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FIRMS' DECISION TO CONTRIBUTE TO FREE LIBRE OPEN SOURCE SOFTWARE COMMUNITIES

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Abstract

The last years Free/Libre Open Source Software (FLOSS) has rapidly been shifting from a model driven purely by the developer community and university support to one where a main driver is industry. Even though a lot of firms have the chance to follow a free ride approach, they choose to contribute to the FLOSS communities with various ways. So, an obvious question is why firms decide to contribute to FLOSS communities. Which are these factors that lead them to be heavily involved in the FLOSS communities? The theory of Planned Behavior along with the Tragedy of the Commons and Digital Commons, and the state-of-the-art research on FLOSS 2.0 is the theoretical basis of this research-in-progress work.

Keywords: ORGANISATIONAL/BUSINESS OSS MODELS, COMMUNITIES OF PRACTICE, INNOVATION & OPEN SOURCE SOFTWARE, OPEN CONTENT LICENSING, SYSTEMS AND BUSINESS MODELS

1 INTRODUCTION

Despite fears about lack of technical support or commercial viability, European firms have been actively adopting open source solutions over the past two years. Today, almost 40% of companies already use some type of FLOSS, and a further 8% had plans to pilot it during 2006. Utility and telecommunications firms, media companies, and public sector bodies lead enterprise adoption by a wide margin. Forty-five percent of the firms using open source have deployed it in mission-critical environments, although the vast majority (70%) uses it for non-key applications. (Mendez, 2005).

So, on one hand we have clear evidences that European firms (multinational and SMEs) are adopting Free Libre Open Source Software (FLOSS) solutions either for crucial processes or not, but on the other hand we still observe the phenomenon that the vast majority of the FLOSS developers are still individuals. According to the latest EU study, at the end of 2005, 61.2% of code of FLOSS projects had been developed by individuals, according to copyright and credit claims, while 19.2% was claimed by companies, 5.6% universities, and 7.9% foundations. But, this situation seems to be changing since more and more key players of the IT industry are declaring their strategy to support and contribute to the FLOSS community. IBM, for instance, estimates spending in excess of \$100 million annually on Linux development now, although this includes maintenance and forms of participation other than just writing code (Ghosh, 2006).

As Fitzgerald (2006) mentions in his latest research work about the transformation of FLOSS to FLOSS 2.0, FLOSS 2.0 development life cycle strategic planning moves to the fore. The principle of individual developers, developing FLOSS on on-demand basis, is superseded by corporate firms considering how best to gain competitive advantage. As a consequence, a shift is occurring whereby the management of the development process is becoming less bazaar-like. In FLOSS 2.0, the emphasis is firmly focused on market creation through a loss-leader approach and involves products with dual licensing, cost reduction and accessorizing.

At this point it has to be mentioned that this research is not completed and it's at the stage of the model formalization. The model that is presented through this paper needs to be validated in the next months by a qualitative and a quantitative analysis.

This research paper has 4 main chapters. In Chapter 2 we analyze the scope and the goal of this research work. In Chapter 3, we make a small synopsis of the latest literature on FLOSS around four themes: (i) firm's involvement in FLOSS, (ii) FLOSS products, (iii) FLOSS developers' motivations and (iv) FLOSS "commons". In Chapter 4 we describe the model we are going to use so as to answer our research question. In Chapter 5 we present the next steps of this research-in-progress work and finally and in Chapter 5 are presented the conclusions.

2 CONTRIBUTION

We observe that FLOSS is shifting the last years from a model driven purely by the developers' community and universities support to one where the main driver is industry. There has been done an extensive analysis about the developers' motivations (Lerner and Tirole, 2002, Bonaccorsi and Rossi 2003, Riehle 2007 and Fei-Rong Wang, Dan He, & Jin Chen 2005), but on the other hand the firms' behavior on contributing to FLOSS communities has not attracted so far a lot of attention. Having in mind the above observations, why firms choose to contribute to FLOSS communities and not to follow a free-rider approach? According to this new FLOSS ecosystem that is described by Fitzgerald (2006), how firms can be part of this "user community" and how can they benefit from their participation in order to gain a competitive advantage? This question is getting more interesting, since according to Dahlander (2004) the FLOSS community protects the commons from being depleted by commercial firms, so firms that attempt to appropriate returns from FLOSS ought to use different strategies to appropriate returns than in private goods. Finally, this research, mainly, aims at shedding a light at the

motivations of firms on contributing to FLOSS communities and the way they are contributing to them. In addition to that, is the phenomenon of the Tragedy of the Commons going to affect the contribution of firms' to FLOSS communities and the relationship between individual developers and firms?

3 LITERATURE REVIEW

By analyzing the current literature about FLOSS, we concluded that we can divide it into four main blocks or themes. The first block covers the way firms try to contribute to FLOSS communities and the relationship with the FLOSS communities. The second block is about the different FLOSS products and the differences between them. The third block covers the literature about the motivations of the individuals developers and the fourth main block covers the subject of FLOSS Commons, or in other words the connection between the model of Tragedy of the Commons proposed by Hardin (1968) and FLOSS.

3.1 Firms' involvement in FLOSS

Teece (1986) argue that in industries with weak appropriability regimes, the ownership of complementary assets determines profits. And this is the case also with FLOSS. Firms' try to "manage" or to "govern" open source communities, as complementary assets, in order to achieve profits or to decrease their gap with the leader in their industry (loss leader strategy). But how they try to get benefited (benefited in any way the firms think)? Do they support open source communities? And Why?

Dahlander and Wallin (2006) support that firms need to access the developers of the FLOSS community and try to convert the knowledge created in the FLOSS community into a complementary asset. They also argue that firms, in order to be able to utilize FLOSS community as a complementary asset, are required to give away a great amount of other resources that could also be part of their complementary assets. This happens due to the fact that many times FLOSS communities safeguard their work from being appropriated by firms.

In addition, property and decision-making rights affects the perception of fairness by the developers of the FLOSS community, which in turn affects their behavior (Shah, 2006).

Also, Osterloh et. al. (2003) have found that firms must gain the confidence of the community by providing evidence that they fully respect the rules defined by FLOSS licenses and the non-written rules of FLOSS movement.

And the relationship between the community and the firms can be easily broken. The results of the study of Oh and Jeon (2007) revealed that participation is significantly reduced in the presence of strong external forces. Regardless of network connectivity, small networks are found to be very fragile when faced with an external force; even a small change in the force can dramatically break up the existing network, triggering the community to become very inactive and eventually disappear. These results provide some support for the difficulty of establishing and maintaining a "critical mass" in virtual communities (Markus et al, 2000; Butler, 2001) and the managerial challenges faced by FLOSS leaders (Healy and Schussman, 2003). And once some key developers leave the community, a snowball effect is possible to take place leading to rapid abandonment of the project (Oh and Jeon, 2007).

Oh and Jeon (2007) try to explain this phenomenon by arguing that conflicts over personal, technical and strategic issues may arise between a company that participates in a FLOSS project and the members of this community due to differences in orientation, motivation and attitude.

On the other hand, Bonaccorsi et. al (2006) argue that the main returns of a company participating in contributing in a FLOSS project are commercial viability and technological learning. The active participation of firms in the FLOSS community will enable them to collect information products,

services, and customers which eventually may lead them to the opening up of new market niches. However, it must be drawn into consideration that by making the source code available may provide advantages to their competitors. In their analysis they consider 5 variables which indicate the adopted business model, (i) open source turnover, (ii) open source products, (iii) types of offered solutions, (iv) strategic importance of FLOSS and (v) intensity of use of GNU GPL license.

3.2 FLOSS products

Krishnamurthy (2003) refers to the fact that not all FLOSS products have the same high potential profit. In order to analyze the profit potential of an FLOSS product, he uses two dimensions - customer applicability and relative product importance. So, four categories of FLOSS products are produced, High profile nichers (low customer applicability and high relative importance), STARS (high customers applicability and high relative product importance), Low-profile nichers (low customer applicability and low relative product importance) and mainstream utilities (high customer applicability and low relative product importance).

Applications for sophisticated users have higher chances of evolving towards a stable release (Comino et. al., 2007). Comino et. al. (2007), also observe that, the presence of commercial firms has become more and more pervasive in FLOSS projects and it is likely that the rationales, the modes of contributing as well as the interactions with the rest of the community differ between commercial and non-commercial contributors. Also, the choice of the licensing terms under which the project is distributed might depend on the nature of the project.

In addition to that, Fershtman and Gandal (2007) find that the output per contributor in open source projects is much higher when licenses are less restrictive and more commercially oriented. These results indeed suggest a status, signaling, or intrinsic motivation for participation in FLOSS projects with restrictive licenses.

3.3 Developers' intrinsic and extrinsic motivation

Lerner and Tirole (2002) group the two incentives of individual developers (career concern incentive and ego gratification incentive) into one incentive based on an economic perspective, which they call it the signaling incentive. And this incentive is stronger when it is (i) more visible the performance to the relevant audience, (ii) higher the impact of effort on performance, and (iii) more informative the performance about talent. In other words, developers will want to work to a FLOSS project that attracts or will attract many developers in order to have more benefits due to network effects.

Also Bonaccorsi and Rossi (2003) have summarized the individual developers' motivations into three main categories, (i) Scientific discovery: the production of FLOSS is a form of intellectual gratification with an intrinsic utility similar to that of a scientific discovery, (ii) Art form: besides being a form of intellectual work, hackers also regard programming as an art form. Several developers describe FLOSS development as artistic satisfaction associated with giving solutions to complex computer problems, and last (iii) Pleasure of creativity: in the new paradigm of development, developers frequently rediscover the pleasure of creativity.

Finally, Bonaccorsi and Rossi (2003) in conclusion argue, "Intellectual gratification, aesthetic sense and informal work style are all recurrent features of the set of different motivations underlying the invention of FLOSS"

3.4 Commons and Free Libre Open Source Software

The "commons" is any resource, which is shared by a group of people. Such things as the air and the water come from commons. In many parts of the world, new land for farming and grazing, land for stock, fish from the sea, and wood for fuel and housing are treated as commons.

In the digital world, we have the digital commons, which share the same characteristics with the physical commons, except the fact that digital commons have no dimensions, since they exist in a none-bounded environment (Greco and Floridi, 2004). FLOSS can be characterized as a “commons” denoting the centrality of the absence of exclusion as the organizing feature of this mode of production and highlighting the potential pitfalls of such an absence for decentralized production (Benkler, 2002).

The phenomenon of the “Tragedy of the Commons” is best served to refer only to the case of unregulated access commons, whether true commons or commons property regimes. So, according to the latter argument, FLOSS cannot face Tragedy of the commons, which is something that Raymond (2001) also agrees.

Now, as far as the FLOSS concerns, Raymond (2001) has expressed his argument that FLOSS cannot face the Tragedy of the commons. When people reflexively apply the theory of the Tragedy of the Commons to open source communities, they expect them to be unstable with a short half-life. Since there’s no obvious way to enforce an allocation policy for developer time over the Internet, this model leads straight to a prediction that the commons will break up, with various bits of software being taken closed-source and a rapidly decreasing amount of work being fed back into the common pool of resources. In fact, the trend is clearly opposite to this. The trend in breadth and volume of open-source development can be measured by submissions per day at SourceForge or announcements per day at freshmeat.net (Raymond, 2001). Volume on both was steadily and rapidly increasing.

Also Raymond (2001) has argued that the real free-rider problem in FLOSS is “more a function of friction costs in submitting patches than anything else. It’s for this reason that the number of contributors is strongly and inversely correlated with the number of steps and phases each project makes a contributing user go through. Such friction costs may be political as well as mechanical”

But on the other hand as Schweik (2005) explains that in the process of sustaining and even growing a team of developers, we can observe a phenomenon of the Tragedy of the Commons. In these settings the tragedy that has to be avoided is the developer’s decision to leave from the FLOSS project and abandon it. And not because of an external factor but mainly because of an internal problem related with the project, such as conflicts over the project management, decrease of financial support, or other matters related to the management and the co-ordination of the FLOSS project. This is also supported by the research of Oh and Jeon (2007), in which is mentioned that “once some of the key volunteers have left the community, a snowball effect is expected to occur, which can lead to rapid abandonment of the project”. Even a small change in the force that connects the community can break up the existing network, resulting to the inactivity of the community and eventually to its abandonment (Oh and Jeon, 2007).

So, firms, which are viewing FLOSS from a strategic point of view, have to manage efficiently the maintenance and perhaps the growing of the FLOSS project team in order to avoid a premature abandonment of the FLOSS project by its main developers.

Also, even though FLOSS can be characterized as a public good due to its non-rivalry and non-excludability characteristics (Ostrom, and Ostrom, 1977), it has owners, who are the ones that decide what is going to be into the next project's public release (Schweik and English, 2007).

Finally, as far as the success or the failure of a FLOSS project is concerned, Schweik (2005) proposed that is based on 3 attributes, (i) the stage of the project, (ii) the size of the development team and (iii) the measures of the success and failure of the FLOSS project. In addition to that, Lerner and Tirole (2002) investigate which technological characteristics are conducive to a smooth open source development. The 3 factors they analyze are (i) the role of applications and related programs, (ii) the influence of competitive environment and (iii) the project lifespan. Finally, O'Mahony's research (2003) proves that developers resist to central governance and to formal organization of the FLOSS projects.

3.5 Other

Although, the previous four blocks of themes cover the majority of the FLOSS literature, there are also some other very specific issues that can affect the firms' behavior to contribute to FLOSS communities. These issues are analyzed below.

First of all, the firm's perception of the FLOSS world and how much "open" a firm is, can affect positively or negatively the attitude of the firm towards the intention to contribute to FLOSS communities.

Yet, the stakeholders' opinion and perception of FLOSS is going to affect positively or negatively the perceived socially pressure to perform the action of contribution to FLOSS projects. In other words, the social pressure towards the intention to contribute to FLOSS communities is going to be affected positively, if lots of other competitive firms have decided to contribute to the FLOSS communities (Miralles et. al, 2006)

Finally, the size of FLOSS applications a firm uses (in terms of the amount of developers dedicated) is going to affect the perceived difficulty of contributing to the FLOSS communities. A FLOSS project with more than 5 developers can attract more developers and general contribution from individuals or firms. In addition to that, firms that use famous horizontal FLOSS applications have great difficulties in contributing, since the size of the community is large and it's more difficult to manage this kind of contribution. Also the firm's resources, in terms of economic value and human resources size, are going to affect the difficultness or the easiness of contributing to the FLOSS community.

4 RESEARCH MODEL

In order to investigate the behavior of firms, we are going to use an extended model of the Theory of Planned Behavior (TPB), a theory introduced by Ajzen (1991). "Ancestors" of the TPB theory such as the as the expectancy-value theory (EVT) has been used to study the FLOSS developers' motivations and continuance intentions (Wu et. al., 2007). So, in order to analyze the firms' behavior in contributing or not in FLOSS communities we choose to use TPB theory, which can fit with the goals of this research.

This theory has been widely used for analyzing behavioral intention in various health-related fields such as leisure (e.g., Ajzen and Driver, 1992), exercise (e.g., Nguyen et. al., 1997), and diet (e.g., Conner et al, 2003). But it also has been widely used in analyzing behaviors in the internet such as e-shopping and e-banking (e.g. George, 2004; Tan and Teo, 2000).

As Ajzen (1991) describes "Intentions to perform behaviors of different kinds can be predicted with high accuracy from attitudes toward the behavior, subjective norms, and perceived behavior control; and these intentions, together with perceptions of behavioral control, account for considerable variance in actual behavior."

So, the TPB model sets three independent factors of intention of behavior (Ajzen, 1991). Attitude toward the behavior is defined as the individual's positive or negative feelings about performing a behavior. It is determined through an assessment of one's beliefs regarding the consequences arising from a behavior and an evaluation of the desirability of these consequences. Subjective norm is defined as an individual's perception of whether people important to the individual think the behavior should be performed. The contribution of the opinion of any given referent is weighted by the motivation that an individual has to comply with the wishes of that referent. Perceived behavioral control (PBC) is defined as one's perception of the difficulty of performing a behavior. In our case the behavior is the participation of firms in FLOSS communities. But this participation can be viewed into two different versions. The first version (Active Participation) is about the fully commitment of a company to a FLOSS project, in which case a firm will participate in the management of the project, in the development and the implementation of the software and in some case in the promotion of the project. The second version (Supporting / Funding participation) can be observed when companies do

not contribute at all in the development of the project and they only try to help by funding the project, supporting it through promotional activities or testing the software.

Firms' involvement in FLOSS is going to affect the construct "attitude" of the TPB as it also supported by the work of Osterloh (2003). However it also seems logic to affect the PBC construct, but until now there is no reference to justify this argument.

The different type of FLOSS products (different types of software) is a factor which affects the PBC construct of the TPB model because different resources are needed for different types of projects (Comino et. al., 2007). Also because different types of software do not have the same high profit potential (Krishnamurthy, 2005) the type of software is going to affect the "attitude" construct.

The developers' motivations (intrinsic or/and extrinsic) (Lerner and Tirole, 2002) are definitely going to affect the "subjective norm" of the TPB model, but if these developers work for a firm (and not only for an FLOSS project) then their motivations are also going to affect the "attitude".

Finally, the phenomenon of the tragedy of the commons as it was explained in the above chapter seems to affect the "attitude" and the PBC constructs of the TPB, since the firm has to contribute to a project, having in mind how to manage their relationship with the FLOSS community, in order not to face a Tragedy of the Commons (Schweik, 2005). It also affects the PBC construct, because a firm has to use the appropriate resources (Oh and Jeon, 2007) so as not to face a Tragedy of the Commons. Although it seems logical, it is not supported by the literature that the FLOSS commons are going to affect also the "subjective norm" of the TPB model.

The relationship between the different themes of the literature review analyzed above and the Ajzen's (2001) Theory of Planned behavior, which is the main theoretical tool used in this research, is presented in the table below. The correlation of the literature blocks and the TPB's constructs is justifiable by the literature, apart from some cases that it seems logical to exist a relationship but cannot be justifiable by the recent literature.

	Attitude	Subjective Norm	Perceived Behavior Control
Firms' involvement in FLOSS	Yes	No	Needs Justification
FLOSS products	Yes	No	Yes
Developers' motivation	Needs Justification	Yes	No
FLOSS commons	Yes	Needs Justification	Yes

Table 1. The relationship between the constructs of TPB model and the themes of the literature review of this research work

In the extended model of the TPB presented below, we have added all the factors taken from the literature review that can affect the three independent determinants of behavioral intention.

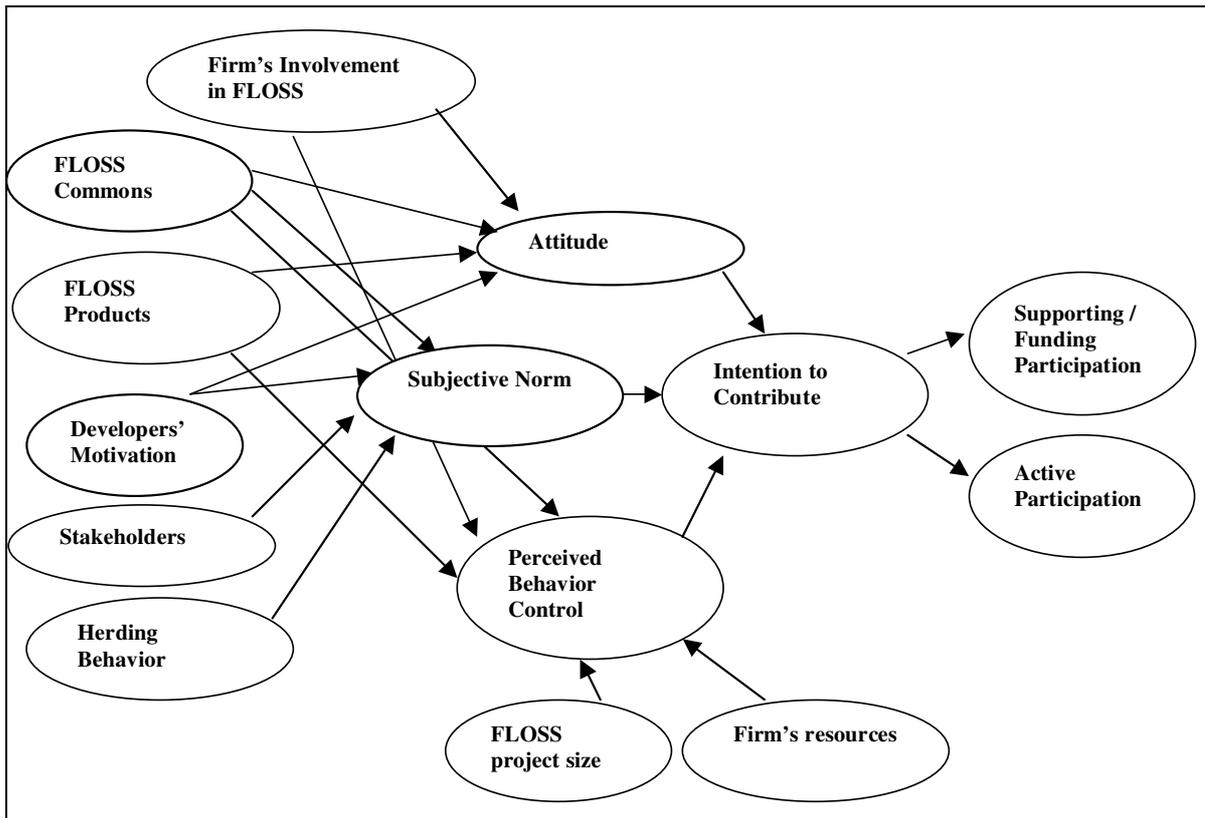


Figure 1. The research model based on the Theory of Planned Behavior

5 FUTURE ACTIONS

As a research-in-progress, a lot of actions have to be carried out in the near future, so as to be completed. The next step consists of a qualitative analysis. A qualitative analysis is going to be used in order to define correctly all the factors that are going to affect the intention of the firms to contribute to FLOSS communities. The method of the qualitative analysis is going to be based on semi-structured interviews with CEOs and CIOs of firms that have adopted FLOSS and contribute or want to contribute to FLOSS communities. The result of this qualitative analysis is the validation of a structural model.

The next step will be a quantitative analysis that is going to be used in order to identify why firms would contribute in the development of FLOSS projects, according to various factors and conditions that have been identified through the literature review and the qualitative analysis. A survey targeted to the CEOs and CIOs of European firms which are users of FLOSS or intend to use FLOSS in the near future, will be the tool to gather data and test the research's hypotheses. The analysis of these data will end up to the validation of the research's hypotheses of the structural model, which was built based on literature review and the qualitative analysis. But, before the execution of this survey, a pilot study is going to take place in order to verify the constructs of the final survey.

6 CONCLUSIONS

The main goal of this research-in-progress paper is to investigate why firms choose to contribute to FLOSS communities and not to follow a free-rider behavior. We try to analyze this behavior by creating a structural model based on the latest literature about FLOSS and the Ajzen's model of Theory of Planned Behavior. The analysis of the current literature about FLOSS has led us to the

categorization of literature into four main blocks / themes: (i) firm's involvement in FLOSS, (ii) FLOSS products, (iii) FLOSS developers' motivations, and (iv) FLOSS "commons". A first version of the structural model has been created, so the next step of this research is to validate this version by using a qualitative analysis (semi-structured interviews with firms' decision makers which use FLOSS and contribute to FLOSS communities or want in the future to contribute to them). The final step of this research will be the validation of the hypotheses of the model constructed after the qualitative analysis by using a quantitative analysis (a survey targeted to the decision makers of firms' decision makers). This research work goals to increase the current knowledge about firms' motivations in contributing to FLOSS communities. An extensive analysis of the individual developers' has been done the last years, but we are still missing the big picture about the case of firms and their motivations in contributing to FLOSS communities.

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