

Measuring non monetary innovation in firms. Cases from Free/ Libre Open Source Software (FLOSS) firms of Argentina

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Abstract

This paper presents a critique of the Oslo Manual based innovation surveys designs in the software sector, upon a series of Free/Libre Open Source Software (FLOSS) firms case studies. The main objective of this paper is to contribute to identify the specificities that acquire innovation in FLOSS firms that traditional innovation surveys usually omit, to improve actual innovation measures and metrics in the software. We applied a qualitative analysis, through a 5 FLOSS case studies of Argentina, aimed to elucidate the nature and particularities of their innovation processes and outcomes, and the characteristics and role of the collaboration with the community in the business model and their innovation strategy.

Key words: Innovation; Free/libre Open Source Firms; Innovation Surveys

Introduction

Latin America is facing difficult times regarding development policies. Besides that since 2000s an incredible growth path was recovered, a renewed neoliberal agenda has arisen again in many countries in recent years. In any case, the growth process in the past decade encourages the necessity to design development policies that transcend the sole impulse of innovation, which is the main true engine of genuine growth, but to advance in more inclusive economical paths. That is one of the main reasons why improved ways to measure and to consider innovation are needed.

Has been more than two decades since many Latin American countries began to undertake innovation surveys, as an input to innovation and development policies design. More than 15 Latin American countries performed innovation surveys, some of them with several waves and even ones including services sectors. That led to scholars in the field in the region, to make a balance of the evolution of their innovation surveys, their limitations and the degree of adequacy to the domestic needs.

Pursuing that, besides the several limitations of actual surveys (as, for example, the restrictions to micro data access, problems with the harmonization of questionnaires, the lack of a cross use of their information with other economic surveys and census, and the scarce use of their results by policy makers in the monitoring, evaluation and re design of policy instruments), there is also a recent concern and need to consider new innovation metrics.

In her Keynote Speech of the 13th Globelics International Conference in La Habana (Cuba), Monica Salazar, one of the creators of the Bogota Manual sustained this view (Salazar, 2015). Between the concerns pointed out, is the challenge to combine qualitative and quantitative metrics and how to consider other novel types of innovation. In particular, how to include in our surveys the innovations of the public sector and the diversity of outcomes from the academic community (mostly in the Latin American context, where developmental Universities stand out), and how to consider and value social innovations, inclusive innovation and grassroots innovations, many of them developed by communities. In a word, how to develop new novel innovation metrics better suited to local needs. The traditional firm-related innovation concepts and metrics were originality developed according the central economies needs, and a reconsideration is needed.

In this paper we try to contribute to the Latin American research agenda in this issue, in seek of new innovation metrics for inclusive development (Dutrénit and Sutz, 2013, Dutrénit and Zúñiga, 2013, LALICS, 2012). Our focus will be the need of a particular consideration of non monetary innovation, as many of the outcomes from the Free/Libre Open Source (FLOSS) activity.

Many of the innovations created in the FLOSS activity are not monetized directly, which introduces a particular difficulty to traditional measuring methods. The FLOSS activity involves an interaction with the Community where several transactions are non-monetary, arising the problem to measure and to quantify their economic relevance (Ghosh, 2003). Even more, one of the major issues where economics failed to understand is how firms operate when their developments and innovations are open to access, and many times free-of-charge. Moreover, how a firm, as FLOSS firms, can be motivated to collaborate in community projects, as long later their innovations can be used by potential competitors.

The nature of the production and innovation in FLOSS activity leads to most innovation surveys on the software sector fails to account for their relevance in the statistics. An additional complexity is that FLOSS can be produced both for individuals collaborating in the community, as long for public agencies and Universities, as by firms. However, as national and sectoral statistics usually came from surveys designed at the firm level, most FLOSS innovations appear invisible in the statistics due to the lack of a firm-level innovation survey design that considered FLOSS.

FLOSS is crucial for developing economies with an emergent software sector, as for example Argentina or Brazil, for several reasons. Their presence mitigates the entry barriers into the activity, as well that solve many of the intellectual property problems regarding “piracy”. Moreover, allows alleviating balance of payment problems through saves in foreign license buys and through substitution of imports (Moncaut and Robert, 2016).

The main objective of this paper is to contribute to identify the specificities that acquire innovation in FLOSS firms that traditional innovation surveys usually omit, to improve

actual innovation measures and metrics in the software. We applied a qualitative analysis, through a 5 FLOSS case studies of Argentina, aimed to elucidate the nature and particularities of their innovation processes and outcomes, and the characteristics and role of the collaboration with the community in the business model and their innovation strategy.

1. Theoretical and empirical antecedents. FLOSS and innovation as a monetary concept

1.1. Traditional views in the innovation literature.

Technical change and innovation are at the center of economic change and growth in capitalist economies. It is a fact widely accepted in economic theory, both from orthodox (Solow, 1956, 1957) as from heterodox views (Dosi et al., 1988, Freeman and Soete, 1997, Lundvall, 1992, Nelson and Winter, 1982). However, traditional orthodox economics has failed to conceptualize properly the innovation phenomenon, fundamentally by their strict (close to dogmatic) adherence to certain assumptions (as optimization micro behavior, the notion of equilibrium, the neglect of real uncertainty, between others). That is the reason why heterodox views from schumpeterian, institutionalism and learning theories have become dominant in the innovation literature.

The contribution of Schumpeter to this field is unavoidable, and their concepts conditioned both the analysis as the topics considered regarding technical change (Schumpeter, 1939, 1942, 1911). From his view, technical change is a central part of the competitive strategy of the capitalist firm. Schumpeter (1939) introduced the distinction between invention (as the generation of a new knowledge), innovation (as the application of past R&D efforts in a new product or process in the market), and diffusion (as the imitation process of an innovation, when is adopted by a large number of competitors).

In general terms, according to Schumpeter (1911), innovation is the creation of new combination of means of production in five types of innovations: i) introduction of new products, ii) introduction of new methods of production, iii) opening of new markets, iv) development of new sources of supply for raw materials or other inputs, v) the creation of new market structures in an industry.

Innovations are subject to a selection social process, non *ex ante* optimal (Schumpeter, 1942). Implicitly, the main selection mechanism in capitalist economies is the market, and innovation has a monetary visible face appropriable by firms. This view is adopted by the Oslo Manual: “A Schumpeterian perspective tends to emphasise innovation as market experiments and to look for large, sweeping changes that fundamentally restructure industries and markets” (OCDE, 2005). The innovation manuals (Jaramillo et al., 2001, OCDE, 2005), are also influenced by latter approaches, as evolutionary

theories (Nelson and Winter, 1982), innovation systems (Lundvall, 1992, Nelson and Winter, 1982), some organizational innovation literature (Lam, 2005); but the schumpeterian conceptions are their main theoretical basis.

From the Oslo Manual perspective, the sourcing of innovations in firms are: i) to adopt innovations from other actors (firms or institutions) as part of a diffusion process; ii) to invest in creative activities to innovate, namely in innovative activities (i.e.: R&D expenditures).

In this line, innovation refers to new products, new production processes and new organizational set-ups introduced in the market, while innovative activities concerns the search for, and the discovery, experimentation, development, imitation and adoption of these kind of novelties. It is the core of the Oslo Manual that guides innovation measurement in many sectors.

Claims from Latin-American scholars in late nineties in the Bogota Manual about the lack of consideration of their innovation specificities, leads to include new commercial and marketing channels as another innovation type. The 3rd edition of the Oslo Manual included these types of innovations, and incorporated a degree of novelty consideration (new to the firm, new to the domestic market, new to the international market).

This conceptions came from schupeterian economics, and are the basis that guide the actual design of innovation surveys that follow the Oslo Manual or the Bogota Manual manuals (Jaramillo, Lugones and Salazar, 2001, OCDE, 2005). Implicitly, innovation refers to an idea introduced to market selection processes that in a way or another, is monetized and (in diverse degrees regarding the sectoral regimes) appropriated by the firm, reinforcing their economic position.

Mostly innovation surveys in the software sector that adopt an assimilation-to-manufactures approach (Gallouj and Savona, 2009, Gallouj and Weinstein, 1997) follow the main standards of the Oslo Manual, with some minor adaptations to the sector. Moreover, it implicitly considers a monetary conception of innovation. However, the innovation literature has pointed out other kinds of innovations, as for example, the innovations of the public sector and outcomes from the academic community, social innovations, inclusive innovations and grassroots innovations; which are not implement by the Oslo Manual to be measured at the firm level.

Nevertheless, many of these kinds of non-monetary innovations are undertaken in the FLOSS universe, even by firms. The FLOSS activity involves an interaction with the Community where several transactions and innovations are non-monetary (Ghosh, 2003). It opens a research path to discuss the traditional conceptions of innovations, and mostly the ways to measure it in the innovation surveys.

1.2. Free/Libre Open Source Software firms and Innovation

The origins of the production of software are related to the efforts made by engineers and scientists of academic, government or corporate labs; embedded in sharing practices, the free exchange of software, and in the write of software upon previous code and programs free available, as their research and development culture. In that sense, the production of software is an activity that was privatized by mid-1970s with their separation from hardware, becoming the software a separate marketable product.

From their birth, the Free Software movement has transformed the software industry. The Free Software movement arose in the academic sphere (mainly, in the MIT, Harvard) in the early eighties as a reaction the proprietary software production. Richard Stallman leaded this reaction, creating the GNU General Public License, a way to license software guaranteeing the freedom to use, study, share, copy and modify the software. This license imposes that further products must enjoy the same license, and it is elaborated, supported and defended by the Free Software Foundation (FSF), a nonprofit institution that gives a legal framework for the FLOSS development (Stallman, 1983). By the end of 1990's, Eric Raymond established the technological and economical virtues of the open source development model but still allowing a business model based on proprietary software (Raymond, 1999). Since their beginnings, FLOSS has challenged the business models and strategies both for SMEs and for Large Multinational Corporations (Dahlander and Magnusson, 2005).

Briefly, a software is a FLOSS if the users has the freedom to run, copy, distribute, study, modify and to improve the software. Free software does not refer to free-of-charge, but in the sense of freedom (which lead to the use of the term 'Libre', to avoid the English language confusion with the term 'Free').

The free software licenses (i.e.: as GPL) guarantees that the source code remain in the public sphere, protecting it from private appropriation. Software is Open Source, when their source code is available with the executable versions. To be considered also as Free Software, it must: i) be available in the public sphere; ii) respect the four basic freedoms from Free Software¹. An open source software can be also Free Software, if accomplish with the four freedoms. In operative terms, from the production an economic perspective, Free/Libre Software and Open Source Software can be used indistinctly, or jointly, as FLOSS.

From the economic point of view, the FLOSS activity in the communities raises the problem of the lack of measurable and quantifiable monetary transactions (Ghosh, 2003). This problem leads to the scarcity of empirical data in big scale, to take into account the FLOSS relevance in the software industry statistics, and naturally, their innovation contribution.

The innovation literature on FLOSS mostly focuses the study on the project or in the community level of analysis (Kogut and Metiu, 2001, Lee and Cole, 2003, O'Mahony, 2003, Von Grogh, 2003, Von Hippel, 2005, von Hippel and von Krogh, 2009). A first stylization of the development and innovation process can be done following these antecedents, usually as a result of case studies².

¹ - The four freedoms of free software are: the freedom to run the program as you wish, for any purpose (freedom 0); the freedom to study how the program works, and change it so it does your computing as you wish (freedom 1); the freedom to redistribute copies so you can help your neighbor (freedom 2); and the freedom to distribute copies of your modified versions to others (freedom 3) (Stallman 1983).

² - Kogut and Metieu (2001) study the Linux and Apache cases. Von Hippel and von Krogh (2009) and von Hippel (2005) present the cases of Fechmail and Apache. Lee and Cole (2003) study the case of

At this analysis level, a FLOSS project is a community web-based development software project. This community is characterized by a production model where the programming work is distributed and dispersed, even globally. Their members share norms and a culture, which jointly with the license standards, guarantees the freedom of the knowledge sharing and prevents privatization practices.

A FLOSS project is typically initiated by an individual or a small group seeking for a solution to a personal, organizational or social need. Usually it is organized in two types of groups: a core and a periphery. The core group includes the authorities of the project, their leaders (where are usually the initiators of the project and the idea) and series of maintainers, that evaluates the contributions received from the periphery to the source code, and eventually accept or reject it, to sustain the quality desired of the software. Also, they establish some of the norms of the community, and selection mechanisms of the improvements.

The periphery is composed by a large (in the most successful projects) number of developers that test the software, report bugs and failures, proposes patches or improvements to the source code. This kind of organization is non structured one, but founded on meritocratic societies.

There is not a contributors recruiting formal mechanism to the projects and, in that sense, there is no formal contracts between the developers and the project, and the relation is to a large degree, volunteer³. The development process is grounded on free development tools a shared infrastructure that allows the hosting of the project (i.e. a GitHub) and the monitoring and testing of changes. That includes mailing lists to particular aims, as bug reporting, the debate of ideas and the availability of essential development tools. This organization of the development process allows the introduction of several high quality innovations (successive improvements to the code) and a wide collective learning process. These innovations and learnings are based on an evaluation process which is very criticized by several members of the community (Lee and Cole, 2003).

This characterization of the innovation process difficulties specially the measurability of innovation, which occurs disperse (even globally) and distributed in a community. As a result, the most salient surveys available upon FLOSS production take as observational units the software workers and developers collaborating in community projects: the WIDI 2001 survey (Robles et al., 2001), the BCG Hacker Survey 2002 (Lakhani et al., 2002), the FLOSS 2002 survey from UNU MERIT (UNU MERIT and Berlecon Research, 2002), the UNGS-SADIO 2004 survey (Borello et al., 2005, Robert, 2006), the survey from the FLOSS WORLD 2007 project (MERIT, 2007).

Even more, some authors propose an observational unit more reductionist to quantify the non monetary transactions, through the authorial decomposition of the source code from open source projects (Conklin, 2007, Ghosh, 2003). However, it is problematic proposal, because a survey designed at that observational and analysis level, does not allow imputing clearly the innovation activity at organizations and firms. At the same time, sectoral and national statistics came from surveys that measure the economic and innovation of a production activity by surveys to firm. As a result FLOSS innovation and their economic impact (in terms of employment, direct or indirect sales and exports,

Linux in general. O'Mahoney (2003) study the appropriability conditions in 6 community projects: GNU, Linux kernel, Apache, Debian, Gnome and Linux standard base.

³ - For a study of individual motivations to collaborate see O'Mahony (2003).

diffusion of product, processes or organizational innovations, etc.) appears invisible in technological and innovation statistics.

There is a lack of innovation survey designs to FLOSS firms. The innovation literature identifies a series of aspects that motivates firms to participate in FLOSS communities which impact in their innovation activities (Colombo et al., 2013, 2014).

There are many ways how firms can in-source knowledge from FLOSS communities. Some FLOSS firms can download OS code and adapt it to the need of their customers to develop specific solutions, as a way to source their innovation and production processes. Also, they can contribute to FLOSS projects paying to their workers to devote working time to participate in mailing lists and to write documentation, code for the projects, debug code, or to answer technical questions and solve problems.

Leading FLOSS projects in the community and/or releasing publicly in-house developed software, the firms can receive freely suggestions from individual volunteers and others firms, debug of code, complementary modules for their software, or user assistance and support. The communities offer access to abundant free-of-charge external resources, as free tools or infrastructure, and commercial resources such as reputation in high quality software production capacities, contacts with possible customers, and alternate marketing and distribution channels (Colombo, Piva and Rossi-Lamastra, 2014, West and O'mahony, 2008). Any kind of software can be successfully advertised through the community, and their acceptance is usually viewed as a 'quality certification', at least a 'quality capacity proof', which could reinforces the reputation and position of the firm in the market.

All these knowledge sources can input the innovation processes of the firm, and are fungible to the development of any software product and to provide diverse services. In order to put in value and to benefit from these resources, is essential the participation in FLOSS communities. Even, the firm can act as an 'insider', if it achieves a proper status in the community, that allows to affects the directions of the FLOSS projects in their main interests desired (Capra et al., 2011).

These aspects are first insights from the literature regarding the ways that FLOSS community can source knowledge to innovation in the firms, which should be verified and considered in the ways we conceptualize and measure innovation in the software sector, when we are seeking to treat firms as observational units.

2. Method and data sources

The engage the objective to identify some specificities that acquire innovation in FLOSS firms, we applied a qualitative methodology, through case studies (Denzin and Lincoln, 2005, Eisenhardt, 1989, Yin, 2009).

We performed during 2012-2017, 5 in depth case studies in FLOSS firms from Argentina, which are diverse regarding structural characteristics as size, location and production specialization. Three SME cases are software firms from Córdoba: **Kunan** employs 14 workers is specialized in CRM solutions based on SuiteCRM (installation, customization, development of customized complementary software modules, training, migration and integration services), remote data base services and mobile solutions; **Machinalis** employs 35 workers and is specialized on solutions and customized development of software in the fields of artificial intelligence, Natural Language

Processing, Data Mining, Machine Learning, Data Science and complex web development; **ECIC Systems** employs 7 workers and offers server administration services, through a platform developed internally upon FLOSS.

The other two cases are Free Software Work Cooperative firms. **Tecso** is a Cooperative located in Rosario (Santa Fe province) employs 132 associate workers and develop customizable software (specially for the public sector, entirely FLOSS), software factory (development of part or modules for other firms), and services as consultancy and support. The other Cooperative, **Gcoop** employs 18 associate workers, is located in Buenos Aires city, and is specialized on ERP implementations, the development of customized software, web development services, and diverse training services.

Table 1. Firm data sources

Firm	Numer of interviews	Period of Interviews	Informants	Total Hours of Interviews	Secondary Data
	2	Oct 2016 – Mar 2017	Technology Manager / Owner Manager OS Department	03:30	II Software Innovation Survey – 2016 Papers from KUNAN workers CRM Suite and Sugar's community web information KUNAN web page CADESOL web
	8	Oct 2013 – Aug 2014	CEO COO CFI / Human Resourser Manager 2 Project Managers 1 Technical Leader 1 Developer	08:40	II Software Innovation Survey – 2016 Intemal Recruiting Document Python community web information Papers's abstracts presented on global and national conferences (PyData , PyConAr, etc.) Quepy (internal project of the firm) documentation Machinalis web page
	4	Jun – Nov 2016 / Apr 2011	2 Managers / Owners	03:20	II Software Innovation Survey – 2016 Slides presented in regional conferences from Fedora (FudCon) PITS (product of the firms) web information ECIC Systems web page
	2	Apr 2017 / Mar 2012	1 Associate Owner / Comercial Manager 1 Associate Owner / Developer & GNU Linux Administrator	02:15	Annual memories of the Cooperative Drupal Assosiation web information Gcoop blog and web information Tryton-ar Github FACTTIC web CRM Suite and Sugar's community web information
	2	Apr 2017 / Jun 2016	1 Associate Owner / Manager	02:00	Tecso web page Online news

The interviews were carried out through a semi-structured questionnaire, designed with open questions around two topics: a) the nature and particularities of their innovation processes and specific outcomes of the FLOSS activity; and b) the characteristics and role of the collaboration with the community in the business model and their innovation strategy.

Also, we triangulate data sources, resorting to web information of the relevant communities related to the firms (Python, Tryton, CRM Suite and CRM Sugar, Drupal), the community conferences where the firms participated (PyCon, PyAr, FudCon, etc.), and the web page information of the firms. For some cases we have data from an innovation survey done in the software sector from Argentina during 2016. This survey

provides information about the production specialization, demand and market orientation, economic and innovation performance, innovative activities, quality standards certification, and use and production of FLOSS.

3. Innovation in FLOSS firms from Argentina

In this section we present the main characterization of the cases considered regarding the particularities that the FLOSS production activities introduced. It is a brief presentation of the most salient aspects of each case: first a descriptive characterization of the business model of the firm and their production specialization; secondly a presentation of their innovation processes and specific outcomes of the FLOSS activity; and thirdly, a presentation of the role of the collaboration with the community in the business model and their innovation strategy.

Table 2. FLOSS firms characteristics summary

Firm	Production Technologies Used	Size (2015)		Percentage of sales from FLOSS products or services	Communities where members of the firm participate	Percentage of FLOSS released publicly
		Workers	Annual Sales (u\$s)			
	HTML/CSS/JavaScript, PHP, Java, Android, MySQL, Oracle	14	≈ 425.000	30%	Suite CRM	20%
	HTML/CSS/JavaScript, Python LUA	35	≈ 500.000 (year 2013)	50%	Python	75%
	HTML/CSS/JavaScript, PHP, Java, .NET, Python LUA	7	≈ 115.000	80%	Fedora	0%
	HTML/CSS/JavaScript, Python LUA, Symfony, Flask	18	NA	100%	Tryton, Drupal, Suite CRM	NA
	HTML/CSS/JavaScript, C++, Java, .NET, Python LUA, MySQL, Struts, Informix	132	≈ 540.000	18%	Tryton, Odoo	5%

Table 2 above summarizes in a comparative way the most salient characteristics of the cases. Afterwards, a more detailed case to case presentation is done.

3.1. Kunan

Kunan is a firm from Córdoba (Argentina), founded in 2006 specialized in three activities: CRM (Customer Relationship Management) solutions, dba remote services and mobile solutions. The OS area comprises basically CRM solutions based on

SuiteCRM⁴ (installation, customization, development of customized complementary software modules, training, migration and integration services), and employs 3 workers (over a total of 14), and FLOSS sales from this department represents 30% of the total sales of the firm.

Regarding their innovative activities, the firm devotes in some extent all the personal habitually to R&D activities, besides having a sole worker exclusively dedicated to these activities (which is not, properly an R&D department).

The personal from the OS area dedicates a half of their working time to collaborate with the FLOSS project's community where the firm has a business interests: the SuiteCRM community. It involves solving problems and posting bugs, discussing and receiving in forums their contributions, to participate in the mailing lists being aware of news, voting about new developments of the community, etc.

That is, the firm authorizes their workers to collaborate and contribute during working time, and to learn in this process. It involves a series of innovative activities around FLOSS collaboration: a) paper writing and lecture of conferences,⁵ b) internal tools development, and c) the public release of modules developed internally, collaborating in FLOSS projects led by organizations outside the firm.

The firm does not release to FLOSS community complete software, but solely specific modules to SuiteCRM. Besides that, it implies an important innovative effort. It demands a significant codification, documentation and translating effort (Polanyi, 1966) about how the code developed works (sometimes, tacit to the firm), to reach the community standards and norms.

Because it is an innovative activity without a direct monetary reward, it is really a great effort to release developments. By this reason, Kunan releases around 20% of their FLOSS developments (and no more, as they wishes). This kind of activity is not taken into account in innovations surveys in the software sector that follow an assimilation approach according the Oslo Manual standards.

They led (together with other firms) a national FLOSS project⁶ during three years (2010-2013), but they abandoned their roles by strategical business reasons. Kunan workers are involved in FLOSS's promotion activities and teaching. Members of the firm has participated in FLOSS training to high school students with social aims, as well in University, in degree courses.

⁴ - A CRM (Customer Relationship Management) it is a software to the relational management of an organization. SuiteCRM is a fork from SugarCRM that became popular when Sugar discontinued the developments of their open source community edition in 2012.

⁵ - Some speeches and lectures were presented in local universities (Universidad Nacional de La Plata, Universidad Nacional de Villa María, etc), and some in foreign Universities (i.e. the Universidad Aquino de Bolivia, in Cochabamba, etc.).

⁶ - The FLOSS is Libertya, an Open Source ERP.

Regarding innovation outcomes (not considered by the Oslo Manual standards), the firm introduced products improvements to “external” FLOSS projects (particularly to SuiteCRM), as modules and patch solves. These are improvements to products delivered to the FLOSS community that are not (directly) monetized by the proper firm.

Finally, between the FLOSS linkages, Kunan is an active member of the Chamber of Free Software Firms from Argentina (Cámara Argentina de Empresas de Software Libre - CADESOL), as well of other firms organizations, as the Technology Cordoba Cluster.

3.2. Gcoop

Gcoop is a FLOSS work cooperative from Buenos Aires city, born in 2007. It is specialized on ERP (Enterprise Resource Planning) implementations in Tryton⁷ (a Python ERP) and the development of customized software in Django (Python), SuiteCRM, and Drupal⁸, web development services in Drupal, and diverse training services; integrally over FLOSS. In that sense, FLOSS and services related represent the 100% of the total sales.

Regarding innovative activities the firm could not separate their routinized activities from R&D activities, neither to calculate an estimated coefficient R&D / sales. Nevertheless, their innovation activities are intense. They collaborate in many FLOSS communities and in other TI cooperative and social associations; they have released publicly many modules developed to the community, individually and collectively with other FLOSS firms; they have participate in R&D projects together with other FLOSS firms; they wrote several papers and lectures in conferences; and they develops internal projects and activities aimed to experimentation with technologies and ideas.

Gcoop has participation in three global FLOSS communities and in three national: Drupal, SuiteCRM, Tryton, Tryton-ar and Python-ar, and Ubuntu-ar. The collaboration is done habitually during working time by all their members. When a worker is assigned to a commercial project in a development related to a FLOSS (p.e. in Tryton), part of their work is to collaborate and participate in this community. It involves from participate in forums and mailing lists, make code contributions (modules) and bug corrections (patching), to organize and to assist to FLOSS events, even donations to some tool or a repository that they found useful (i.e.: a github). Also, they have received collaborations and patches to their leaded projects.

7 - Tryton is a general purpose application platform under the license in Python and, that provides the core base of a complete business solution (i.e. accounting, sale management, inventories, etc.), as an ERP. See <http://www.tryton.org/>

8 - Drupal is a free and open source content-management framework to web development. See <https://www.drupal.org/>

Gcoop is member of the Drupal Association⁹, and it is validated internationally as a Drupal services and training provider. Ten members participate actively in the Drupal community. As a result, GCoop has done two contributions to the Drupal Core of Drupal 8, and has participated in 11 Drupal projects, including 3 modules publicly released by the firm. Particularly, the firm has released three modules to Drupal commerce developed to logistics clients (Commerce Andreani, Commerce Urbano and Commerce E-Trans). Also, Gcoops appears in the Association as a co organizer of four regional Drupal events (DrupalCamp Córdoba 2010, DrupalPicchu 2014, 1st DrupalCon Latin America - Bogotá 2015, and the DrupalCamp Chile 2015).

For the ERP solutions, the firms collaborates with the Python and Tryton communities. They contributed to the Python community with public libraries integration, and they developed (and released to the community) five ERP modules to Tryton (party_ar, subsidiario, citi_afip, contract_discount and sale_pos_ar), which are tools to implement Tryton in Argentina. Some of these releases, as well the creation of the Tryton Argentinean location (the github and the web of the local community), were carried out in association with other national FLOSS firms.

For many of the custom software developments, GCoop participates in the SuiteCRM and in the SugarCRM communities¹⁰. There, they are released a module for the community edition of SugarCRM in 2012, and a utility tool for programing in diverse modules of this FLOSS.

The public releasing of code, FLOSS and modules is an habitual activity of Gcoop. In the cases of commercial projects, sometimes they offers to the client a lower price of the development, if the firm considers important to release the code, or if applicable to other products to offer. There is not a formal agreement with the clients regarding intellectual property, they just let it know to the client about the decision to release a code, and invites the client to participate as an sponsor of the module (i.e. Andreani is a sponsor of one of the modules released in Drupal Commerce). Some developments are so customized, that losses utility a public releasing; which affects a calculation of some kind of coefficient of percentage of software liberated.

Some of their internal or social projects (see below) are directly publicly released, or started as a leaded project by the firm¹¹. In this case, full programs are released (see, for example, “Letras Viajeras” project). In some of these projects, they received contributions (as patches), but those are in some extent proportional to the size of the community (the case of ERP communities are smaller in the FLOSS world).

9 - See <https://www.drupal.org/gcoop>

10 - See section 3,1 for a characterization of SuiteCRM. Gcoop began to participate in SugarCRM, as long Sugar sustain the development of a Community Edition (an OS version). SugarCRM stoped this development in 2012, and a fork is SuiteCRM.

11 - For a full list of the public releasing of Gcoop (of any kind) could be consulted <https://github.com/gcoop-libre>

The choice of the FLOSS community to be part is an strategical decision of the firm. They chose communities with a large size (in the field), a good basis of developers in this sense, and with successful implementations to show. That allow to GCoop to share some of their internal R&D activities with the community, and it difficult to specify the (real) R&D investments of their innovations and developments. Also, to carry out their ideas, due their financial possibilities and dimensions, some projects must to be engaged in association with other FLOSS firms. A successful case of this collaborative R&D activities, is the development of prototype of a Mobile Data Center for transitory needs or for areas with difficult access, or lack of services, built in a container. This project was carried out in association with other 4 Work Cooperatives TI and a University.

The firm is very active in paper writing and lectures speaching for conferences. Internationally it included lectures in the LibrePlanet 2014 of the Free Software Foundation (MIT, US), speeches in DrupalCon 2014, Tryton Unconference 2013, International Free Software Forum of Porto Alegre (Brasil), between others. Regionally, they have participated in PyCon.ar, PyCams, four Events of Free Software and Social Economy, DrupalPichu, between many others.

In GCoop there are internal projects and activities aimed to experimentation with technologies and ideas, with working time devoted also to projects with social impact. It included, for example, a FLOSS project released publicly¹² called “Letras Viajeras” (Traveling Words), which is a software developed for Public Libraries to generate wifi access to e-books in the public transport in the Province, through cell phones or tablets. They also developed in collaboration with universities (Universidad Nacional de Quilmes) and a non-governmental organization (a Network of technologies for social inclusion - RedTisa) a Tryton based software for the management of social entrepreneurships and the confection of social balances of their activities. Between their users beneficiaries are production units of handicap workers, cultural centers and other social organizations. GCoop also develop diverse web tools in Drupal for the ‘One to one Netbook program’ of Argentina (Conectar Igualdad), which included a proper GNU/Linux SO distribution (Huayra). The firm developed a web platform to tacking and to evaluate the different steps of the program and web portal to manage congress of the program around the country. An other example was the development of an ERP for Work Cooperatives in Tryton, that incorporates local specificities and specially, the Cooperatives particularities, allowing to incorporate the creation of social balances to the traditional accountancy reports

All these are social projects, with a working time assignment inside the firm. There is a proper interest in their social aims by the members of the cooperative, not-led by commercial ends. To the latter examples, the list includes web development for social movements, ERP implementations for firms recovered by workers, Tryton developments for community radio stations, etc. Many of them derivate in social innovations and social technologies, and mostly receives sole a partial monetary

12 - See https://github.com/gcoop-libre/letras_viajeras

compensation (none, in others). About the monetary paid of the hours devoted to the services and development, is the end to solve social needs.

They also give training courses for FLOSS capacities promotion. In some case, these activities are done with social ends (in 2013 they gave a course to people in employment vulnerability situation) and sometimes it involves pure diffusion of FLOSS use (i.e.: in 2011 they gave courses on GNU/Linux programming to high school students, in 2016 they gave two courses of introduction to FLOSS and secure communications, and they organize an open hackers lab for teenagers).

Also, the firm participates in a Federation of FLOSS and TI cooperatives of Argentina (FACTTIC – Federación Argentina de Cooperativas de trabajo, Tecnología, innovación y Conocimiento) and in the Free Software firms chamber (CADESOL). These associations acts as local FLOSS communities, where a high degree of collaboration is observed

3.3. Machinalis

Machinalis is a software firm from Cordoba founded in 2009 and specialized on solutions and customized development of software using Python technologies (with Django framework) in the fields of artificial intelligence, Natural Language Processing, Data Mining, Machine Learning, Data Science and complex web development and Process Automation. Around 50% of the sales of the firm comes purely by FLOSS development and related services.

Inside the firm, two kinds of software projects are carried out: FLOSS solutions to clients (typical commercial custom developments, using FLOSS tools and technologies), and internal FLOSS projects (not client oriented). Internal projects are innovation bets of the firm to generate learning processes, develop internal tools, satisfy their workers, and to reach positions in the market. These projects are fully FLOSS and publicly released to the community, not directly sold.

Regarding their innovative activities, R&D activities in Machinalis are transversal to the whole organization. As a result, an R&D department becomes unnecessary.

All the workers from Machinalis has a formal dedication of their working time to collaborate with the FLOSS community, as a part of their projects in the firm (both commercial and internal ones). The firm is an active member of the Python community, with members with important international collaborations and with a recognized central role in the Python Argentina community.

The collaboration involves intense learning by interacting process, both to commercial as to internal projects. The interaction serves to the firm to tester and validation of new code of the internal projects of Machinalis, receiving continuously feedbacks about their quality, and also problems and bugs. In the commercial projects, the interaction is also natural (in forums and mailing lists sending questions, reporting and solving bugs, etc.),

from the moment that the firm incorporates libraries or OS code from others; to interact with these others developers.

Also, Machinalis uses the interaction with the community to improve their personal recruiting (reaching their desired cultural values and technical competences), and to marketing ends. Basically, they have a community marketing strategy, by the promotion of the firm abilities and competences, through papers and lectures in FLOSS conferences, and the public releasing of FLOSS developed by members of the firms.

Both are innovative activities related to their collaboration in the community. Firstly, the members of the firm wrote papers and presented lectures in several international and national conferences of the Python community¹³ (as PyData, or PyCon.ar) and in local and academic events. Basically, they present their projects developed, or certain aspects of their projects, as their ideas and visions; seeking (and reaching) for visibility of the firm in the industry, contact interesting partners and potential clients.

Secondly, an habitual innovative activity of the firm is the public releasing of OS code and FLOSS. They are released complete FLOSS, modules and parts, libraries, and tools. The internal projects are fully released publicly to the community, while in the commercial projects there are partial possibilities to liberate the developments. One principal obstacle is due to property regimes in the contracts with the clients, that restrings by confidentiality reasons the liberation of the code bought. Anyway, also in this cases the FLOSS could be public released partially by the firm, when exists innovations that it is considered that not conform an essential part of the solution sold, but it is a part of the intellectual capital of Machinalis and that the technological community should be rewarded and compensated by their contribution of free tools, which also benefits their clients. Other obstacle to the liberation process, is the specificity of some solutions in very customized software development. As a result, in global terms, Machinalis releases publicly around 75% of their software developments.

They leaded various FLOSS projects in Python technologies. The projects more populars and with a larger number of contributors and likes are Quepy, a FLOSS that convert Nature Languages into data base queries (with more than 750 stargazers¹⁴ and 140 commits), iEpy (with 520 stargazers and more than 1780 commits), Telegraphy (with 200 stargazers and 220 commits), and MyPy-Django (with more than 100 stargazers)¹⁵. These are innovation outcomes without a (direct) monetary revenue, but the reinforces the reputation and position of the firm in the market

3.4. ECIC Systems

¹³ - Revisar zip de slides y mencionar algunas lectures. Están Pydata 2016 x2, Pydata 2017, PyData 2014 x 2; PyCon.ar 2012 y PyCon.ar 2010

¹⁴ - A stargazer is an user that give the project a 'like'.

¹⁵ - The FLOSS projects leaded by Machinalis members could be consulted in <https://github.com/machinalis> .

ECIC Systems is a small firm from Cordoba, founded in 1986 that offers server administration services. The sales coming from FLOSS related services represent around 80% of the total sales of the firm.

The services are provided through a platform developed internally upon a FLOSS: PITS router¹⁶. PITS router is a data traffic centralized control and security's networks software, that allows the provision of services to networks' administrators (VPN administration, web servers, etc.). It is a FLOSS with a GPL license, which is not sold itself, but their implementation, configuration, support, and use services of the platform (i.e: ECIS offers centralized networks administration services to several types of clients).

The software was developed integrally in-house (without collaboration of the FLOSS community), with a financial support of a technological promotion instrument (FONTAR, is one of the more important subsidies to finance technological innovations in Argentina). The software is not released publicly, due to scarcity of working time to do it, but there is the intention to liberate it.

One of the owners of ECIC Systems is an Argentinean Ambassador of the Fedora community¹⁷, and collaborates frequently. However, the collaboration is done in the personal time of the worker. This participation includes the organization of community events and conferences (i.e. FudCon Cordoba 2015, ect.), speeches and lectures in congresses, give training courses in FLOSS, the administration of LATAM mailing lists, and collaborating in the IRC community channels fixing bugs, answering question, and in some cases, offering code.

Besides that the firm does not devotes working time (or financial support) to this collaboration activities in the community, the collaboration of this worker allows to ECIC to request for (and receive it) free-off-charge confection of documentation needed to their business activity.

The firm also participated in a frustrated intention to conform a Free Software Cluster of firms in the province of Entre Rios. The participation in this initiative, allowed to ECIC to access to the FONTAR aid, and it was an opportunity to engage relation with other FLOSS firms of Argentina.

3.5. Tecso

Tecso is a work cooperative from Rosario (Santa Fe province), founded in 2003. It is specialized on customizable software (especially for the public sector, entirely FLOSS),

¹⁶ - See <http://pitsrouter.com.ar/>

¹⁷ - Fedora is a Linux operating system distribution (<https://fedoraproject.org/>). Is the community version of an operating system supported by RedHat, which offers an Enterprise edition to big clients.

software factory (development of part or modules for other firms), and services as consultancy and support.

It offers solutions in four vertical areas: government, insurance, industry and for services sectors (including bank and finances, health sector). Their FLOSS products are concentrated in ERP solutions and proper complete software systems development for the public sector, and the FLOSS activities report around 18% of the sales of the firm. Also Tecso offer an implementation of some foreign privative solutions from IBM to the industrial sector (particularly, around automation) and Microsoft (a CRM, MS Dynamics).

Regarding innovative activities, Tecso has a formal R&D department (with around 10 permanent workers) located in a Technological District of Rosario. It behaves as a traditional software firm, in relation to these activities. The department carries out internal R&D projects, with a particular budget, with commercial ends. Actually, their more important projects are developing drones jointly to a platform to images processing and a project in informatics security. This projects were rewarded in an internal 'ideas contest' into the cooperative, managed by the R&D area, with the aim to promote an innovation culture.

Members of Tecso collaborate with the Tryton and Odoo communities¹⁸. The collaboration is done during working time, as long a project in ERP is active. That is, the participation is active, but conditioned to the duration of some projects to clients.

The participation involves a large series of activities: discuss in mailing lists and forums, solving bugs and problems of the community, reading papers and writing papers and reports for the community, and also receiving support about the implementation and customization of their FLOSS. However, the firm does not collaborate releasing code or modules in these communities. Tecso participates more in Tryton, because it have a larger community than Odoo.

The FLOSS development activity of Tecso is practically all done in-house in this case, and the public releasing is concentrated in complete software systems. In particular, their more successful releasing has been their solutions to government. The releasing has involved a particular contract/agreement with their client (the Rosario city's government). Two FLOSS are the most relevant: SIAT and GAEM.

The software SIAT (Sistema Integral de Administracion Tributaria – Integral System of Tax Administration) is a web system to manage activities in the tax's calculation, issuance, collection and control. It was developed originally to the Rosario city's government implemented in 2009. Next year, the government and Tecso signed an agreement to release publicly the system with a copyleft license GNU GPL v.3. After this agreement, the cooperative planned the liberation process and assigned working time to the releasing process. The software GAEM (Gestión de Actas Electrónicas

¹⁸ - See section 3.2 for a description of ERP Tryton. The software Odoo is an Open Source ERP and CRM.

Móviles - Mobile Electronic Acts Management) is a system to enact transit infractions using mobile devices (cell phones, tablets, etc.). The system was developed in 2013 and, after an agreement with the government, is public accessible under a copyleft license GNU GPL v.3¹⁹.

After the public releasing of these systems, many city government implemented it (Santa Fe city, Nogoya, Cordoba, Moron, Parana, Villaguay, etc.), generating support and implementation services demand, in some cases directly to Tecso. In some extent, the releasing has serves to the Cooperative as a a marketing promotion of the firm, allowing new business.

Also as long they offer a privative CRM implementation, the learning of this software has enabled Tecso to develop an OS module alternative to their clients in Tryton, which is in process to be approved by the Python community to be public released.

The FLOSS linkages includes also the participation in FACTTIC, with other FLOSS and TI work cooperatives. It is considered by the firms as a community, as long many collaboration processes with other FLOSS firms arise from FACTTIC.

Finally, the cooperative devotes annually efforts in a social project every year. The members of the cooperative votes for a social contribution, which is not an assignment of work to a particular software development, but some type of donation to a social group.

¹⁹ - The system could be acceded, download, cloned, etc, in <https://github.com/RosarioCiudad/gaem-client-gpl> and in <https://github.com/RosarioCiudad/gaem-server-gpl>

4. Results and Discussion. How to measure FLOSS innovation at firms?

When analyzing the innovation processes of the five FLOSS firms considered in this study, a set of phenomena or characteristics appear that challenge the adequacy of the Oslo Manual criteria to measure innovations, or that at least called for some adaptations in the indicators recommended.

In order to facilitate the understanding of how these particular phenomena or characteristics of innovation in FLOSS firms affect the ability of Oslo Manual indicators to measure innovation, we grouped them according to the distinction that the Oslo Manual itself makes between types of innovation (measures of innovative output), and innovative activities and efforts (innovative input measures).

With regard to the particular characteristics of the types of innovation introduced by the FLOSS firms studied, the following are noteworthy:

- **Introduction of new or improved products that are not monetized.** In this regard, it must be distinguished between:
 - Development of new products that are not sold, but are used by the developer or other users. In the cases studied there are two clear examples of this type. One of the firms, ECIC Systems, developed completely a FLOSS, not for the purpose of selling it, but to build on its service offer. For its part, Machinalis developed and released a software seeking to show their capabilities to potential customers, improve its reputation and strengthen its position in the market.
 - Improvements to “third party” products that are accepted by the Community. It comprises improvements that a firm makes about the software of projects of the Community, and it is not necessarily the own collaborating firm that implements it in its business scheme. Kunan, Gcoop and Tecso formally assign working time of their employees for these activities.
- **Social innovations.** Although social innovations are not prerogative of FLOSS firms, it is true that in this type of firms they appear with a relatively high frequency, so that their explicit consideration can not be disregarded with in any attempt to measure innovative activity in FLOSS firms. The Oslo Manual recognizes the existence of social innovations, but explicitly excludes its treatment. Two of the five firms considered in the study (Kunan and Gcoop) introduced this type of innovations. In one case, innovation was aimed at improving informatics teaching and training in high schools. In the other case, various types of social innovations have been introduced, directed to labor cooperatives, cultural centers, social organizations, disabled workers and even public transport users.

On the other hand, when analyzing the activities and innovative efforts of FLOSS firms, some particularities arise that can affect their forms of measurement and, therefore, it is interesting to point out. These characteristics or particular elements are:

- **The public release of complete software and modules.** Four of the five firms studied routinely perform or have performed this type of activity. The release of software requires performing documentation activities, coding, follow-up on the evaluations of the community and corrections, etc. The time dedicated to releasing is a creative activity that demands a significant effort.
- **Development of tools and modules for internal use with OS code.** Most OS firms perform, to a greater or lesser extent, these types of developments.
- **Development of internal projects not linked (in principle) to customers.** There are several of these experiences in which these firms devote time to developments that have no predetermined use or purpose, but which at some point find a concrete application: or in a innovation released that can generate a certain reputation in the market and serve as a marketing strategy (Machinalis), or in new marketable products (Gcoop), or in social innovations (Gcoop).
- **Collaboration in FLOSS projects of “third parties”.** All the firms studied collaborate, to varying degrees and with different degrees of formality, on third-party FLOSS projects.

But in addition to these distinctive features, referring both to the types of innovations introduced and to the activities and innovation efforts of FLOSS firms with respect to those taken into account by the Oslo Manual, there are two other elements that are very important for characterizing and measuring processes of innovation in FLOSS firms and which are not present in other productive activities. These two elements are closely related to the role played by the OS Community in the innovation process of OS firms.

- A first element that cannot be ignored in the analysis and measurement of innovative activity of firms is that, in some cases, **the “OS community” appears as a relevant selection actor**, different from the market, accepting some novelties, rejecting others. FLOSS communities become a selection mechanism alternative to the market.
- The second element is that **OS communities can play a role as a R&D pool for FLOSS firms**, especially for medium and small firms. In these cases, the Community acts as a ‘huge R&D department’ in which the firm participates with its own R&D resources. In the case of Gcoop, the investment in R&D demanded by many of their ideas is too big to be financed by the own firm in isolation, so they should actively seek the support of the Community. Kunan benefits from the updates and program improvements made by the Suite CRM Community and Machinalis also actively participates in the OS community by making and receiving various contributions. This consideration of the role of the OS community in the processes of innovation of the firms does not challenge the way of measuring the

innovation proposed by the Oslo Manual, but it questions the idea of using as an indicator of competences the fact of having or not a R&D department, at least in SMEs.

Another significant element to take into account, although not directly related to the characteristics of the innovation process, is that most of the firms studied have “hybrid” business models, in the sense that they work in both the proprietary and the free software segments. This means that these FLOSS firms can introduce new or improved products that are monetized or not monetized. In others words, that are selected or not by the market.

Once identified the distinctive features of the innovation process in FLOSS firms, it is now necessary to evaluate how these characteristics affect the way innovations are measured in the Oslo Manual. As regards the types of innovations introduced, the results of the analysis are as follows:

- 1) A first issue of discussion is whether “novelties” that are not monetized can be considered innovations. Oslo Manual measures exclusively innovations of the business sector that are monetized. It recognizes the existence of social innovations that, due to be non-monetized, must be measured using other criteria and indicators, but it does not recognize or implicitly deny the existence of business innovations that are not monetized. The analysis of the cases of FLOS firms outlined in this article indicates that it is necessary to recognize the existence of business innovations that are not monetized. The problem that appears then is to define a criterion to establish when a novelty is considered innovation and when not, that can replace the one of successful introduction in the market. Here we propose to follow a criterion similar to that generally adopted in the case of social innovations, which is that of its effective and continuous use (Echeverría, 2008). So in the case of FLOS firms, this criterion would be the acceptance by the OS Community or effective and continuous use of the software in question.
- 2) A second issue is how to measure these non-monetized business innovations, since the Oslo Manual does not consider them.
 - In the case of development of new products that are not monetized, these situations could potentially be captured by the traditional question of whether or not the firm has introduced product innovations, present in almost all the surveys that follow the recommendations of the Oslo Manual. In order to distinguish between innovations in new products that are monetized and not monetized, an additional question asking about the number or the percentage of both types of product innovations could be introduced. Another possibility, more adapted to the case of firms that introduce a high number of product innovations, would be to ask for the percentage of development of new products that have been released to the FLOSS community. However, the latter would provide us with a weak proxy

indicator, since there are new FLOS developments (eg, ECIC), which are not released.

- When it is about improvements to products from third parties, to measure the introduction of innovations, it is important to differentiate two moments. The first moment is the acceptance of this improvement by “the Community”, specifically by the firm that leads a particular OS project. The second one is when the leader of the project or any other software firm applies the improvement somehow in their business model.

If the criterion closest to Oslo Manual is followed and innovation is considered to occur in the second moment because of it is when is applied in the market, the “innovator” would be the one who uses or applies it. In this case this type of product improvements could also be captured by the questions of type of innovations introduced characteristics of Oslo Manual but “at the cost” of not imputing the innovation to the true developer.

In this way, the innovation efforts (the inputs) appear dissociated from the innovation results (the output), at least partially and at the firm level. That is, while a sole or a group of firms, or the OS Community carry out the activities and expenses that demand innovation, another or other firms could appear as the introducer of the innovations

On the other hand, if innovation is considered to occur in the moment of acceptance by the community, the collaborating firms become generators of the innovation. Also in this case it might be possible to measure the introduction of improvements through questions about types of innovations introduced by the Oslo Manual, although this would mix the improvements that the firm makes on its own products and those it performs for, and deliver to, third parties. Failure to distinguish between these two “destinations” of introduced product enhancements may bias the results of studies that relate the introduction of innovations to business performance. This would require additional information. One possibility is to ask about the percentage of product improvements that have been released, delivered and approved by the FLOSS community, although this only allows us to obtain an approximate indicator of improvements for third parties.

- 3) Accepting as innovation new or improved product novelties that are not monetized require new indicators to measure innovative performance of firms, while others - such as the percentage of turnover coming from new products or Improved products-, lose significance. This is because many product innovations are not monetized by the firm itself that introduces the novelty, but can be done by other firms that implement the software to which it has contributed. This also happens in reverse way too, the sales of the company itself are affected by product innovations and product improvements that are imbued in the FLOSS used by the community, and this cannot be captured by the percentage of sales that comes from of innovation.

- 4) Given the frequency with which FLOSS firms introduce social innovations, it is necessary that the surveys recognize their existence and importance, even though they are not monetized. Our proposal is to consider them as another type of innovation, without inquiring about the degree of novelty, since it is measured at market level (new for the firm, for the local, regional or international market).

Finally, with regard to how to measure activities and innovation efforts in FLOSS companies, the results of our analysis indicate that:

- I. There are activities carried out by FLOSS firms that should be incorporated as innovatives. This is the case of efforts to release developments of modules, parts or complete software programs. The time dedicated to release it is an innovative activity (i.e.: an innovative input), while the release of software or module published and accepted by the Community, is a type of product innovation (i.e.: an innovation output).
- II. There are other activities carried out by these firms, which can be integrated without major problems to the traditional forms of innovation activities foreseen in Oslo Manual. Specifically:
 - a. The development of tools and modules for internal use with OS code should be included as a software development activity for internal use of the firm.
 - b. Minor collaborations on “third party” FLOSS projects (which require bug fixes, bug reports, participation in newsletters, etc.) could be considered as a training activity. The logic of this is that one of the main motivations of firms to collaborate with the OS Community is that this is a way to learn and be constantly updated with the software used.

Final remarks and conclusions

The FLOSS cases allow criticizing the predominance of the monetary conception of innovation that underlines the typical innovation manual standards regarding how to measure and consider innovation in firms. A broader conception is needed, that comprises innovations that have economic and production impact in society, but are no longer generated or selected by market processes.

Our qualitative analysis enabled to state some preliminary recommendations to improve the measuring of innovation through innovation surveys into the software sector. There are also other reflections that arise from our study, some of them relevant to peripheral economies specificities, which deserve a more profound research. The question of the challenge to the private intellectual property regimes relevance is overwhelming, and the arising of new superior (in terms of their innovation performance) conceptions, like community or collaborative ownership in the software sector, should be seriously studied. Especially due to their development implications for peripheral and emerging economies.

Also, the relevance of the leadership of FLOSS projects in the community deserves a cautious treatment. Our case studies highlights the predominance of releasing of complete FLOSS developed in-house and modules for FLOSS project leaded by third-parties, mainly foreign actors; and the leaded projects tend to be minor, or small. Some particular characteristics of the software firms of the peripheral economies could be explanatory of this (as, i.e., the lack of financial support, or dimension of the firm, to sustain the management of a community project), and it could be needed to be aware of the number of community projects leaded as a measure of their innovativeness.

From the beginnings of Manual Innovation's confection, the central economies characteristics were taken into account, what generates the latter claims from Latin American scholars of innovation. The consideration of FLOSS innovation in surveys is in an early stage, and it is a good opportunity to considerate the emerging economies specificities from their early stages.

References

- Borello, J.; A. Erbes; V. Robert; S. Roitter and G. Yoguel.** 2005. "Competencias Técnicas De Los Trabajadores Informáticos. El Caso De Argentina." *Revista de la CEPAL*, (87), 131-50.
- Capra, Eugenio; Chiara Francalanci; Francesco Merlo and Cristina Rossi-Lamastra.** 2011. "Firms' Involvement in Open Source Projects: A Trade-Off between Software Structural Quality and Popularity." *Journal of Systems and Software*, 84(1), 144-61.
- Colombo, Massimo G.; Evila Piva and Cristina Rossi-Lamastra.** 2013. "Authorising Employees to Collaborate with Communities During Working Hours: When Is It Valuable for Firms?" *Long Range Planning*, 46(3), 236-57.
- _____. 2014. "Open Innovation and within-Industry Diversification in Small and Medium Enterprises: The Case of Open Source Software Firms." *Research policy*, 43(5), 891-902.
- Conklin, Megan.** 2007. "Motives and Methods for Quantitative Floss Research," K. Amant and B. Still, *Handbook of Research on Open Source Software: Technological, Economic, and Social Perspectives*. NY, US: Information Science Reference, 282.
- Dahlander, Linus and Mats G. Magnusson.** 2005. "Relationships between Open Source Software Companies and Communities: Observations from Nordic Firms." *Research policy*, 34(4), 481-93.
- Denzin, Norman K and Yvonna S Lincoln** eds. 2005. *The Sage Handbook of Qualitative Research*. Sage.
- Dosi, Giovanni; Christopher Freeman; Richard Nelson; Gerald Silverberg and Luc Soete.** 1988. *Technical Change and Economic Theory*. Pinter London.
- Dutrénit, G. and J. Sutz.** 2013. *Sistemas De Innovación Para Un Desarrollo Inclusivo: La Experiencia Latinoamericana*. México, DF: LALICS.
- Dutrénit, G. and P. Zúñiga.** 2013. *Políticas De Ciencia, Tecnología E Innovación Para El Desarrollo. La Experiencia Latinoamericana*. México, DF: LALICS.
- Echevarría, Javier.** 2008. "El Manual De Oslo Y La Innovación Social." *Arbor*, 184(732), 609-18.
- Eisenhardt, Kathleen M.** 1989. "Building Theories from Case Study Research." *Academy of management review*, 14(4), 532-50.
- Freeman, C. and L. Soete.** 1997. *The Economics of Industrial Innovation, 3rd Ed.* London: Pinter.
- Gallouj, F. and M. Savona.** 2009. "Innovation in Services: A Review of the Debate and a Research Agenda." *Journal of evolutionary economics*, 19(2), 149-72.
- Gallouj, Faiz and Olivier Weinstein.** 1997. "Innovation in Services." *Research policy*, 26(4), 537-56.
- Ghosh, Rishab Aiyer.** 2003. "Clustering and Dependencies in Free/Open Source Software Development: Methodology and Tools." *First Monday*, 8(4).
- Jaramillo, H.; G. Lugones and M. Salazar.** 2001. *Manual De Bogotá. Normalización De Indicadores De Innovación Tecnológica En América Latina Y El Caribe.* . Bogotá: Colciencias.
- Kogut, Bruce and Anca Metiu.** 2001. "Open-Source Software Development and Distributed Innovation." *Oxford Review of Economic Policy*, 17(2), 248-64.
- Lakhani, K; Bob Wolf; Jeff Bates and Chris DiBona.** 2002. "The Boston Consulting Group Hacker Survey." *Boston, The Boston Consulting Group*.
- LALICS.** 2012. "Declaración Lalics (Latin American Network on Learning, Innovation and Competence Building). Aportes Desde La Ciencia, La Tecnología Y La Innovación a La Inclusión Social," *Seminario LALICS-CSIC*. Montevideo:
- Lam, A.** 2005. "Organizational Innovation. ," J. Fagerberg, D. C. Mowery and R. Nelson, *The Oxford Handbook of Innovation*. UK: The Oxford Handbook of Innovation,
- Lee, Gwendolyn K and Robert E Cole.** 2003. "From a Firm-Based to a Community-Based Model of Knowledge Creation: The Case of the Linux Kernel Development." *Organization science*, 14(6), 633-49.

- Lundvall, B.Å.** ed. 1992. *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. London: Printer Ed.
- MERIT, UNU.** 2007. "Final Research Report and Policy Impact,"
- Moncaut, N. and V. Robert.** 2016. "Determinantes Del Uso Y Desarrollo De Software Libre En Argentina.," *XXI Red Pymes Mercosur*. Tandil:
- Nelson, R. and S. Winter.** 1982. *An Evolutionary Theory of Economic Change*. Harvard University Press.
- O'Mahony, Siobhán.** 2003. "Guarding the Commons: How Community Managed Software Projects Protect Their Work." *Research policy*, 32(7), 1179-98.
- OCDE.** 2005. *Manual De Oslo. Guía Para La Recogida E Interpretación De Datos Sobre Innovación*. Luxembourg: OCDE.
- Polanyi, Michael.** 1966. *The Tacit Dimension*. US: Gloucester.
- Raymond, Eric.** 1999. "The Cathedral and the Bazaar." *Knowledge, Technology & Policy*, 12(3), 23-49.
- Robert, V.** 2006. "Límites Y Efectos De La Difusión De Software Libre En Un País En Desarrollo. El Caso De La Argentina.," J. Borello, V. Robert and G. Yoguel, *La Informática En La Argentina*. Buenos Aires: Prometeo-UNGS, 205-28.
- Robles, Gregorio; Hendrik Scheider; Ingo Tretkowski and Niels Weber.** 2001. "Who Is Doing It? A Research on Libre Software Developers." *Research Paper, TU Berlin, August*.
- Salazar, M.** 2015. "Twenty Years of Innovation Measurement in Latin-American Countries: Lessons Learned," Keynote speech presented in the 13th Globelics International Conference, La Havana:
- Schumpeter, Joseph A.** 1939. "Business Cycles.," New York: McGraw-Hill,
- _____. 1942. *Socialism, Capitalism and Democracy*. Harper and Brothers.
- _____. 1911. *The Theory of Economic Development. An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*. Transaction Publishers.
- Solow, Robert M.** 1956. "A Contribution to the Theory of Economic Growth." *The quarterly journal of economics*, 70(1), 65-94.
- _____. 1957. "Technical Change and the Aggregate Production Function." *The review of Economics and Statistics*, 312-20.
- Stallman, Richard.** 1983. "El Manifiesto Gnu." *El manifiesto de GNU*.
- UNU MERIT and Berlecon Research.** 2002. *Floss Final Report*. The Netherlands: European Commission.
- Von Grogh, Georg.** 2003. "Open-Source Software Development." *MIT Sloan Management Review*, 44(3), 14-18.
- Von Hippel, Eric A.** 2005. *Democratizing Innovation*. Cambridge, Mass; London, GB: MIT Press.
- von Hippel, Eric and Georg von Krogh.** 2009. "Open Source Software and the "Private-Collective" Innovation Model: Issues for Organization Science." *MIT Sloan School WP 4738-09*.
- West, Joel and Siobhan O'mahony.** 2008. "The Role of Participation Architecture in Growing Sponsored Open Source Communities." *Industry and innovation*, 15(2), 145-68.
- Yin, Robert K.** 2009. *Case Study Research: Design and Methods*. Sage.