Social capital as a factor of motivation for free/libre/open source software development

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Abstract: - This paper provides an overview of the main principles governing free/libre/open source software (FLOSS) movement, and places its theory and practice into the context of Manuel Castells's network society. Itanalyses various motivators for FLOSS development, and shows that individual motivation for FLOSS development is dialectically intertwined with organizational structures and ethical values. On such basis, it arrives to the conclusion that motivation for participation in FLOSS development is simultaneously individual and social, economic and political. People have multiple and diverse motives for FLOSS development and their combinations may create radically different kinds of social capital. Consequently, social capital within the FLOSS movement is far from homogenous, and it is more accurate to talk of multiplicity of social capitals and various cross-sections between them. Based on such conclusion, the paper identifies the main methodological restrictions and proposes directions for future research.

Key-Words: -Social capital, FLOSS, motivation, network society, hacker ethic, free software, the Cathedral, the Bazaar

1 Introduction

FLOSS movement is based on rich theoretical background which consists of diverse and often contradicting approaches. In the context of motivation for FLOSS development, it is important to stress some fundamental differences in the levels of openness between open source software (FOSS) [1] and free (libre) software (FLOSS) [2]. Free software movement refers to the philosophical idea that every user of free software must have certain basic freedoms in its usage. By contrast, open source movement is predominately interested in practical issues pertaining to software development model, and is not interested in ideology of software development. Therefore, all free software is also open source software, but not all open software is free software.

For decades, FLOSS movement has managed to thrive despite lack of financial motivators for development. In our previous research, we have inquired mechanisms of building social capital through social networking [3] and the relationships between virtual social capital and real-world business opportunities [4]. The existing body of research shows that social capital is an important motivator for engagement in various types of social networks, and that virtual social capital may have profound consequences in the real world. On such basis, this paper inquires social capital as a factor of motivation for free/libre/open source software development.

In the first chapter, the paper draws attention to social changes brought about FLOSS movement. It shows that participation in FLOSS projects is directly linked with attitudes of individuals, through use of their knowledge and skills to help in the development and creation of a community. It identifies developer motivation as one of the key prerequisites for success of FLOSS movement. On such basis, this paper investigates social capital as an importantmotivator for free/libre/open source software development.

In the second chapter, the paper provides an overview of various theories of individual and organizational motivation for FLOSS development. On such basis, it recognizes methodological restrictions and creates a unified conceptual framework for this research.

In the third chapter, the paper looks into social capital as a factor of motivation for free/libre/open source software development. It shows that ethical values are dialectically intertwined with

organizational structures and individual motivation for FLOSS development.

On such basis, the paper refines the existing understanding of links between FLOSS movement and social capital, asserts that there are different kinds of social capital in FLOSS community, concludes that success of the movement depends on their cross-sections, and identifies the main methodological restrictions and future challenges.

2 The socio-historical background of free software philosophy

Early computer systems of 1940s and 1950swere primarily used for military and scientific purposes. One of the first research institutes who have studied the use of computers was the Massachusetts Institute of Technology (MIT). In 1958, it founded the Laboratory of Artificial Intelligence (AI), which became the birthplace of computer science and culture. In his classic book *Hackers,* Steven Levy (1984) [5] describes a subculture that was formed in the lab during 1960s. Young researchers spent their time programming and studying new technologies. More often than not, their efforts had received very little institutional support for their efforts. Such people are called hackers,or persons who enjoy researching computers and its systems in order to create new and different challenges. For hackers, a computer is not just a tool but it is an end in itself. Computer is something that should be respected, and programming includes arts and aesthetics programmers (Hafner& Lyon, 1996, Levy, 1984; Turkle, 1982) [6] [5] [7].

Hacker subculture that originated at MIT has created traditions and social norms that have influenced the whole world. Their values rely on freedom, intelligence, technical skills and interests in computers, while bureaucracy, secrecy and lack of mathematical skills are put to the margins.

According to Levy hacker culture consists of six tenets:

1. Access to computers - and anything which might teach you something about the way the world works - should be unlimited and total. Always yield to the Hands-On imperative!
2. All information should be free.
3. Mistrust authority - promote decentralization.
4. Hackers should be judged by their hacking, not bogus criteria such as degress, age, race, or position.
5. You can create art and beauty on a computer.
6. Computers can change your life for the better. (Levy, 1984) [5]

During 1970s and 1980s, software was mainly developed within the academic community in conjunction with large companies such as the AT&T and Bell Labs. At the time, software was primarily regarded as a means or a tool that allows independent operation of computer hardware. As such, software was primarily considered as the result of scientific research. It was accessible to everyone and easily accessible to all interested members of the academic and research community. In such environment, software was "worthless" (free) in comparison with the hardware (computer) that had a price as a defined commercial value. This perception had a positive impact on innovation, creation and development of new knowledge and technology solutions.

In the early 1980s there was a conflict within the MIT AI lab when some hackers formed a company which they called *Symbolics*, which dealt with the sale of computer-based technology that has been developed within the laboratory. The company *Symbolics* hired most hackers, thus leaving an empty lab. Furthermore, *Symbolics* made software placed on your computer confidential, and this process has caused a crisis. Community and lifestyle of the community was completely destroyed. On such basis, in 1984 Richard Stallman (RMS) renews idea of free open source software.

Labeling himself as the "the last survivor of an extinct culture" (Levy, 1984: 427; Williams, 2002) [5] [8], Stallman identifies the newly created ethical problem that is tied to ownership of software. For this reason, in 1984 Stallman publishes *the GNU Manifesto*, in which he announces his intention to develop a free and open Unix system. Also in 1984, Stallman startsGNU project with a primary goal to develop a free, non-commercial operating system based on UNIX. In 1985 he founded the *Free Software Foundation* (FSF) to support the development of the GNU operating system and software products based on the concept of free software.

According to Stallman, software is free software if it allows users the following basic freedoms [2]:

- The freedom to run the program, for any purpose (freedom 0).
- The freedom to study how the programworks, and change it so it does your computing as you wish (freedom 1). Access to the source code is a precondition for this.
- The freedom to redistribute copies so you can help your neighbor (freedom 2).
- The freedom to distribute copies of your modified versions to others (freedom 3). By doing this you can give the whole community

a chance to benefit from your changes. Access to the source code is a precondition for this.

In 1997 Eric S. Raymond publishes the book *The Cathedral & the Bazaar* stating two different models or two ways of development of FLOSS [9]. Method *Cathedral* advocates the idea that each software release comes complete with source code, but the code that occurs between the two editions of the software is only available for the development team. In *Bazaar* method, software is developed by the community of developers and its source code is available at any time to each developer. The greatest advocate of *Bazaar* way of software development was Linus Torvalds, founder of the famous operating system Linux. He asserts that the main advantage of *Bazaar* method of software development is speed, because when source code is immediately available to many developers, they can quickly find its weaknesses and / or omissions and improve them [9].

Those concepts are directly reflected in work ethics of software developers. In 2001 Finnish theorist Pekka Himanen promoted the "new" hacker ethic in his book *The Hacker Ethic and the Spirit of the Information Age* [10]. The book also contains prologue written by Linus Torvaldsand an epilogue by Manuel Castells. Himanen believes that hackers are the architects of the new economy. Although often misunderstood in their intensions, they are changing the world in a different and a quiet way. Himanen believes that the hacker ethic is closely associated with the ethics advocated by Plato and Aristotle. On such basis, he provides "standards" for anyone who wants to do business in the age of the computer.

Himanen shows that today's society is based on the Protestant ethic, and the moral imperative of the economy, while the individual is perceived based solely on money and profits. The author confronts Protestant ethic with the hacker ethic where work is entertainment, and theguiding principle in this world is not money but the exchange of knowledge and skills. Source of ideas for work is taken from creativity and not as a duty that must be fulfilled at a given time. The current social hierarchy is abandoned and a new hierarchy is introduced based on communitarianism.

Prologue written by Linus Torvalds shows the simplicity of thinking and experience in hacker's world. The main topic of his prologue is Linus' Law, which divides hacker motivation it into three basic and mutually inter-dependent categories: survival, social life and entertainment.

Theorist Ludwig von Mises argues that money aims at creating "artificial" reality in order to meet "real" essential needs. This comes down to ubiquitous symbolism, where all needs are exchanged for money and money is a replacement for every need [11]. In contrast, Torvalds challenges the concept of money as the main motivator for work, and argues that for hackers money is just a means for the exchange while their work is actually a pleasure to fulfill their inner satisfaction.

There are fundamental differences in the levels of openness between open source software (FOSS) [1] and free (libre) software (FLOSS). Both movements offer access to software development in similar ways, but they represent different views that often clash. Programmers who select free software consider moral protection of intellectual property rights, while developers who use open source software are predominantly interested in practical aspects of the concept of openness. Therefore, developers' choices are ultimately political, and contain their affection for one or another movement.

Table 1: Comparison between Free Software Movement [2] and Open Source Movement [12].

Free Software Stallman [2]	Open Source Raymond [17]
Defines the benefit of free software as the correct moral choice	Defines benefits of open source in pragmatic terms
Emphasizes programmer moral obligation to share with others	Emphasizes personal programmer wishes
Understands software development as a process open to the whole community	Understands software development as a process restricted to certain groups of people

3 Motivation for participation in free/libre/open-source software development

Most free software is produced by various volunteers who do not get any (or at least significant)financial benefits from development of free software. Furthermore, in the network society, software development is a truly global enterprise. Such structure of collaboration between software developers causes some serious business-related challenges. Developers who work together on a

project probably never personally meet each other. It is difficult to assess whether the person who started to build / develop a piece of software is capable for the task. Therefore, control over the development of a software project is very weak, and motivation for participation in free/libre/open-source is the main prerequisite for successful software development projects.

Corporations and governments are investing significant financial resources in their programmers, while the FLOSS community works for free. At the first glance, it could seem that FLOSS project should be unsustainable. However, this is not the case, because members of FLOSS earn from giving users additional support services, maintenance, assistance and counseling to individual users of the system, maintenance training, education, publication of books, distributing FLOSS applications on a variety of media, training, software development according to specific customer requirements and in various other ways[2].

In addition to these active methods of collecting the funds necessary for the development of free software, there is a passive way through which the users have the option to donate monetary contributions. Motivation for companies and organizations engaged in the development of FLOSS is free access to high-quality software development for their own needs whose usage affects the quality of employee development to improve internal operations and business processes.

In today's economic crisis, FLOSS becomes more and more interesting to various organizations and companies that have limited budgets for acquisition and development of software. When a certain company is involved in implementation and development of a FLOSS product, it improves the company's reputation, because it shows that their goal is not only to acquire earnings and profits, but they are interested in quality and further sharing of their resources in order to contribute to the common good of the wider community. So the motivation of the companies developing FLOSS is quite clear.

The next question is: What motivates a large number of volunteer developers, who invest time and expertise in software development without being financially rewarded? Theorist Muffatto lists the following factors that affect the motivation to actively participate for each programmer-volunteer in projects to develop FOSS (Table 2) [12].

Muffatto shows that the dominating motives and reasons for participation and contribution in FLOSS development are: improving personal technical knowledge base, learning and improving productivity, resolving own software needs and peer

recognition (reputation improvement). Based on this research, we can also conclude that the direct economic factors of motivation are significantly less important than indirect impact factors such as the increase of knowledge or improved reputation.

Obviously, most identified motivators from the latter category can be subsumed under the umbrella of the traditional concept of social capital. Based on our earlier research, virtual social capital is directly linked to real-world business opportunities [4]. At the end of the day, through the concept of social capital, even non-economic motivators may therefore have profound financial effects.

Table 2: Motivators for participating in FOSS projects (Muffatto, 2006) [12].

External motivators	Internal motivators
Technical	Personal
Improve one's own technical knowledge base.	Personal sense of accomplishment.
Solve technical problems and satisfy personal needs (scratching an itch)	Work on intellectually stimulating projects
Exploit peer-review to improve a software product	Pure creative satisfaction(joy of hacking)
Economic	Social
Improved reputation	Sense of belonging to a community
Job offers/promotion and future career benefits.	Share knowledge and skills (gift culture and economy)
Paid consulting opportunities.	Oppose proprietary software and monopolies

Motivation for FLOSS development has been investigated in several other studies. Some studies do not deal solely with the individual, but point selflessness as one of the motives for making such software (Ghost, 1998) [13], while others claim that

specific forms of organization are more important than self-motivation (Benkler, 2002) [14].

According to Ghosh (2005), the main questions regarding personal motivation for FLOSS development are:

- Are FLOSS developers rational, and if so, are altruistic or highly motivated?
- Are they driven by money, and if so, is it because of survival or profit?
- Are they interested in becoming famous?
- Are they writing FLOSS software in order to improve their position in the labor market? Or do they just want to satisfy their need for programming?
- Are they friendly?
- Is programming a way to express artistically, or is it just a process of self-development at the university?
- Do FLOSS developers expect pay-back from the community, or simply work for the pleasure of giving to others?
- Are developers politically driven, targeting destruction of major software companies?

Certainly, those research questions are not suitable for all target groups, and should be understood as a complete overview of the research area [15]. Acknowledging methodological restrictions, such structure makes them an appropriate starting point for this research.

4 Social capital as factor of motivation

FLOSS movement is deeply situated in the context of information and communication technologies – therefore, its habitat is Castells's network society. According to Castells [16], within the globalized systems of trade and production, the dynamics of "irregular geometry"is shaped by periodic expansion and contraction where a number of countries and other geographical areas are becoming turned off or disconnected from / turned on and connected to / the chain of supply and demand. In this dynamics market forces are counterbalanced by communal forces which, although weak, provide a bottom-up response to global top-down developments.

This is exactly the case with FLOSS movement, which replaces corporatetop-down software development with various communal bottom-up approaches. According to Katunarić, the community raised to the level of objective social movement should be understood as a possible form of interpersonal relationships through work / production, language / sense making and decision making / political discussion. In the context of motivation for FLOSS development, therefore, we are not talking about some kind of utopian "communal paradise" consisting of idealist hackers who code for the better world. Instead, the idea of community must outline at least some agents opposed to the community, who are not enrolled in programs of communal movement and yet are so important to understanding the further fate of the movement [17].

In *The Hacker Ethic and the Spirit of the Information Age*, Pekka Himanen [10] provides a succinct analysis of hackers' motivation, and links them directly to characteristics of the networked Protestant society(Table 3). In his research, hackers are presented as an idealist community operating in the harsh system of capitalist production, squeezed between new and innovative ways of conceiving production and realities of everyday life.

Table 3: Hackers' motivation according to Pekka Himanen [10].

Networked and Protestant Society	Hacker Ethic	
Money	Passion	Work Ethic
Work	Freedom	
Optimal	Social Values	Money Ethic
Flexible	Open	
Stability	Activity	Non-ethical
Determination	Social Responsibility	
Measurable Results	Creativity	

Himanen shows that ethical values are directly linked to organizational structures: it is impossible to conceive a multinational corporation working according to ethical principles of hacker ethic, or a non-governmental organization working according to Protestant ethics. Furthermore, ethics and organization are directly linked to individual behavior. In his term

"peer production",Benkler strongly stressesthe importance of structural assumptions in the dynamics of individual and group consumption [14]. Lerner and Tirole describe organizational structure within FLOSS development teams in terms of "simple economics", and argue that the structure spreads through reputation (as signs) within the community, including the market [18]. On such basis, it can be concluded that community ethics and organizational structure are direct predictors of individual and group behavior. Therefore, they make a significant impact to the processes of creating and maintaining social capital.

In his analysis of hacker ethic (see Table 3), Himanen lists motives such as passion, freedom, social values, openness, activity, social responsibility, and creativity. Obviously, those motives are mutually interdependent. At a higher conceptual level, they are directly linked to hacker ethic. At the organizational level, they are directly linked to social capital. However, the listed motivators are very diverse, and each FLOSS developer is motivated by a unique combination of ideals.

In order to illustrate this point, let us take a brief look at two artificially created profiles of FLOSS developers. The first developer is very creative, has a strongly developed sense of social responsibility, has very little individual compassion and respect for individual freedom. The second developer is exactly opposite, and values freedom and openness over social responsibility. Obviously, two opposed sets of values will create radically different kinds of social capital. Being a respected member of a community that places social responsibility above all other values will actually have a detrimental effect in the community that highly values individual freedoms. Therefore, we arrive to the conclusion that different motivators may create radically different kinds of social capital.

It is commonly accepted that FLOSS movement is directly based on social capital, which synchronizes vast numbers of volunteers and channels their efforts into larg(er) projects [10] [18]. Our research refines this further and shows that this social capital is dialectically linked to individual motivators for joining / participating in the community of FLOSS developers, and therefore far from coherent. There are different kinds of social capital in FLOSS community, and success of the movement depends on their cross-section.

The drawn links between ethics, organization and social capital can be conceived as dividing forces which separate various movements such as open source software (FOSS) and free (libre) software (FLOSS). However, they can easily serve in favor of cohesion. Despite ideological differences, proponents of FOSS and FLOSS can contribute exactly because they share some common motivators and the resulting social capital. Social capital may indeed be one of the main factors of motivation for free/libre/open source software development, but success of any development project will develop on cross-section of diverse motivators between all participants.

5 Discussion

Research on motivation for FLOSS development often emphasizes instrumental aspects such as maximizing capabilities of hardware, personalization of software, and providing efficient and productive infrastructures for the community (Ghosh) [15]. Other research strands include investigationof the internal structure of FLOSS projects and the involved communities (Michlmay, Robles & Gonzalez-Barahona; Koch) [19] [20]. The remaining large group of theorists focuses to ethics and politics of FLOSS (Vainio and Vaden; Himanen) [21] [8].

In this research, however, we have shown that the underlying ethics and politics of FLOSS development make a significant impact to overall success of a FLOSS project. Motivation for FLOSS development reaches much further than instrumentality of social capital, and should be understood in the context of wider social debates.In short, this paper proposes a unified view to ethics and organization, social capital and motivation, project management and ideology, in development of FLOSS.

Such proposal has profound consequences to theory and practice. Despite their attractiveness, FLOSS development models cannot be merely transferred / incorporated into the corporate world, because of their ethical / intellectual baggage, and vice versa. Instead, the two worlds must cross-fertilize – like in the example of open source software – and create a novel model of developing software and making for one's living. Looking for differences between various ethical frameworks and intellectual movements can only deepen the existing divisions. Looking at cross-sections may provide important conceptual bridges, but none of the ethical frameworks will remain untouched.

This study is subject to an important methodological restriction. In order to provide links between diverse fields such as ethics, organization, individual motivation and practice, it had no other choice but to draw conclusions from theories developed in diverse research traditions. Manuel Castells might have based his theories in complex sociological theories [22] [23] [24], but PekkaHimanen's motivators [10] are heavily drawn from own experience. Research methods in law and business [15] [14], are obviously very different from research methods in social science [17] [21]. Therefore, it is reasonable to expect that simultaneous usage of results derived from these traditions might distort the reality.

However, discrepancies arriving from wide diversity of research frameworks are inherent to doing science in Castells's network society [24]. We live in the complex world, and that complexity simply must be reflected in our research.Therefore, as we already concluded in an earlier paper [4], recognition of methodological restrictions does not merely help us interpret current research results. More importantly, the identified restrictions should be used as important indicators for future research directions.

6 Conclusion

This paper investigates social capital as a factor of motivation for free/libre/open source software development. Based on Castells's theories of network society and"irregular geometry" [16], Katunarić's work on global communities [17], and Himanen's and Torvalds's investigation of various motivators for FLOSS development [10], it arrives to the conclusion that individual motivation for FLOSS development is dialectically intertwined with organizational structures and ethical values. This creates a complex virtual eco-system characteristic for FLOSS community, and motivation for participation in that system is simultaneously individual and social, economic and political.

Developers have multiple and diverse motives for participation in FLOSS community and various combinations of those motives may create radically different kinds of social capital. Therefore, social capital within FLOSS movement is far from homogenous, and it is more accurate to talk of multiplicity of social capitals.

At the one hand, such multiplicity can be conceived asa dividing force which separates various movements such as open source software (FOSS) and free (libre) software (FLOSS). At the other hand, however, a common cross-section between motivators and the resulting social capital may easily serve in favor of cohesionwithin the community.

Such cohesion inevitably causes methodological restrictions arising from simultaneous usage of wide diversity of research frameworks. The identified restrictions are inherent to the growing body of research on social capital in FLOSS movement, and provide possible directions for future inquiry in the field.

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