based resources also offers FOSS as a suitable vehicle to address software needs of local Cuban organizations.

## FOSS: A Viable Alternative

In general, FOSS has been accepted as a revolutionary idea in software development, leading to the growth of a worldwide community that supports the exchange of software code, ideas, advice, solutions, and knowledge. Notwithstanding altruistic arguments about the origins of FOSS, it offers enormous advantages to any ICT-using individual, company, community, or country, particularly from the developing world. According to Weber (2003), countries with a variety of socioeconomic and political backgrounds are making steady advances in

FOSS development. Some of them are considering mandating the use of open-source software for applications within a whole sector such as the public sector also referred to as e-Government. This is the case of Germany (eGovernment News—Open Source Software 2005), China (Feller and Fitzgerald 2002), Peru (Chan 2004), and Tanzania (Kamuzora and Baruch 2005).

Although other technical advantages of FOSS use will be mentioned discussed below, it is important to highlight in this section others that have a more general effect. They include

- Feasibility to develop software products adapted to local conditions and users within different countries and organizations;
- Independence from stipulations and prices of proprietary software;
- Independence from companies and countries that develop proprietary software; and
- Opportunities of sharing and modifying code as and when necessary.

These are characteristics that apply to any country, but they are particularly relevant to the developing world. Cuba, being a developing country, could ideally be a recipient of benefits from all or most of what FOSS can offer. In that case, the present article could be a repetition of what has been written for other countries and organizations, with particular emphasis on Cuba. There are, however, issues that impose a different analysis of FOSS perspectives and benefits for Cuba. Some of these issues have been discussed earlier in this article, and they include

- National socioeconomic and political context;
- Existing policies toward IT ownership and Internet access;
- Existing limitations to both trade and copyright imposed by the U.S. embargo; and
- Policies regulating aspects of life within a changing environment where uncertainty and change are an intrinsic part of daily existence.

On the other hand, although Cuba had a fairly predictable business climate during the Soviet era, such a context has been fraught with change and instability over the past 15 years. Such a changing environment promises a completely new background in the near future, when internal and external political and economic conditions are likely to compel lifting of the U.S. trade embargo. Although predictions of the future are beyond the scope of this article, some presumptions can nevertheless be made. In such a new context, for instance, Cuba will be in a position to be reinserted into the world economy, finding in the United States one of its main economic allies.<sup>1</sup> Under such circumstances, Cuba will be another developing country, with one of the highest current foreign debts in the world<sup>2</sup> and therefore in need of making the best use of resources available. The highly qualified manpower that has been formed over the past decades can play a key role by then toward Cuban development.

Under such circumstances, advantages of FOSS use within the local background should be analysed from two different perspectives: Cuba as it is today and Cuba within an embargo-free international setting.

### ***What FOSS Can Offer to Today's Cuban Economy***

#### **Customization of software solutions**

Local organizational reality is shaped by both national and international conditions. An emaciated economy as a result of what used to be a rigid U.S. trade embargo will necessarily be characterized by poor infrastructure in most of its organizations. This is particularly important in terms of ICT, where much of innovation and creativity is needed. With the passage of time, proprietary software seems to require higher processing power, which implies up-to-date hardware capacity. This is simply not available in every Cuban organization, where hardware availability changes from very old PCs with a couple of megabytes in their hard disks (or nonexistent hard disks) to the latest developments from Intel. Most of them are, however, expected to do the same in terms—at least—of word processing.

A wide range of software available through the FOSS mode usually has smaller requirements and performs better than their proprietary counterparts, making marginal demands on hardware (minimal memory and processing power are required in most cases). Such performance is also based on the capacity to be adapted to different hardware and other obtaining connectivity conditions.

The availability of source code and opportunity to change and adapt it allow for local versions of application software for organizations and, at the same time, a common platform for different sectors or the whole country. Cuban IT professionals could customize most application software to suit local requirements and even provide improvements to software, because it is one of the objectives of the open source software community. The local FOSS community would also ensure that existing barriers such as language—interfaces of most of the software available in Cuba is in English—could be overcome through the redesign or translation of user interfaces. All of these would also influence users' perspectives about ICTs facilitating education, training, and development issues within organizations and schools nationwide.

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1. *Even with the restrictions imposed by the trade embargo, the United States is currently Cuba's seventh commercial partner since 2003, and new agreements are being signed. Only Venezuela, Spain, China, Canada, the Low Countries, and Italy (in this order) are ahead of the United States in economic trade with Cuba.*

2. *Cuban foreign debt was estimated at \$42.4 billion by the end of 2002 (Institute for Cuban and Cuban-American Studies 2002).*

### Prices and Copyright

It is expected from every software user—whether a person, organization, or country—to know and respect the licenses related to any copyrighted work. Software is no exception. In the case of Cuba, however, where no software company based in the United States is making any progress in terms of commercialization of its products, a different analysis is required.

The differential between the average income of a Cuban IT professional and the cost of any proprietary software in the market automatically makes it unaffordable for the Cuban IT community. In general, whereas the average income of a Cuban IT professional is less than \$180 a year, the current cost of a copy of Microsoft's Windows XP Professional according to Amazon.com (2004) is \$279.99. Such a wide cost disadvantage does not only hold true for the Cuban case but is also commonly prevalent for most of the developing world; however, it is widely recognized that software companies such as Microsoft know how to penetrate developing markets even in poor countries, offering local policies and prices. This could be the case of Cuba now, if they were allowed to trade with it. Windows XP Professional would not be sold at such a high price for a Cuban organization, at least under current conditions.

Even in that situation a large section of the Cuban ICT using community would neither buy a piece of software (adhering to copyright regulations) nor use FOSS to avoid these issues. Price is not the problem of today, and FOSS is not today's solution to copyright laws for software use. Although it might not be completely ethical, Cuba can and has argued that it has no reason to respect copyright laws of a country that does not recognize most of Cuban laws. Meanwhile, software companies continue to wait, being in a perpetual state of limbo. In light of such a conflictual ICT milieu, software is one of the key issues to be included in a future agenda between the two countries.

### ***What FOSS Offers for Tomorrow's Cuba***

If Cuba is today mostly free of problems related to prices and copyright of proprietary software, everyday reliance on the use of such software increases the potential size of these problems in the future. Going too far risks falling from heaven into the deep blue sea, when the time comes and depend-

ence from U.S.-based software companies proves to have a price. This is a problem for the future, avoidable with suitable FOSS support today. Designing and implementing a realistic and solid strategy to gradually include FOSS in the day-to-day activities of schools, colleges, and organizations nationwide with the ultimate aim to replace as much of the proprietary software being used as possible could be a suitable approach toward the future. Characteristics of FOSS such as its low hardware requirements, compatibility with existing proprietary software and file formats, and the current existence of a large number of applications designed under FOSS principles support the design of such strategy and its smooth implementation, without major technical impediments. Expansion of the FOSS community to many developing countries, where projects have been successfully developed, could offer significant experience to the local community. Some examples from Brazil, India, Tajikistan, and Laos have been studied by Dravis (2003) could be seriously considered.

Schools and colleges, which include a large part of computers available to the Cuban population (more than 60,000 by the end of 2003), would have legal access to all kinds of software, from operating systems to office and task-specific tools. This would have a double impact, as the future workforce would also be ready to be part of the FOSS use and development community, independent (if not free) of proprietary software and its developers. Organizations would not only make a better use of the technology available in terms of hardware and connectivity. They will be able to avoid legal complications in the future, gain independence of ownership, and influence pricing. Private computer owners, who are a very small percentage because of Cuban regulatory conditions, would also benefit from such a move.

There is much that can be expected from a concrete FOSS strategy in Cuba today. Such strategy, however, will not be as beneficial today as it will certainly be in its future context. FOSS has the potential to offer the platform for software independence to a newly arrived country like Cuba, with such a unique environment. It sounds sensational, but we recognize that there are many reasons that hinder implementation of such a strategy. Such reasons range from resistance to change to shortness of

policy horizons, compromising capability to define local policy.

### FOSS Developments within the Local IT Community

FOSS development in every country increases the number of local professionals working through formal means or informal experimentation on IT developments. They also improve their capacity to design and implement software solutions by interacting with their counterparts elsewhere in the world. Such growth may be produced with minimum investments in training such personnel, as well as having their continual support to the national economy. In the Cuban case, some attempts have been made by the ICT community to introduce the use of FOSS in the country.

#### *Introductory Stages of Development*

The current situation of software in Cuba has made professionals from diverse subject areas to try to join—sometimes successfully—the FOSS community, led by students and specialists of computer sciences and information management. They are engaged in a national project called Linux-Cuba, which aims to promote use of such operating systems and create a set of resources to help and increase use of FOSS in Cuba. Although Linux-Cuba has very little support, according to the project leaders, it is formally a recognized project.

Linux-Cuba provides free resources to the national open source community, organizes conferences and workshops, and offers free courses nationwide. It is open to the international community of Linux users through its Web site. Initiatives such as Linux-Cuba are not part of official responsibilities of any organization. In the majority of cases professionals involved do not receive any support. There are cases, however, in which they are able to use the technologies available within the organization in their spare time for the purposes of the project. Lack of possibilities for Cuban professionals to have their own IT resources hinders strengthening of Linux-Cuba and any other initiative.

The Cuban government is said to recognize the need to prioritize FOSS developments within IT regulations. To that aim it has defined a strategy for using free software to develop a national software industry based on open software principles (Ministerio de la Informática y las Telecomunicaciones de

Cuba 2002). This strategy is still to be implemented, which is expected to be a difficult process. The Cuban government is considering development of the national FOSS strategy as a conventional IT software development project. Although evaluation of such a strategy will not be part of this research, there are a few important issues that are worth considering here:

1. The cost of implementing the strategy will be high.
  - On the one hand, resources and time will need to be put into the implementation stage.
  - On the other hand, it will require offering IT professionals freedom to access, use, and modify online resources from within the FOSS community. This challenges the current Cuban Internet access policy, and, therefore, its implementation will require a great deal of political will.
2. Understanding of the role of such strategy is not widely spread among people and institutions in charge of its implementation. The process supposes to invest time, resources, and effort to develop alternative software when schools and the economy are already running without such software. It requires commitment through understanding of the issue. A similar approach to that of other “mandatory tasks” may be applied by people involved, and so, a similar result may be obtained: as the outcome of the process is unlikely to have any economic impact in their lives it will not be seen as a priority.
3. Quality of contributions of members of the Cuban coding community connected to FOSS can be good; however, because they will not receive any benefit from their work, levels of effort and consequent quality of outputs might not be as high. This could be seen as a problem already exposed by the FOSS community; however, conditions of Cuba make the situation of its professionals completely different to other developing countries. Whereas professionals in other developing countries have economic restrictions as the main barrier to their development, Cuban professionals also have to deal with difficulties in many other ar-

eas including access to technologies, access to Internet, access to foreign media (television, radio, newspapers), traveling abroad, and so forth. Admittedly a socialist mindset-driven agenda does not help motivation for FOSS development.

Some efforts have been made to have IT professionals in the country to cover needs of the economy and even to develop a Cuban software industry. Computer sciences have been taught for more than 30 years in the University of Havana and three more universities. Informatics has also been running longer than a couple of decades in several universities throughout the country. One more university was created in 2002 with the sole aim to train IT professionals. The center is called the University of Informatic Sciences. It is located in Havana, and its students come from across the country. This university provides special conditions and resources to large number of students and staff not available at any other school in the country. The first graduates will be ready to go to the Cuban industry from 2007, providing a quantum thrust to IT capability.

Another attempt to develop and use local solutions to the IT-related problems in Cuba is the production of software to provide the national market with products such as antivirus programs. Segurmatica, a company created a decade ago with such an aim, has been trying—with the help of government policies—to replace the use of pirated copies of proprietary antivirus software with the so-called SAV (from Segurmatica AntiVirus). Unfortunately, these efforts are in a very early stage and have not produced the expected results, at least not enough to replace the use of pirated antivirus software in the country.

Infomed (2004), the Cuban health information network has been running from 1994 using Linux. It has also developed an entirely free hospital-management system that is set to be very important for Third World countries that want and need open-source software (Hanson 2004). Infomed has also developed a virtual library of medicine available to the Cuban and international medical sector (Riera 1999). This is an organization, however, with both academic and political purposes, supported since its foundation by the Cuban government, so the development of such a network is an investment ad-

ressed to internationally disseminate advances within the Cuban health systems. Health professionals have no means to access the network and its resources as much as they need such information.

### **Limitations to ICT Development**

Two dimensions affect the widespread use of FOSS in Cuba. The first relates to the economic reality that has been discussed earlier. The second relates to the social conditions that are conducive to integration of FOSS. The availability of support from the Cuban government to the people is an important indicator of whether FOSS will actually be able to enhance labor productivity.

### **PC Sales**

In March 2002 the Cuban government banned the sale of computers and computer accessories to the public, except in cases where the items were “indispensable” and the purchases were authorized by the Ministry of Internal Commerce (Scheeres 2002). According to article 19, chapter II, section 3 of the ministry’s Resolution number 383/2001,

The sale of computers, offset printer equipment, mimeographs, photocopiers, and any other mass printing medium, as well as their parts, pieces, and accessories, is prohibited to associations, foundations, civic and nonprofit societies, and natural born citizens. In cases where the acquisition of this equipment or parts, pieces, and accessories is indispensable, the authorization of the Ministry of Internal Commerce must be solicited.

Such legislation, barring sale to certain individuals and allowing sales to some others creates unnatural discrimination and inequality of access to ICT.

### **Prices**

Although e-mail accounts are available through the Cuban Postal Service, this service remains unaffordable for Cuban professionals. A 3-hour prepaid card costs \$4.50, one-third of the average Cuban monthly income. To afford Internet accounts and browse the network, Cuban Web surfers need to pay 8¢ per minute, which is a prohibitive rate with regard to the average Cuban salary (Reuters 2004). Acquiring a PC is also beyond the economic wherewithal of the average Cuban IT professionals.<sup>3</sup> Even when they were authorized to do so, they would

3. *The average income of a Cuban professional is less than \$180 per year.*

have needed to pay more than \$500 for a PC, as shown by TECUN (2004), one of the Cuban IT shops.

Importing PCs from abroad could be a means of addressing unaffordable PC prices for a small percentage of Cuban people who travel to other countries.<sup>4</sup> Nevertheless, it also creates enough problems to avoid people bringing equipment into the country as they should follow the same rules as to buy the PC domestically. Those who manage to get support and permission required to travel abroad sometimes acquire a new or second-hand PC. They will, however, need the authorization of a corresponding ministry to enter Cuba with a privately owned PC. The ministry, when deciding, would consider whether such a PC is indispensable to the owner.

### Access to the Internet

As part of the implementation of the Internet policy described in section 2, in January 2004 the Cuban government began to crack down on unauthorized Internet usage. The state telephone monopoly ETECSA was ordered to stop unofficial access to the network by its users. Days later, the main Internet service provider in Cuba announced that home users could connect if they paid in dollars. Because Cuban incomes are not in U.S. currency, prohibitive conversion rates make it impossible for the population to pay for an Internet service. The latest rates apply not only to Internet access, but also to any other product or services charged in a foreign currency.

The bulk of tasks to be accomplished by Cuban professionals leave no extra time to spend in developing a piece of software for the organization. Most Cuban workplaces have basic computing support that is likely to create gaps between existent demand and available supply. In a small number of cases there is higher level of computing support, though they are also subjected to a range of restrictions that reduce any resultant advantages. Access to the Internet, which is a prerequisite to be part of the international FOSS community, is not available for the vast majority of professionals, and thus the motivation to continue previous works or start new projects will decline. The lack of freedom to possess a computer and access external information obstructs, to a large extent, the possibility of develop-

ing a FOSS program in Cuba. To deal with an ever-increasing need for software, an alternative path like that offered by FOSS seems to be most appropriate. Through the use of FOSS somehow the ever-growing specter of legality and illegality of software use can be effectively addressed.

### Fieldwork for Current Study

Within the national background described in previous sections, the role of ICT use in Cuban development could also be accounted for by perceptions of FOSS users within Cuba. To look at such perceptions and therefore substantiate the basis of the arguments discussed, fieldwork was carried out.

### Methodology, Tools, Procedure, and Subjects

Because one of the authors was based in Havana, it was considered convenient to base the fieldwork on of a questionnaire or interviews of groups that were likely to influence the type of software that was being used within Cuba.

According to conditions in which the research was conducted, face-to-face interviews were considered likely to provide a realistic picture. Therefore, a semistructured interview formed the basis of fieldwork that was undertaken. A questionnaire was then designed with the aim to informally interview a number of people from some Cuban organizations.<sup>5</sup>

Because the Cuban capital has the most important IT infrastructure and largest number of higher education institutions and organizations working with ICT, two institutions and a number of IT-related people within those institutions were targeted. The institutions were the University of Havana—particularly the School of Mathematics and Computer Sciences—and an organization dedicated to manage large-scale import and export of goods. It may be noted that the target organizations represent the two domestic sectors with greatest access to technologies, named higher education (standing for academia) and government organizations (representing the IT industry).

Although the number of respondents was not initially set as a target, the purpose was to interview as many people as the conditions and time restrictions allowed. The only criteria agreed by research-

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4. Permission from the government is required for every Cuban citizen to travel abroad. It can be either given or denied according to many factors considered by the government.

5. The questionnaire is included as an appendix to this article.

ers in advance were to include a variety of people, playing different roles with regard to ICTs within every institution. The questionnaire was designed in such a way that no question would explicitly require a political interpretation of the Cuban context by the respondent.

Every potential respondent was given a 2-minute introduction to the research, requesting her or his co-operation before proceeding to ask the questions if they agreed to cooperate. The questionnaire was applied in Spanish; its application lasted around 30 minutes and a verbal in-depth use of analogies was necessary to reinforce or amplify different dimensions of questions and answers. A significant effort was made by the researcher to distance himself from any official meaning of the terms being used and thus avoid respondent bias. The researcher took notes of the answers, and these notes were finally approved by the interviewee. The questions, although on a face-to-face basis, were considered anonymous, a point that was stated from the very beginning in each case. The researchers did not register the names of the interviewees.

After 40 respondents, the emergent pattern of interviews revealed that there was little difference between the different interviewee accounts. A total number of 51 respondents were included in the survey, with the following distribution: 11 from the industry; 10 academics in different roles within the university; and 30 students of computer science. The answers were compiled, translated into English, and analyzed to ensure that data could then fit in with rest of the report.

### **Limitations**

The researchers had to deal several obstacles with in carrying out the study. In view of short time scales and very serious governmental restrictions on information access, acquisition of useful data was difficult. Respondents and subjects could not necessarily contradict existing government policies.

The most significant difficulties faced by the process of conducting this fieldwork include

1. The time frame of this research allowed only 6 weeks to be allocated to the fieldwork.
2. Gaining access to the right information from Cuban people is not always easy. Because the government controls the ICT industries in

Cuba, ordinary Cuban citizens often do not have access either to certain information from other countries or to local statistics that are only managed by certain groups of the government. They therefore often prefer not to specify any criteria for information access.<sup>6</sup>

3. A questionnaire trying to go too deep into the problematic being studied could have added to the complications in the research delineating adverse circumstances in which it was applied:

- Potential respondents would not have been happy to collaborate on suspicion of the government being behind the research. Should they have accepted to contribute to the research, their replies would have been superficial and complacent to the person gathering data through the questionnaire.
- Under Cuban conditions no research can be performed without previous approval of the Ministry of Science, Technology, and Environment, and studies must be under governmental control. Nothing very critical—directly or indirectly—to governmental rules and policies or revealing weaknesses of existent government policy can be carried out in Cuba.

Even with these limitations, the application of the questionnaire was considered relevant. The main reasons were

- This research would make, through this questionnaire, a significant contribution to the limited amount of information available in this subject area.
- This questionnaire would provide an impartial approach to the problematic of IT within Cuba. This area has received little international attention and most of the time is inclined toward either the Cuban or U.S. legislations.
- The results of the questionnaire would allow the authors to critically raise many issues regarding U.S. and Cuban ICT policies that may be explicitly discussed in future reports.

In a period of 6 weeks between May and July 2005, the fieldwork was carried out and the results are presented and discussed in the following section.

6. The release of a note in a national newspaper (*Impulsara nuestro 2005*) announcing that Cuba will gradually switch to the open-source Linux operating system could create certain prejudice in respondents toward this research.

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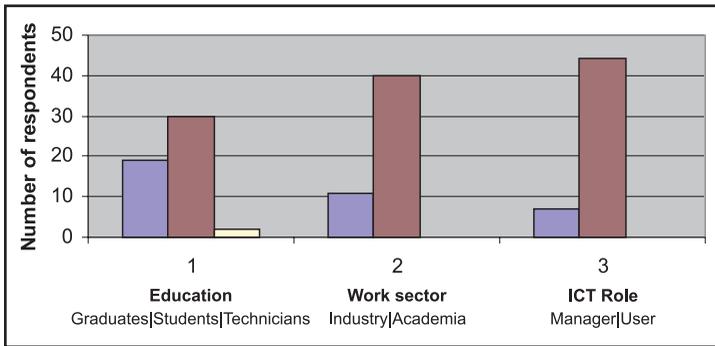


Figure 1. Distribution of the surveyed sample in terms of education level, work sector, and IT role within the corresponding organization

**The Questionnaire**

The questionnaire included 12 questions grouped in three main sections covering the following areas:

1. Respondent’s profile (including formation, work experience, and IT profile);
2. Knowledge and use of FOSS; and
3. Perceived importance and imperatives of the FOSS in Cuban development.

The main questions, as indicators of the factors being studied, were addressed to assess the role of ICT within the Cuban development, the way such a role can be substantially improved and the importance of FOSS in particular within the Cuban development.

Collateral but relevant information was offered by questions related to the use of FOSS and proprietary software by respondents. With the aim to facilitate its understanding, it will only be included as

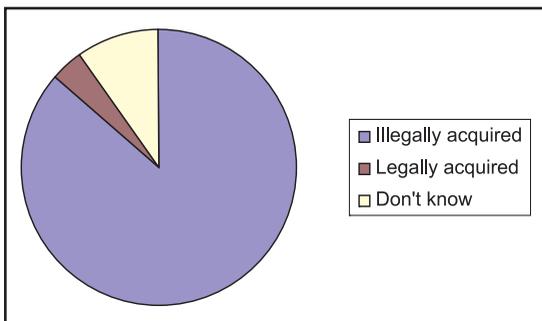


Figure 2. Proportion of the number of respondents that admits they are using proprietary software illegally acquired (blue) in relation to those that use legal copies (brown) of such a software

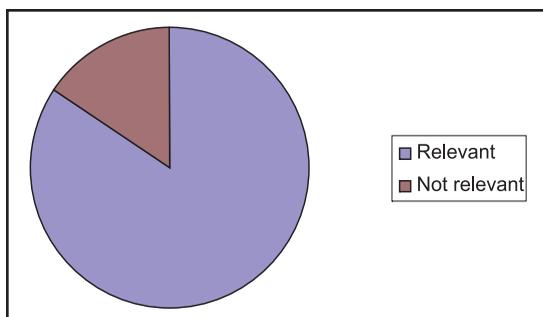
a summary of the main findings, avoiding the bulk of figures involved in the full analysis of the answers. A more detailed analysis using micro figures would be offered in a separate report in the future.

*The sample:*

Fifty-one people were interviewed:

- Nineteen have completed at least one degree and 30 are in the process of completing it.
- Eleven work in the industry.
- Seven are IT managers and 44 IT users.

- All of them know what FOSS is.
- Fifty-one have access to a PC. Whether they have access to such computers at home or at their workplace was not an issue, because asking such question in the current conditions in Cuba would hinder the quality of the data.
- All of such PCs have any proprietary software installed. The most common proprietary software mentioned was Microsoft Windows and the Microsoft Office.
- Forty-four affirmed that this proprietary software was illegally acquired. Only 2 of the 51 recognize that the proprietary software being used is legal. In light of the significance of this question for the research, the distribution of answers is graphically represented as follows.
- Twenty-seven of the 51 respondents affirm that they have no access to any FOSS in their PCs.
- All of the 51 respondents consider ICT as an integral part of the development of Cuba; 39 of them give ICT the highest weight in such development.
- Forty-three respondents consider FOSS as a key component of Cuban development, as represented below.
- Twenty-nine consider that FOSS will contribute to eliminate the socioeconomic differences between Cuba and developed countries.
- Eighteen consider that FOSS will contribute to eliminate the socioeconomic differences inside Cuba.



*Figure 3. Proportion of the number of respondents that considered the use of FOSS being a key component in Cuban development (blue). Those who did not consider FOSS relevant are represented by the brown piece of the diagram.*

- Other key issues required in the current Cuban context to improve ICTs support for development were mentioned by respondents. They included the possibilities offered by FOSS to support the development of Cuba, according to the interviewees.

### **Summary pointers from fieldwork**

The finding of this research as supported by the fieldwork can be summarized as follows:

- Although an increasing number of computers in Cuba have some kind of FOSS installed (ba-

sically a version of Linux as the operating system), the vast majority of existing software solutions are based in proprietary software, most of them illegally acquired.

- The Cuban people working directly with IT who were interviewed recognize the importance of ICT, and FOSS within it, for the socio-economic development of Cuba.
- The current Cuban context is characterized by restricted access to Internet, restrictions in access to PCs and IT accessories by the population, weak links between institutions using and producing software and lack of investments in new IT and in IT updates, among other issues. Although changing such conditions does not necessarily bring an ICT development, these norms underpin any Cuban policy in terms of IT.
- In general, Cuban people expect a progress of a FOSS strategy as one of the driving forces of the national development and hope the current norms are modified so that this progress takes place.

### **Conclusion**

The limitations of this research and conditions in which the survey was carried out make it necessary

*Table 3. Key Issues that Respondents Consider Necessary in Order for ICTs to Support Cuban Development*

ICT-Related Requirement	Number of Respondents
No restrictions in access to Internet	29
Access to computers and accessories in the national market	25
Communication with the world through access to conferences, international meetings, e-mail, etc.	6
Better qualification for IT users and software developers	8
Investments in new IT and in IT updates by the government	6
Links between economic sectors using and producing software	3
Better distribution of IT	3
National standardization of software development	2
A better use of the intellectual capital	2
Better salaries in the IT sector	1
Legal protection of software	1
Legalization of private investments in IT	1
Better use of existing IT	1

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*Table 4. What the Use of FOSS Can Offer in Terms of Cuban Development as Stated by Respondents*

<b>What FOSS Can Offer Cuba</b>	<b>Number of Respondents</b>
Lower costs of software development (no need to pay licenses, software accessibility, software reusability)	23
Development of software industry (local contribution to software development, national and international commercialization of IT)	18
Economic, academic, intellectual and cultural development	9
IT independency	6
Advantages for software developers	4
A better position for Cuba if the US embargo ends	4

*Note. Seven people felt unable to formulate a criteria about this issue; nine people consider that FOSS is not very important, offers nothing special and that proprietary software is the same or better, backing therefore the use of proprietary software.*

to not overreach conclusions other than the current situation of the Cuban IT system and expectations of Cuban people. Therefore, this section will provide views of the researchers derived through expectations and experiences of the field work and considered literature review.

FOSS offers a significant number of advantages to any country, organization, or person, particularly those from the developing world. By being part of the international FOSS community, Cuba could obtain several of such economic, legal, and even political advantages. In addition to those advantages and, even more important, the design and implementation of a concrete and realistic national FOSS strategy have more to offer Cuba in the near future. Prices and copyright issues related to proprietary software, as they are seen today by the Cuban people, will have to change dramatically within a brief turnaround period. Working toward the future socioeconomic and political context will make it possible to avoid frustrating ICT dependence, which will retard national development.

Cuba is just starting on efforts to nationally develop FOSS. On the other hand, however, the prevalent situation in Cuba is conflictual. Although intending to implement a FOSS strategy, there are at the same time restrictive policies in the widespread use of the Internet and the possession of a PC. Existing Internet and ICT-related policies do not help potential FOSS developers, both graduates and those experimenting, produce software solutions through engagement in an international community.

Cuban people recognize the importance of ICT,

and FOSS within it, in terms of Cuban development and getting a place in the international economic context. They are able to identify clearly the Internet and ICT ownership policies as the main weaknesses of current Cuban ICT milieu and are desperately eager to see changes in both ambits.

The level of educational training in Cuba could lead the country to be one of the main players in the international FOSS community. This, however, would imply a change in the way IT and the Internet are seen by the government, which, far from helping the population to access information available worldwide, hinders acquiring a PC or interaction with professionals living abroad. To develop the Cuban FOSS sector, this issue needs to be seen as part of the economic (and also political) scenario and not in isolation or as a threat for them.

For any national FOSS project to be robust and secure, developers working on such an enterprise will need access to source code, supported by as many organizations as possible of those interested in results. The definition of FOSS implies access to resources, so the strategies must cover ways to satisfy such a requirement. There are adequate IT resources in Cuba to facilitate people joining the FOSS community. Appropriate management of available resources is likely to be able to allow it. The software crisis in Cuba could be resolved by suitable use of combined experiences, available resources, and clear reliance on FOSS. Somehow, technological advances seem to have overtaken what can be achieved by traditional notions of control. Despite poverty and lack of resources societies are forever

discovering new mechanisms to survive and grow therefore the current government in Cuba could encourage the use of FOSS in its organizations and development of a national FOSS community connected to the international one.

The research found that there must be stronger political will to reduce gaps between goals and implementation reality to successfully achieve intrinsic advantages of FOSS use in Cuba. Therefore, the main recommendation of this research based on its fieldwork is to change current regulation in Cuba regarding ICT ownership and access to information. Rather than supporting Cuban development, existing regulations hinder growth of local FOSS strategy and, in the process, stifle popular expectations.

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## Appendix A. The Questionnaire

### Introduction

This is an academic survey to study the need and importance of using Free and Open Source Software in Cuba. The survey is not related to any official statements and it is not the aim of the researchers to do so. Please answer the questions truthfully and feel free to share your views. There are no right or wrong answers. None of your personal details will be shared with any other person or institution. Thank you.

Questions:

1. Are you
  - a. Graduate of Higher Education
  - b. Graduate of a Technical degree
  - c. A student
2. If you are employed, what is your employment sector?
  - a. Services
  - b. Industry
  - c. Academia
3. How do you describe your technological profile?
  - a. ICT User
  - b. ICT Administrator
  - c. I don't use Information Technologies
4. Do you know what free and open source software is?
  - a. Yes
  - b. No
5. Do you have access to a personal computer?
  - a. Yes
  - b. No

If you have answered "Yes" to the previous question, please answer the following questions:

  - a. Does this computer have any proprietary software installed? [*The researcher explained what proprietary software is.*]
    - a. Yes
    - b. No
  - b. If Yes, was this software legally acquired?
    - a. Yes
    - b. No
    - c. Don't know
  - c. Does this computer have any free and open source software installed? [*When necessary the researcher explained what a FOSS is.*]
    - a. Yes
    - b. No
    - c. Don't know
6. From 1 to 10 (10 is the highest) what importance do you think ICTs have as an integral part of the Cuban social, economic and political development? Which issues do you consider more important than ICT?
7. Do you consider that accessing and using FOSS is an important element of such development?
  - a. Yes
  - b. No
8. In your opinion, will FOSS contribute to eliminate differences in access to technologies:
  - a. Inside Cuba?
    - i. Yes
    - ii. No
  - b. Between Cuba and developed countries?
    - i. Yes
    - ii. No
9. Could you mention any other factor that would contribute to develop the ICT sector in Cuba? Would you like to mention any other factor(s) that you consider relevant to this research?