Free Access to Open Content and the Role of NGOs in the Use and Design of Free Software and Open Hardware in Developing Countries

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Abstract: *The author describes a possible context in which non-profit NGOs foster economic growth in developing countries. Since economies in developing countries are confronted with various difficulties that prevent growth, it is very important to use existing know-how and resources that are placed on the Internet on discussion, research and development fora. Those repositories and archives may offer solutions that enable enterprises to be flexible, feasible, legally safe, technologically efficient, yet to preserve independence from inflexible suppliers and manufacturers. The author emphasizes that non-governmental organizations founded by the citizens themselves may be a genuine organizational form in which motivation, knowledge, dedication and independence may ensure proper management and development techniques for end-user oriented development..*

CHARACTERISTICS OF CONTEXT

Development as painful and risky crossroad

In many developing countries and regions we see tremendous efforts to foster economic growth. Although those countries are affected by huge discrepancies in access to social welfare and sometimes to basic needs for their population, they realized in some cases that social welfare and economic growth may be realized by rapid involvement of larger number of scholars, scientists, engineers, companies, NGOs and various civic initiatives with the aim of fostering economic growth and creating incentives for innovative entrepreneurship.

Technological development is often a very expensive process of research and development of solutions to solve specific problems. Research, manufacture, sale, trade, distribution, industry process control, development of information infrastructure are demanding applications where technological problem-solving is hard and costly. Legal persons that own copyright over a certain solution may condition anyone, including other legal entities and states that want to implement that solution, to pay royalties that, over time, sometimes cost more than the solution itself. Although some technical solutions do have a short life-time cycle, there are many that last for years and those solutions may become quite costly due to accumulation of royalties for the period of use.

In many developing countries, GDP per capita is very low and total cost of ownership of proprietary software is very high by comparison. In addition, disturbances on international financial markets pose a serious threat to developing countries that are often forced to tie their currencies to the exchange rate of hard currencies. For that matter, developing countries face that collision between the need for a societal decision to foster economic growth and social development, current economical conditions and restrictions that many companies, governments and other inter-governmental organizations are trying to impose on them. Brasil, China, and India have faced such difficulties in disputes with the pharmacy industry from developed countries.

Mistakes in attempts to solve such problems may introduce new financial burdens that may jeopardize their economy and introduce huge political difficulties. Those political difficulties are often serious and they may endanger the world security due to the tendency of the governments to shift their politics towards the military approach to increased social and political difficulties.

Consequently, question of economic growth and access to open content is not just technological curiosity or a hobby of those that technically skilled and educated. It is important for world security too.

International legal obstacles to democratization of innovation

Increased economic, technological and political competition between companies and countries posed questions in international politics that introduced international treaties aimed at regulating issues of copyright, intellectual property, free trade and other rules that would protect companies from "unfair competition". Governments are forced to sign treaties that condition them politically to obey strict licensing policies. Disobedience is followed by exclusion from other international organizations and economic and political cooperation processes.

In the "Report on the Preparedness of Serbia and Montenegro to negotiate a Stabilization and Association Agreement with the European Union" the European Union suggested explicitly that legal system of Serbia and Montenegro should follow an obligation to monitor and realize ex-officio control of copyright and intellectual property regulations. Some regulations from international intellectual property treaties are proven to be efficient, yet some are proven to be detrimental and even counterproductive , encouraging companies and politicians to introduce laws that violate human rights, increase corruption and support dictatorships.

Then and Now

Copyright was used first in England as a method for the Crown to take control over possibly seditious publications. Later, the Copyright Act of 1709, known as Statute of Queen Anne, was intended to prevent monopolies over the printing of books. Thus, although firstly copyright was aimed to control printing, it turned into and act with anti-monopoly statements. Furthermore, the US Constitution Article I, Section 8, entitles Congress to have the power to promote arts and science by securing for a limited time to authors and inventors exclusive right to their writings and discoveries. Obviously, copyright is a pendulum that moves between respect for creators and monopolies and rights to freely use, create, modify, distribute certain goods and services.

Such dilemmas and controversies may cause painful political conflicts. We witnessed such disputes when the so-called "digital-era" started to dominate the market. Since we are moving from an analog world where so-called "first-sale rights " have been respected, to the digital-era where there are more and more restriction,s it is time to reconsider our politics and to ask ourselves if we must turn into non-democratic regimes. We cannot abandon technological advances and go back to the analog era, but there is an increasing tendency to impose rules that entitle users to do only what is allowed, assuming that all other possible uses may be liable as set in the end user license agreements or other legal regulations.

Due to the increased commodification of markets and the possibility that corporate entities can claim their own copyright, over time copyright expanded over a number of products and that liability covered more possible actions by the users than ever before. At the same time, large corporations became so powerful that even many countries are not able to fight against their economic power. Consequently, the pendulum of copyright moved more to the side of monopoly, political powers, and control -- where ity started before the Queen Anne Statute. Citizens' innovations, knowledge, freedom to share information and knowledge took the role of publishers of "seditious publications" . Thus, the debate over monopolies and copyright that took place between Thomas Jefferson and James Madison is still valid and deserves our attention and careful consideration. Thomas Jefferson was against monopolies of any kind while James Madison was argued more for "protection of authors".

Democratization of Innovation – Impetus for Economic Growth

Eric von Hippel [1] and other scholars have observed that the relationship between users and manufacturers is not one-way. In many cases, manufacturers are not just entities that manufacture product that users will use and wait passively for another product to appear on the market. Users are not just purchasers, they are often smart, intelligent and highly skilled people that understand the purpose of the product and technology that may improve certain product. Indeed, the users are often inventors and serve as informal advisors and even small R & D labs that suggest to manufacturers how to improve their products or which new products they have to introduce to the market. Hence, in many cases in history of the technological and scientific developments, we see that multitude of collaborative developments may gain significant results and that citizens themselves are inevitable constituent part of any significant development.

The companies that fear innovation and lack of control over the use of products should reconsider their business models. Fear of innovation and change was always present in politics, law, society, culture and economies . In many cases, companies were afraid of technological developments, but later it proved that innovative approaches to business created more incentives for profit and economic development. Thus, the development of internal capacities to grow, learn and change is a substantial part of the capability to endure all bumpy roads to success. Lack of such capacities cannot be compensated for by increased lobbying of politicians to increase control over product and service users. Governments should create bodies and fora that will help legal persons to harness the benefits of openness so learning and growth may be more accessible to legal persons and citizens themselves.

Free to Develop – Societal Decision

Free access to information and knowledge and freedom to share information are substantial freedoms for any developing country while in economic technological and organizational transition. Freedom of innovation and follow-on innovation, access to information and knowledge become an important factor in fostering economic growth in developing countries so developers do not need to reinvent the wheel in solving each problem. In the developed countries, development teams are usually organized as small companies that sell solutions or they are employed by big companies that are more involved in big commercial projects than in solving technological problems in small and financially less capable environments.

The phenomenon of the free software movement is a typical example of mainly informal gathering of developers and users developing free software, and lately open hardware, with the aim of fostering democratization of innovation and use of software and hardware. Paradigms of free software (Free Software Foundation www.gnu.org) and open hardware emerged as a result of human need to protect and develop its liberties in the technological field too. There are hundreds of thousands of people involved in such projects, whether they are software developers, demanding users and testers, researchers, or engineers faced with certain technological problems. Nowadays, tens of millions of people benefit from using the results of their efforts.

Free software movement may serve as the model how to build infrastructure for the realization of societal decision to practice right to develop themselves in developing countries. However, establishment and operation of such infrastructures is in the interest of manufacturers, governments and the customers themselves. Economic growth may be achieved by successful distribution of easily distributable and modifiable technological applications and developments that will enable end users to use them and improve according to their needs in their own countries.

Numerous engineers, software developers, scholars, scientists and individual enthusiasts use technological advancements, including the Internet, to form information gathering and exchange places where they share information on development of software, hardware and other scientific and social consequences of technological developments. Activists and volunteers, joined by universities, civic initiatives and companies have developed operating systems, software packages and hardware that developed schools and companies world-wide. Regional government in Extremadura, Spain, supported its school and small and medium enterprises by involving them in development and deployment of free software in schools. The Open Society Institute supported project of localization of free software on Romani language with the aim of helping Romani children to have better access to knowledge and information on their language.

Although the Internet serves as the communication channel for those projects, deployments are realized locally. The World Wide Web, IRC, E-mail, forums, mailing lists are essential ways to open content and establish international *de facto* societal decision-making processes on technological advancement, and the deployment of free software and open hardware. Due to flexible but legally grounded licensing practice, the free software and open hardware movement has proven to be not just an informal movement, but also legally binding on users to respect freedom of others. Technological knowledge is not only for technically skilled and educated people in good physical condition. The development is much wider and it applies to people with disabilities too.

Accessibility of information and knowledge should be the paramount consideration of each government, since the development will be impossible without empowering their own people regardless of their disabilities or difficulties in apprehension of content. A good example of that effort is Foundation Sidar from Spain (http://www.sidar.org). Sidar is working on increasing accessibility of web content for people with disabilities. Such an open and inclusive practice is at the core of initiative called Inclusion Digital by Emmanuelle Gutierrez y Restrepo (http://www.inclusiondigital.com) where there will be placed e-learning materials for people with disabilities so they may acquire new skills and knowledge for their personal growth, employment and/or self-employment. The Linux Center in Belgrade works on modification of GNU/Oralux, that is GNU/Linux, for people with visual impairments with the aim of training people with visual impairments to use it for employment and self-employment practice.

OPEN HARDWARE AND FREE SOFTWARE

Right to develop for all

Beside free software that is defined 21 years ago (www.gnu.org), there are emerging initiatives for the design and development of open hardware. Jamil Khatib in his paper [1] "Free Chips for All" gave his view of open hardware: "All design files should be available for free. This includes schematic, HDL, and layout files. Software and firmware interfaces such as drivers, compilers, instruction set, and register interfaces should be available and open source. All information and documentation, like application notes and interfacing information, should be openly available. In short, all information needed to modify, use, and implement the hardware design should be available for free in order to designate a project as complying with the open hardware specifications." Richard Stallman in his article [2] On "Free Hardware", written for Linux Today, emphasizes some possibilities for licensing: "People often ask about the possibility of using the GNU GPL or some other kind of copyleft for hardware designs. Firmware such as programs for programmable logic devices or microcoded machines are software, and can be copylefted like any other software. For actual circuits, though, the matter is more complex. Circuits cannot be copylefted because they cannot be copyrighted. Definitions of circuits written in HDL (hardware definition languages) can be copylefted, but the copyleft covers

only the expression of the definition, not the circuit itself. Likewise, a drawing or layout of a circuit can be copylefted, but this only covers the drawing or layout, not the circuit itself. What this means is that anyone can legally draw the same circuit topology in a different-looking way, or write a different HDL definition which produces the same circuit. Thus, the strength of copyleft when applied to circuits is limited. However, copylefting HDL definitions and printed circuit layouts may do some good nonetheless."

Sometimes free software and open hardware nicely interact in embedded systems. The International T2 Project (http://www.t2-project.org) is an informal team of young developers that created a free system development environment based on GNU/Linux and users may build their own customized GNU/Linux targets for their desktops, servers, routers, embedded hardware etc.

Liberating licensing practice: the copyright pendulum swings toward freedom

Copyright protection agencies may advise free software and open hardware designers to choose proper licensing depending on the legal system in a country. Flexible licensing enables people to freely use, modify and distribute software and hardware designs as well as documentation necessary for the efficient work of software and hardware designers and those involved in deployment. Innovation and follow-on innovation are important parts of economic growth. Copyright, licensing and patenting where it applies is not meant primarily to protect holders but to create incentives for action, development and benefit to communities. Consequently, governments should support further development of a legal framework that will provide incentives for those who are creative to disclose their innovations to other contributors to the innovation process. Thus, fear of openness should not be justified, since creation of incentives for innovation may help in building new business models and technologies that will help transform certain industries, and introduce of new jobs, products and services. Chambers of Commerce and similar bodies should be opened to citizens' initiatives and should serve as clearing houses and resource centers for development. NGOs and even informal civic initiatives may provide the momentum for the successful and redefined work of chambers of commerce.

"FREE/OPEN" MAY BE FEASIBLE

Companies can harness benefits of openness

Since the manufacture of chips and processors advanced at a very fast pace, while the capability, complexity and programmability of those chips is increasing rapidly, manufacturers need to find a way to increase sales. Some manufacturers followed the paradigm of openness in product design and market management. For example, Xilinx (www.xilinx.com) sells some of their products with implementation instructions, schematics and gerber files. By doing so, Xilinx enabled engineers to have shorter time-to- market or time-to-implementation and fostered its sales. Another example of such an approach is Elphel Inc. [3] which designed a network camera based on Spartan-IIE FPGA by using the free WebPack by Xilinx. Elphel Inc. gives all documentation for building that camera free of charge (www.elphel.com). The same method is in many cases used by the company Cirrus Logic (http://www.cirrus.com) that gives away for some of its products complete documentation including gerber files, schematics, diagrams and support. US company Genesi (http://www.genesi-usa.com) published the design of their motherboard PegasosPPC that is based on the PowerPC platform. That tendency is also followed by Sun Microsystems (http://www.sun.com). IBM, Freescale, and numerous other companies realized that openness may be a way to attract developers and customers worldwide in order to foster their sales and the economic cooperation various customers. A Positive consequence of such an approach is that developers may contribute to the development of their

products and help them to advance existing products and introduce new products on the market. Time-to-market may be rapidly shorter if company does have intensive and productive communication with its own users community.

NON-PROFIT FOR ECONOMIC GROWTH

Non-profit is not anti-profit

Experience of IBM, Freescale, Genesi and has other manufacturers shown that individuals and non-profit organizations may contribute significantly with their experience, knowledge and skill to make shorter time-to-market and time-to-implementation. We put time-to -implementation beside time-to-market, because non-profit organizations and individuals may be actively involved in deployment and customization activities aimed at developing their own communities.

However, the preference and mission of non-governmental non-profit organizations may be implementation in terms of fostering economic growth and development rather than profit generating due to their legal definition and restrictions. Power.org is an organization with a mission to develop, enable and promote Power Architecture technology as the preferred open standard hardware development platform for the electronics industry, and to administer qualification programs that optimize interoperability and accelerate innovation for a positive user experience. Collaborative efforts of NGOs with companies, universities, or research centers may result in the development of possible application fields and best practice studies that describe how certain solutions may be implemented in real life situations. Genesi is planning to do such a project in India, and a pilot project in Serbia with the EFIKA II platform, based on the Freescale system, on chip MPC5200B, with various interfaces and thousands of GNU/Linux applications ported to it. So, with little effort by local developers, it may be an e-learning tool, VoIP access point, Internet access point, patient monitoring device, telecommunication device, thin client, small server, router, local community accessible information center et cetera.

Users' imagination increase application fields of certain product

However, open-minded people in Genesi cooperate with NGOs, companies and individual developers that want to contribute to better customization and shorter time-to-implementation period. Application fields for the non-profit organizations may be:

- projects that improve the functioning of the public sector (development of information infrastructure, development of software and hardware for better functioning of, for example, social and health policy, providing local authorities with tools for better administration management, accessibility aware information centers, increased interoperability et cetera);projects of common interest (development of software and hardware for ecological preservation and protection, development of tools for optimization of traffic, pollution measurement and fire alarm tools, development of tools for broadcast or production in arts, culture, mass media, democratization of media in audio and video blogging, communication and coordination in disaster and relief operations et cetera);
- projects that enable enterprises to have a more inclusive employment policy (development of software and hardware that enable visually impaired or people with motor disabilities to perform their job tasks efficiently, development of software and hardware that may decrease injuries while performing job tasks, development of education and training materials for employees et cetera);
- projects that directly foster economic growth (developing of software and hardware that may improve optimization and industry process control, introducing new technologies and opportunities for business development, improving telecommunication infrastructure and various telecommunication services, digital signal processing, mixed signal designs, increased

interoperability and inter-connections optimizations et cetera);

Profit generating activities may be the result of ventures and projects undertaken by cooperative efforts between profit and non-profit legal entities. An interesting point is that non-profit non-governmental organizations use resources that are found on public servers that host archives from universities, companies, research centers and institutes, civic initiatives and organizations focused on technological developments and/or individuals who decided to give their research, studies and findings to the public.

Thus, international science and technology fora may serve for the good of people in any country including developing countries. The Chamber of Commerce, Ministry of Economy, Ministry of Science and Technology, universities, NGOs and individuals themselves may undertake joint efforts to develop free software and design of free hardware. A good example is the Processor Architecture Laboratory at the School of Computer and Communication Sciences, Lausanne, Switzerland. (http://lap.epfl.ch)

Development tools, firmware and complete development documentation may be to users according to the GPL or similar licenses. To make equal starting points for all who access development documentation, it is needed to provide all schematics, block diagrams, parts list, gerber files and detailed assembly and manufacturing instructions. . Smaller manufacturers and users may be in trouble if they lack documentation on how to assemble, mount or manufacture a product. This is very important since with fast market developments smaller manufacturers or end users may not survive if they miss that link.

Hence, giving help or the opportunity for development must no disempower end-users in harsh market environments. Jack Ganssle in his book [4] "The Art of Designing Embedded Systems" emphasized that often embedded systems are late and buggy due to various pitfalls in the organization of work or approach to writing code, whether it is firmware development or hardware design. Proper code-writing techniques, detailed commenting the code, code inspection et cetera, may be organized on Internet sites so the code that is inspected may be implemented easily , so post-deployment activities will be minimal. In addition, free and open communication with developers may be very helpful to those who are more focused on implementation, administration and maintenance of technological solutions to the problems that end-users encounter.

Active coordination – not just occassional cyber space phenomena

Efficient administration of repositories of free software documentation for free hardware design may be a vital practice for profit and non-profit legal entities. Although some repositories, such as (HTTP://www.opencores.org), (http://www.opencollector.org), already exist, it may be useful to concentrate more on free hardware design including proper administration and management techniques that are proven to be successful. Conclusions that Ganssle [4] wrote in his book may prove to be very helpful to increase efficiency of the development and implementation of code and documentation with th aim of avoiding or decreasing expensive debugging activities while implementation is taking place. Business damage caused by bugs may be disastrous and debugging activities expensive. For that matter, it is important that those involved in free software and free hardware development, code and documentation, testing and control, maintenance, and repository administration receive significant support from those who are responsible for successful economic growth.

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