The Material and Social Dynamics of Motivation:

Contributions to Open Source Language Technology Development

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Volunteer motivation has been a central theme in Free/Libre/Open Source Software (FLOSS) literature. This research has been largely dominated by economists who rely in their surveys on the distinction between intrinsic and extrinsic motivations and the 'hacker ethic' – for profit juxtaposition. The paper argues that survey-based analytical frameworks and research designs have led to a focus on some motivational attributions at the expense of others. It then presents a case study that explores dynamic, non-individualistic and content-sensitive aspects of motivations. The approach is based on socio-cultural psychology and the author's observations of a hybrid firm-community FLOSS project, OpenOffice.org. Instead of separating intrinsic motivations from extrinsic ones, it is argued that complex and changing patterns of motivations are tied to changing objects and personal histories prior to and during participation. The boundary between work and hobby in an individual's participation path is blurred and shifting.

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With the emergence of new forms of Internet and volunteer based peer production communities (see von Hippel, 2006; Benkler 2006; Tapscott & Williams 2007) such as Free/ Libre Open Source Software (FLOSS), the question of individual motivation has become important. Why make a contribution to collective use without getting remuneration for it? Early FLOSS studies and theorizations sought to categorize the motivation of 'hackers' to explain the motivation of programmer-developers in programmer-to-programmer projects. The so-called 'hacker-ethic' principles presented by Himanen (2001) or 'Linus's law' (Torvalds, 2001) characterize FLOSS programmers' motivation as an antithesis to the Protestant work ethic. Rather than seeing work as an obligation and seeing salary as the primary incentive, this contemporary diagnosis contends that programmers engage passionately and playfully, 'just for fun' (Torvalds, 2001; Nikkanen 2002), in the creation of useful and socially valuable

software (see Levy, 1984; Stallman, 2004; Raymond, 2001).

Since then, various approaches to examining FLOSS developers' motivations have emerged. Economists were among the first to study FLOSS motivation (e.g., Lakhani & Wolf, 2005; Bonaccorsi & Rossi, 2006). They conducted surveys based primarily on the distinction between intrinsic ('just for fun') motives and extrinsic motives (getting a reward). In contrast there have been attempts to reflect on the nature of FLOSS motivations drawing on secondary sources and personal observations (Weber, 2004) and attempts to analyze interview data, gathered from volunteers working in two different FLOSS projects, on the basis of grounded theory (Shah, 2006). Neither of these two latter studies related their findings to any extant body of research or theory about human motivation, in effect leaving aside the question of what constitutes motivation.

The result is that the present corpus of knowledge of FLOSS motivations has introduced several categorizations of motivations, but yet also left several important issues unexplored. Such issues include, for instance, the nature of the relationship between the different categories of motives; how motives are related to the specific technological artifact developed; how the motivation of an individual contributor changes over time and how motivation changes across different projects (see Freeman, 2005; Krishnamurthy, 2006; Shah, 2006).

Each of these methods has led to a somewhat different portrayal of the motivations to contribute to FLOSS, as I shall elaborate below. This state of affairs motivates the present inquiry. Given that the methodologies used for studying FLOSS motivations seem to have an important bearing upon the kind of findings that emerge (e.g., Eisenberger & Shanoc, 2003), it becomes of some interest to see if an alternative, potentially more in-depth, theory-methods approach could offer novel insights and/or shed critical light on the methodology and results of previous studies (see Clarke & Leigh Star, 2007; Fujimura, 1992).

In conjunction with taking a more rounded look at motivations, we should suspend taking for granted that the developers are hobbyist programmer-hackers. For example, at the site studied in this paper, the OpenOffice.org project, the product developed is oriented towards end-users and the project organization is a hybrid firm-community. I would prefer to use the term 'contributor' to include the participants regardless of if their contribution comes in the form of words or in the form of code/software.

The inquiry proceeds as follows. First, I briefly introduce the three types of inquiry made in the literature to FLOSS contributor motivation. I then sketch an alternative to these studies from a dynamic and non-individualistic standpoint by drawing on Activity Theory (e.g., Miettinen, 2005; Hakkarainen, 1990) and Cultural Psychology (e.g., Gruber 1980; Dreier, 1999). This research tradition provides resources for forming two sensitizing concepts (see Blumer 1954)— 'types of contributions' and 'personal path of participation'—as indicators of individual motivation to participate in collective activity. These tools allow a nuanced look at my research question: who are the volunteers and what motivates them to contribute? I then turn to my empirical qualitative inquiry on the OpenOffice.org Lingucomponent project, which develops open source language writing aids. The findings open the way for the further development of the qualitative line of research within FLOSS motivation stud-

ies and provides critical insight on the potential shortcomings of the currently dominant lines of inquiry.

Studies on FLOSS volunteer motivation

The majority of FLOSS motivation studies have been conducted by economists, who prefer to operate in an individualist and rationalist framework with regard to human cognition and motivation. This is visible also in their FLOSS motivation studies. Economists' FLOSS motivation studies could be criticized on various grounds and from various theoretical sociological and anthropological perspectives. In fact, criticism of this kind has been levelled at economists ever since the beginning of sociology and anthropology. However, in this article, I shall confine my critique to the topical area of motivation studies. My aim is to root motivation studies in FLOSS in motivation studies in other socio-cultural settings. I examine the theoretical apparatus which economists have used in FLOSS motivation studies. Their frameworks do not draw directly from economics, rather they are based on a psychological theory that roughly correspond to their understanding of human behaviour. The distinction between intrinsic and extrinsic motives (Ryan & Deci, 2000; first introduced by White, 1959) has been used as the basis of most survey studies conducted by economists (Luthiger, 2005; Lakhani & Wolf, 2005; Ghosh, 2005; Bonaccorsi & Rossi, 2006; Hars & Ou, 2001; Bitzer, Schrettl & Schröder, 2004). For example, Lakhani & Wolf (2005) found that FLOSS developers contribute out of a combination of intrinsic enjoyment-related and extrinsic income-related and obligation-driven motivations. The same inner-outer distinction can be found in the work of Hars and Ou (2001). They report that external motivations (expected future returns and personal needs for software) play a greater role in explaining participation, whereas Lakhani and Wolf (2005) found that enjoyment-based intrinsic motivation related to a sense of creativity when working on a project was the strongest driving force. Both studies conclude that FLOSS motivations are heterogeneous, which means that no single motive alone can explain participation in FLOSS. Nevertheless, they divide volunteers in to classes according to the strongest motive, and do not analyze the relationship between different classes of motives.

This line of research has two problems. The first one is related to the limitations of the survey method in studying human motivation. Because survey studies tend to focus on a large number of different projects with hundreds (even thousands) of developers answering the same survey, it is evident that motivation is seen as something that can be explained across different projects/technologies. Moreover, because surveys consist mostly of a set of predetermined answers, there is little room left for individual differences, nuances and unexpectedness. While survey information is important in acquiring an overall picture and opening up new questions, it is not informative about complex and developing human motives.

The second problem is related to the theoretical framework used in the surveys. In making the distinction between intrinsic and extrinsic motives, economist studying FLOSS motivation use the psychological theory of self-determination proposed by Ryan & Deci (2000). Intrinsic motivation refers to pursuing something because it is interesting and enjoyable (for its own sake), whereas extrinsic motivation refers to some outcome of activity or an instrumental value such as getting

a reward. This theory can be criticized on various grounds.

First, Ryan & Deci (2000) measure different amounts (levels) of motivation, thereby assuming that motivation is quantifiable. This is questionable if we regard motivation as a complex, qualitative aspect of human collective conduct, always dependent on human interpretation. Second, motivation is regarded as a priori given:

> ...our own approach focuses primarily on psychological needs, namely, the innate needs for competence, autonomy, and relatedness...(Self Determination Theory) is specifically framed in terms of social and environmental factors that facilitate versus undermine intrinsic motivation... (Ryan & Deci, 2000)

This conception views motivation primarily as a biological innate state (see Hertzberg, 1966; Maslow, 1954). Needs form a hierarchy in which higher needs are based on the satisfaction of lower ones. However, as Allport's (1937) principle of functional autonomy suggests, biological motives develop separately from self-expressive ones which are founded and constructed as a part of emerging collective activities (see also Harré & Clarke, 1985). Third, Ryan & Deci (2000) focused on the arousal and orientation of needs within experimental settings where it has been possible to control different variables. The transferability of an experimentally informed theory to the study of computer- and Internet-mediated activity can be questioned. Fourth, the distinction between intrinsic and extrinsic motivation is artificial since it assumes that one can not at the same time experience fun and enjoyment in one's task and simultaneously be pleased to receive a reward for doing so (see Eisenberger & Shanoc, 2003).

The second way of making sense of FLOSS motivations is exemplified by Weber (2004), a political scientist. He attempts to synthesize earlier studies with his personal observations and discussions with volunteer programmers. Weber critiques the binary opposition of altruism versus self-interest in explaining volunteer motivation. He suggests discarding the assumption that volunteers participate because they are altruistic by explaining that it is common for FLOSS developers to engage in intense and emotional fights over technical and organizational decisions. Consequently, he offers six classes of motives: 1) Art and beauty 2) Job as vocation 3) The joint enemy, Microsoft 4) Ego boosting 5) Reputation and 6) Identity and belief systems (Weber, 2004: 135-149). Weber states that survey data alone cannot explain the diverse motives of FLOSS developers and that other types of data are needed such as interviews and mailing list data. While this argumentation is plausible, it remains unclear what data he has used and analyzed. Neither does he construct any explicit theory of motivation.

Critiques like that of Weber have given rise to more comprehensive/holistic studies of FLOSS motivation (e.g., Krishnamurty, 2006; Shah, 2006; Mikkonen, Vaden & Vainio, 2007). The study by Shah (2006) was the first attempt at a qualitative line of FLOSS motivation research[1]. She studied the motives of developers from two different FLOSS communities (open and closed) with different governance structures. She found two groups of participants in both projects. 'Need-driven participants' were motivated by the need to use the software in question for work-related purposes, by reciprocity, by future improvements and

by career concerns. 'Hobbyists', on the other hand, were motivated by fun, enjoyment and feedback from others. While the 'open source' community was populated by both hobbyists and need-driven participants, the 'gated source' communities mostly comprised need-driven participants.

The findings of Shah's study re-iterate my concern with the choice of methods and analytic frameworks, but on a somewhat different plane. Despite that fact that Shah seems to have used a qualitative and open-ended research methodology, and found that motives changed in two cases from need for software to hobby, she ended up more or less reproducing the binary opposition between intrinsic-extrinsic motivations in earlier research and the hacker ethic discourse presented by FLOSS advocates[2]. We may ask a) if the dichotomized characterization of need-driven and hobbyist contributors really conveys the variety and intricacy of the motives involved in her study or in FLOSS more generally; and b) whether the choice of not using any explicit theory of motivation may in fact fall back on whatever happens to be the dominant implicit framework of the enquirer or line of study. With this in mind we can ask if explicit discussion of theory and methods should enjoy more prominence also in the emerging qualitative line of FLOSS studies.

To move beyond mere questioning and critique, I now sketch out an approach in the study of motivation that takes into account the content, the objects, the backgrounds and the changing dynamics of participation.

A non–individualistic and dynamic approach to studying motivation

From among the alternative theories available for studying FLOSS motivation, I turn to Cultural Psychology, Critical Psychology and Activity Theory, because all three have a long tradition in studying object-related motivation and participation in scientific and technological contexts as well as in a myriad of others. Cultural Historical Activity Theory (e.g., Hakkarainen 1990; 1999; Miettinen, 2005), Cultural psychology (e.g., Gruber, 1980; 1981) and Critical Psychology (e.g., Dreier, 1999) have dealt with the problem of the relationship between individual motivation and collective activity. The starting point for these is the acknowledgement that developing human motives are of social and cultural origin.

The key concepts of Activity Theory are cultural mediation, historicity, and the object-orientedness of activity (see Leontjev, 1978; Vygotsky, 1978). Signs are used in communicating with others and in regulating one's own behavior. Tools on the other hand are used in changing the external world. Historicity refers to how things come into being. Object-orientation means that people within a community are directed towards certain goals that contribute to something larger than any individual could accomplish single-handed.

According to Hakkarainen (1990: 122) four important features characterize object-oriented activity and the study of motivation. First, the concept of activity offers an escape from the dichotomy between the inner and outer worlds. Second, the development of motives is connected to how the object of activity changes and develops. Third, understanding the object of activity as a process directs attention to the outcome of that activity. Finally, motives cannot be observed or analyzed directly, but rather through analyzing other components of activity, such as mediating artifacts and division of labor.

People are often not conscious of the object of the collective activity they are

involved in. It is not easily definable, because it is the outcome of a collective effort. Individuals attribute different meanings to the object of activity and contribute to it via a division of labor by deploying and developing their specialized skills and expertise. It is precisely through the division of labor that the individual is related to the object of activity (Miettinen, 2005). In my empirical analysis, I use a sensitizing concept, 'types of contributions', to indicate how, with their special skills, the participants contribute through a division of labor to the construction of the object of their activity.

The question of individual motivation is tied to the question of one's uniqueness and distinctiveness as a person in relation to others. Hence, to better understand the individual's point of departure and emerging patterns of participation in different elusive social practices and activities (i.e., to investigate the concrete relations between the subject and his/her affiliations), I draw on the work of Dreier (1999) and Gruber (1981; 1980). Dreier (1999) develops and elaborates a theory of the individual that is grounded in the conception of personal participation in structures of social practice. Subjects are not considered to be well-bounded and autonomous, or reversible with respect to relations, dialogue or positions in discourse. Rather they move around in and across social practices and simultaneously create indirect and direct links between these practices for themselves and other people. The concept of 'personal life-conduct' refers to personal sense making (see Hakkarainen, 1990) and personal conflict management related to participating in these complex and diverse social arrangements where subjects have different and changing potentialities, concerns and modes of participation. 'Life-trajectory' on the other hand is needed to understand how individual life-courses extend across social time and space (Dreier, 1999).

In the study of the creative career of Charles Darwin, Gruber (1981; 1980) developed the notion of a 'network of enterprises'. It refers to any group of interrelated projects and activities which the creative person is involved in. Enterprises are parallel, long, developing and durable. Gruber (1980) identifies four meanings of a network of enterprises for the work of the creative person: 1) by constituting the person's organization of purpose, it defines the working self; 2) it provides a structure that organizes the work of the individual; 3) it allows the person to choose tasks for different moods and situations; and 4) it helps the creative person to define his/her uniqueness.

To understand the individual volunteer and his/her motivation to participate, it is imperative to focus on the volunteer's different simultaneous, competing, contradictory and changing personal projects with their respective motives, and their relation to the collective object of that activity. The inter-connectedness of a person's multiple activities makes up his/her *multiple working self*. In this way it is easier to understand the project-like nature of work in general, and FLOSS as a special type of research (Weber, 2004) in particular. My sensitizing concepts 'types of contributions' and 'personal path of participation' work as analytical tools and are directly based on the concepts of personal life-trajectory and network of enterprises. Motivation is not an abstract, solely innate, or universal entity, but depends on what people concretely do (see also Lin, 2005), what type of contribution they make. Motivations are not static, but evolve during participation. The aspirations and ideas that lead a person to enter a project can be one thing, may (and

often are) transformed in the course of participation, through contact with other participants and working with the objects of collective activity.

Hence, we need to grasp the idea of motivation as evolving and to do justice to the complexity of motivation, beyond any simple intrinsic - extrinsic division. 'Types of contribution' is suggested here as a way towards understanding how an individual is connected to a collective activity and 'personal participation path' for understanding how the individual's life history and unique motives combine to his/her participation. The inquiry thus follows both the collective object (i.e., the ensemble of technologies developed via a division of labor) and the subject who contributes.

Case overview, data and methods

The empirical site of this study is the OpenOffice.org Lingucomponent project. It is a sub-project of the firm-community hybrid OpenOffice.org project, which develops applications such as word processing, spreadsheets, presentations, drawings, web-publishing, email, scheduling, and database. The purpose of the volunteer-initiated Lingucomponent is to develop and provide open source writing aids such as spell checking, hyphenation and thesauruses in different languages for (end) users of the OpenOffice.org Office suite.

OpenOffice.org was born out of Sun Microsystems' strategic move to beat Microsoft. Sun Microsystems was one of the first to stand in opposition to Microsoft in 1998 when the firm was undergoing investigations for illegal bundling. Soon after, Sun acquired a German software company called StarDivision and with it an out-of-date office application called 'StarOffice'. A year later Sun released the source code for its proprietary StarOffice to FLOSS volunteers. The new open source version was named OpenOffice.org. The globally distributed OpenOffice.org project has both paid employees and volunteer contributors working together on a common code-base. The aim of the OpenOffice.org project is to develop a complete set of FLOSS Office end-user applications while the aim of its sponsor Sun Microsystems is to use the OpenOffice.org code base for developing its proprietary StarOffice productivity suite.

Thus, OpenOffice.org reflects a recent cultural line of development within the software industry – the emergence of so-called 'hybrid' FLOSS projects that combine principles of proprietary in-house software development and FLOSS in a single project. While FLOSS development in projects such as Linux and Apache could be characterized as a programmer-to-programmer project, OpenOffice.org is clearly oriented towards end-users. While most of the core technical projects have been initiated by Sun, the Lingucomponent projects, as well as the Native Language (NL) projects, have been set up by volunteer contributors. The NL projects are important, because they offer information and resources in an OpenOffice.org (end)-user's native language. The Lingucomponent project on the other hand is an important vehicle for the diffusion of OpenOffice.org to different countries and languages. It could be characterized as the 'cross-roads' of the larger OpenOffice.org project as many of its contributors also belong to OpenOffic.org Native Language projects.

Since the study of Internet-based communities is in its infancy (see Hine, 2000), new methods combining both online and off-line data have to be developed. I conducted a two-phased qualitative analysis

on multiple data (thematic phone-interviews, notes from OpenOffice.org conference 2004 meetings, historical documents, mailing list discussions, homepages, Google, blogs, real-time video and audio presentations from OpenOffice.org conference 2005). Internet Relay Channel (IRC) data were not used because the project did not communicate via it and most of the interviewed contributors said they did not use IRC at all. IRC enables people to chat in real time with others and is often used by software developers. However, some whom I did not interview may have used IRC when participating in other projects, but this would have been almost impossible to track.

I began observing the Lingucomponent project's developers' mailing list in May 2004 after an extensive four-month period of getting to know the OpenOffice.org umbrella project and establishing a personal network of contacts. Eventually, after having discussed my plans with the OpenOffice.org Community Manager, I was kindly directed to study the Lingucomponent, which unlike most of OpenOffice.org projects, was initiated by a volunteer.

The first phase was a categorizing one. Altogether 918 emails sent by 131 people to the Lingucomponent mailing list during the period from April 19 until October 22 2005 were analyzed. The reason for including all the participants (during the 1,5 year period) in the analysis was that it turned out to be impossible just by looking at the number of sent emails or the code repository to determine whose contribution was important and whose not. Moreover, understanding the content of someone's message required reading the whole thread of messages and related others, and finding additional information via Google. Including all participants and all emails in the initial analysis also increases its validity. Doing qualitative analysis on a large amount of data like this is laborious as it requires handcrafting the sample.

I started my analysis by tracking the subject's discussions. I organized the mailing list discussions in alphabetical order by author, and began identifying types of contributions (see also Shah, 2006) on the basis of the content and purpose of the email (the object of speech). The length of emails ranged from one page to one short paragraph. Some emails referred to more than one purpose, which meant that some people were engaged in more than one discussion, i.e., type of contribution. Simultaneously, I identified different groups of people according to their main contribution. As a result a group of forty-one people making tool-related announcements was found. I named this group 'tool providers' and focused my analysis on their contributions because they seemed central to the project. I categorized the tools offered in relation to the OpenOffice.org suite, and also identified their educational and institutional backgrounds to better understand the context of tool development. The contributions categories were not predetermined or fixed, but emerged from the contributors' own speech and evolved during participation as exemplified in the following phase of the analysis.

The second phase of the analysis was more qualitative, and it was based on semi-constructed thematic phone interviews and follow-up email interviews a year later. I conducted 10 thematic interviews early in 2005 with Lingucomponent leaders and with some people who where active on the mailing list and responsive to my interview inquiry. Seven interviews were done by phone and three by email due to language difficulties. Four did not respond to my inquiries. I used the first

interviews to construct a document with a participation time-line, background information, and possible reasons for participating. I sent the personal documents to each interviewee, and asked them to modify, erase or add to my text if needed. I also asked them to write about their current and future situation. The document acted as a kind of interactive and dynamic artifact. From these interviews I chose all six tool providers' interviews and, in dialogue with the contributors in question, elaborated personal paths of participation. I analyzed all speech related to educational history and involvement with FLOSS and OpenOffice.org/Lingucomponent with the aim of identifying important events and related motives.

Contributions of the tool providers for OpenOffice.org Lingucomponent project

The Lingucomponent was established in June 2001 by a volunteer programmer, the project's main leader. The default spell checking engine used in the project was 'MySpell' created by the leader on the basis of Ispell code. These Ispell-based engines support most Western languages, but they could not be used for languages with a rich morphological structure (e.g, Hungarian, Estonian, Finnish). Hence, Myspell was replaced by a new engine called 'HunSpell'. The author of Hunspell became the main leader in 2005. There is also a co-leader, who provides general information, makes dictionaries available on the website, and forwards emails. The leaders were the only contributors with explicit, more readily identifiable roles.

It was difficult to picture how the majority of the people on the mailing list related to the project. There was a lot of talk but not many code contributors to the main code base. The project leader(s) were the only ones contributing code to the repository. For many participants participation was sporadic in nature: when a special topic came up, those interested jumped in, gave their discursive contribution and left. Gradually I understood that my initial 'gut feeling' of the project as an unorganized one was not just ignorance about language technology, but something that the interviewed volunteers themselves had also experienced:

> ...So it's like nobody really knows who is working on what… (Interview with a volunteer, 10.2.2005)

Most messages were related to technical or linguistic issues. Contributing to technical discussions required programming skills and some knowledge of the OpenOffice.org architecture. Likewise, contributors to linguistic discussions required either linguistic skills/profession or a good deal of knowledge with respect to their language(s). However, some programmers also engaged in these discussions, because they knew what was technically possible with the available tools. The tools announced on the mailing list indicate that many contributors want to share their work on the list, but do not necessarily contribute directly to OpenOffice.org code base (Category 3). The job-offers/co-operation offers imply that the mailing list is used as a forum for recruiting people. Forty-three introductions or 'applications' from newcomers were sent to the list, but no responses were found. The last group of messages comprised general procedures such as voting, forwarding or redirecting messages, expressing support and occasional answers to a few end-user questions (Category 6).

Contribution in the form of discourse	email example (original)	Number of people contributing
1. Technical discussions related to Dictionaries & Spell checkers; Thesaurus; and Grammar Checkers	"I did not write patgen or the alt linux hyphenation code (which is based on patgen) but AFAIK, the dot anchors the pattern to either the start of the word or the end of the word. so .blah means the pattern only matches blah at the beginning of a word…"	25
2. Linguistic discussions related to Dictionaries & Spell checkers; Hyphenation; and Thesaurus	"…affixes are an artificial construct, and what matter really are cases. The affixes don't actually reflect the grammar and don't give any real insights. The case systems - and grammar to an extent - varies even between Estonian and Finnish (that are related languages). I also used very much only examples where no mutation - especialy mutation of the root - happens as such would reduce the scope of what can be compressed."	16
3. Tool Announcements	"…I have written a java program that takes a textual description of suffiix variations of a language (like english, portugues, spanish, italian, french) and generates a java class that that contains a method to perform a lexical analysis of any given word to generate possible root words to be looked up in a dictionary. I suppose this could be adapted to generate c++ classes or c functions."	31
4. Job-offers & Offers of Co-operation	"What we seek…1) Find OpenOffice.org developers that could mentor us throughout our development process.2) Attract interested Estonian, Finnish or Hungarian developers to join our team.3) Increase our awareness of similar projects for unrelated languages that could contribute some code fragments to get us started."	10
5. Contribution "applications"/expressing interest in contributing	"Hello Mr. (project lead) I am interested in joining your development team to Redesign the spell checker. How can I get started?"	43
6. Other (voting, requests for help and features, expressions of support, forwarding e-mails, occasional responses)	-------	38

Table 1. The table provides a hint of the nature of the project: the skills needed for participating in the mailing list discussions, and the use purposes of the mailing list.

Parallel to the above categorization, I was able to find different types of contributors on the basis of the contributor's main contribution. These were:

1) forty-one tool providers who were connected to the project via a) Lingucomponent leadership, b) Native Language projects, c) other OpenOffice.org – independent projects;
2) twenty-eight Native Language leaders and other contributors;
3) forty-four newcomers, comprising a) eight applicants with no explicit idea regarding their contribution, b) twenty-eight task-oriented applicants, and c) eight Google's summer of code applicants);
4) five expressers of support and appreciation;
5) two end-users asking for help in questions concerning the use of OpenOffice.org;
6) five end-users making requests for features concerning OpenOffice.org;
7) three occasional suppliers of answers;
8) five Sun representatives.

The tool providers were chosen for further analysis[3]. They usually announced they had developed/are developing a tool or are engaged in another project which develops a tool that might be of use to others on the list. Very often these were tools that can not be integrated into the main OpenOffice.org because of licensing issues, minority language issues or OpenOffice.org architectural issues. Many tool providers also engaged in discussions specific to their respective (minority) language and related technical-linguistic discussions. Tool providers' purposes for using the project's mailing list could be characterized as putting one's work on display for potential collective use and further development, as conveying one's skills and capabilities, and as a tool for hooking up with the right people. Hence, the mailing list is used as a forum for publication, discussion, and recruitment and future collaboration (see Figure 1).

What tools were announced on the mailing list and how were they related to OpenOffice.org? I found two types of tools on offer: plug-in tools for end-user use and independent tools for end-user and contributor use. Plug-in tools can be installed straight from the OpenOffice.org file (wizard) and tools menu, while independent tools have to be downloaded from their respective sites. About half of the tools were plug-in tools, while the others were independent tools.

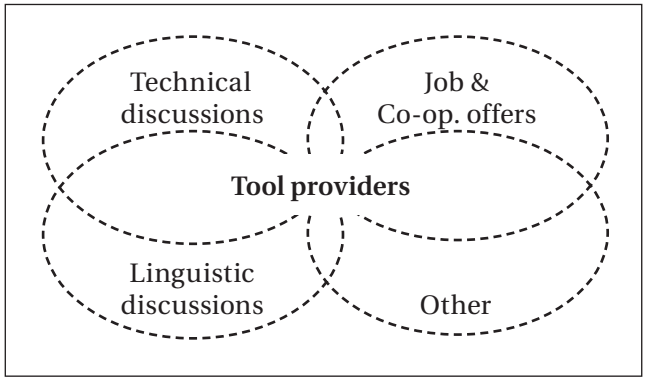

Figure 1. Tool providers and their activities.

Twenty-four contributed spell-checking dictionaries based on Myspell, which is the default OpenOffice.org engine for building dictionaries. A spell checker engine incorporated into the OpenOffice.org core code makes it possible for non-programmers to participate in the development of linguistic features for OpenOffice.org. Using Myspell to create dictionaries does not require programming skills, only rather good knowledge of the language in question and Myspell rules. These spell checking dictionaries are text files. Four dictionaries were not based on Myspell due to licensing issues or language specific issues (morphological structure etc.). Most dictionaries are available for download on the project's web-page, and can be plugged in by the user. In addition to the default engine Myspell, there are two other engines produced by two different programmers-contributors that can be used for dictionary creation.

The rest of the contributed tools were mostly independent of the OpenOffice.org technical core due to licensing issues, OpenOffice.org architectural issues and minority language issues (e.g., morphological structure). Thesaurus dictionaries use as their basis a tool called OpenThesaurus, which is web-based software for building a new thesaurus. It was developed by one of the Lingucomponent contributors, and is now used for developing new thesauruses. Building a thesaurus requires some knowledge of PHP and MySQL. I found five contributors in this category.

Hyphenator dictionaries are created with OpenOffie.org's default program called 'ALTLinux hyphenator'. My data shows that the two hyphenation dictionary contributors used independent programs in creating their dictionaries.

All seven grammar checkers are independent, because OpenOffice.org lacks the connecting interface. The project's home page provides links to these grammar checkers. The grammar checkers currently available could be integrated into OpenOffice.org, but to do that would require knowledge of the OpenOffice.org architecture and programming skills in C++. One of the project's to-do tasks is to extend OpenOffice.org so that grammar checkers could be integrated the same way as spell checkers.

> A grammar checker is independent from OpenOffice.org. What is needed is just the interface in OpenOffice.org so that any grammar checker engine can be plugged in, like a spell checker. As far as I know, no development has happened in this direction, so any help is welcome... (Volunteer 7, 6.7.2005)

Creating such an interface was addressed several times in the emails with the conclusion that it would be a very arduous task to create 'universal' rules for very different spoken languages.

Four contributors offered other end-user tools. An installation program 'DicOpenOffice.org' for installing dictionaries via OpenOffice.org Writer's wizard and an on-line converter, 'OpenOffice.orgconv', were developed directly for OpenOffice.org. Spell checking facilities for a text editor 'VIM', a program 'ConjuGnu' for conjugating Spanish words, and a word prediction program for disabled people 'Favele' were OpenOffice.org -independent.

Tool-building tools for people developing end-user tools were also on offer: a framework that allows one to quickly build MySpell and Aspell spell checkers from the same base word list; a lexical analysis program; and a Python program for extracting strings from an OpenOffice.

org file, translating them and putting them back.

The tool categorization implies that there are many important contributions a) in the form of plug-in tools for end-user use and b) in the form of tool-development tools for contributor use (both programmers and dictionary contributors), despite the fact that the actual OpenOffice.org code base (its linguistic component) does not seem to benefit. Most of the tool contributors did not contribute directly to the OpenOffice.org suite, which explains why the version repository for the OpenOffice.org code showed so few code contributions. However, their additional tools announced on the mailing list play a vital role in the diffusion of the OpenOffice.org suite to countries with limited computational resources. Hence, understanding the tool contributions (the material) is essential for understanding the project's organization and mailing list activity (the social).

Tool providers' personal paths of participation

Who were the tool providers and why did they choose to participate? I examined the tool providers' institutional background and position in an effort to better understand who these people were. In doing so I also wanted to question the distinction between hobby vs. work (see Torvalds, 2001; Himanen, 2001), as it seemed to me that contributing some of the above depicted tools in fact required highly developed professional skills and expertise.

Most of the tools announced were developed independently from OpenOffice.org governance in one-man/woman (open source) projects, in small two-member teams, or in small groups as part of some larger project. Some were developed as part of existing OpenOffice.org Native Language (NL) projects. All Linguicomponent leaders also contributed tools.

My analysis shows that over half of the tool providers were from universities, while the rest were from IT-companies or non-profit localizations projects[4]. The institutional backgrounds of the tool providers indicate that these people were professionally involved in the localization of FLOSS and OpenOffice.org. It is if course hard to tell where these people were physically located when contributing (home, work or some other place), and what kind of social networks they mobilized at the time.

In order to get to the essence of the question of what motivates these tool providers to contribute, I constructed personal paths of participation for the six inteviewed tool providers. The following short path description narratives are written in a two-phase manner. The key event in bold refers to the actual point of entry/contribution concerning the Linguicomponent project. The events prior to this key event can be seen as reasons/motives leading to it, while the ones succeeding show how motivation to participate in the Linguicomponent project changes over time. With the help of these narratives and some quotations, I reflected on the complex evolving motives of the tool providers.

> *Path 1: From participation inspired by own use and semi-unemployment to participation inspired by family's bilingual background and future work prospects.*

An unemployed oil fluids technologist, a US immigrant, moves to Venezuela to live with his Venezuelan wife. The country's economic situation leads to unemploy-

ment. He starts a grocery business and starts using MS Office Excel for maintaining a simple inventory. Because of repeated errors in the program, he switches to Sun's StarOffice. Via this he hears about the open sourcing of the StarOffice code and the new OpenOffice.org project, and starts using OpenOffice.org instead. He offers multiple motives for using OpenOffice.org and participating in the project:

> ...the thing about an open-source thing is kind of a, in a sense of a hobby. I'm sure I spend more time at than my wife would prefer… for the little bit of time that I spend on it, I get an office suite that works and does everything I need to do…also everything else I use is basically GPL … the open source movement is still really a bunch of geeks and semi-geeks at heart… They're basically doing this because they waste so much time playing with computers anyway, that it just gives us some sort of focus… we came to look for things that did not have a purchase price. Mainly just because it's so much easier to download…

Among the unspecified urge to play with computers, most visible seems to be his use-value related need for a costless, easy to download and modifiable office suite 'paid off' by means of reciprocity.

He starts contributing to Lingucomponent by porting a Spanish dictionary from Ispell to Myspell because he needs one. After this tool contribution, he founds the Spanish Native Language project, and now starts acting as a liaison between the English and Spanish-speaking people of OpenOffice.org. He is requested to work for Lingucomponent as a co-leader with the tasks of directing mailing list traffic, maintaining the project's website, and uploading dictionaries onto the website. He also actively speaks to different audiences in Venezuela about OpenOffice.org. Simultaneously he takes care of his wife's bilingual play-school's computer club, and does some technical translations. When asked about his future plans, he responds:

> … Set up some courses [related to Sun's StarOffice] and whatever to, to do something to generate some income… I suppose. But that's just basically outside of the OpenOffice thing…

This quote highlights an interesting evolving contradictory motive in relation to the 'hobby-speech' identified in the first quote. While he explicitly rejects future work with Sun's StarOffice as not related to OpenOffice.org, one can ask by looking at his participation path, whether this recent development would have been possible without his commitment and successful career in OpenOffice.org.

> *Path 2: Participation inspired by own bilingual background and occupation as researcher to participation inspired by his growing concern for minority languages.*

A doctor of (theoretical) mathematics works in the US at a department of computer science as a professor. He has also developed an interest in Natural Language Processing, and spends about twenty per cent of his working time programming. Because he is on sabbatical, he spends even more time programming. He characterizes himself as an 'old-school' programmer who prefers not to use graphical interfaces. Hence, he does not use OpenOffice.org. He describes himself as peripherally involved, without any particular attachment to the OpenOffice.org project.

He starts working with Irish, his second language, by establishing an open source project for minority languages. **As a result of his own project, he contributes an Irish dictionary based on MySpell.** Further, he develops a command line grammar checker engine for minority languages with limited computational resources. He also develops a web crawler software tool for building minority language corpora automatically. Essentially his work entails 'number crunching' on large data. He continues working with representatives of different minority languages, and has contributed seven MySpell spell checking dictionaries. The intertwining and evolution of different motives can be seen clearly in his speech:

> … I believe, sort of the usual technology engineering arguments, that you produce better software. I'm also something of a radical with respect to free [software]…I have time to, I'm on sabbatical now so I have this year to do whatever I want. Write software… I feel like there's some moral obligation for academic people to release what they do as free software. In the same way that you publish your papers and people can use the results. And that's not really what happens… especially in natural language processing… people write…parsers and grammar checkers and machine translation and all that technology, since it's so hard to develop, people keep to themselves…it hurts minority languages and people that can't… that don't have the sort of economic resources to develop things… people who [I work with] are in Africa . I mean they are lucky to have an internet connection, kinda puts it into perspective…I don't have any sort of direct interest in OpenOffice…I try and attract volunteers in my own projects.

The usual technology engineering arguments' as motives for choosing to develop FLOSS could be seen as contemporary hacker-speech, often produced in the beginning of the interview. However, these motives get entangled with others like the values of freedom and sharing and the related problem of producing costly language technology. Moreover, the larger motive of helping those without the necessary economical resources, derived from direct contact with representatives of such countries, blends in with the more temporary motive of recruiting people.

> *Path 3: From use-inspired participation to family-inspired participation to dropping out.*

A software engineer and ex-missionary from of Hawaii works part-time on a university campus as a system administrator while finishing his degree. Now he works full time within the management information systems department. He uses OpenOffice.org (mainly Calc) in doing his job, and has developed 'OpenOffice.org lib utility library' — a Perl module to be used for creating simple Calc and Writer documents from the web — in his own open source project. **He starts looking for something to spend his time on and finds a focus via his wife:**

> My wife dislikes me using computers all of the time even though she knows I have a degree in Computer Science. She decided to study Hawaiian and return to school to get a Hawaiian Studies degree, so I figured she would not complain about me working on a Hawaiian spell checker for OpenOffice.org.

He starts dictionary development, but quits because it turns out to be difficult: the existing Hawaiian word lists which would make his job easier are owned

by the university, and hence cannot be shared. Moreover, he does not speak Hawaiian himself. He would have had to start from scratch. Developing the OpenOffice.org lib utility library on the other hand is easier to tie into his job, so he continues on maintaining that instead of developing the Hawaiian dictionary. He would also like to develop dictionaries for other Polynesian languages because students at his university come from over sixty different countries. He continues promoting, or 'converting' (as he says), OpenOffice.org and educating people about it on his university campus. Here one can see how a use-value-related motive of extending the capabilities of the suite grows into a more general need to promote OpenOffice.org. The motive and focus for this general but unspecified need to do something is then found in family-relations. However, it fades away owing to obstacles.

> *Path 4: Participation inspired by occupation as researcher, country's economical situation and own mother tongue to participation directly as part of his job description.*

An electrical engineer works as a researcher and teacher at a computer science department in a university in Brazil. **He attends a workshop organized by the Brazilian government, where he is told that a grammar checker would be of great benefit for Brazilians, Portuguese-speaking people**. He initiates a nine-member project, which is led by his professor at the computer science department. They share an interest in research concerning Natural Language processing and in Free Software philosophy.

For one year the university team works on the grammar checker without getting paid. Eventually the team gets funding from a governmental organization that supports technological projects. With new computers, the team is able to put more time into developing this important tool:

> …we are working in a university, in a public university. And these universities don't have financial support to keep computers and we are working with Pentium, about 10 years old Pentium. Could you imagine working, very, very low computer? And with this support we bought a computer, new computers and a great change to our project. Our dedication was improved, our dedication to our project…because we need relate this results to [research funder], our results of the project, research to [research funder].

His occupation as a researcher provides the ground for the motive of starting a new project and hence, helping his compatriots. The significance of the FLOSS policy taken by the Brazilian government in the emergence of this new research object should not be underestimated. The research team's volunteer working period is also motivated by the hope of eventually obtaining funding. Getting funding on the other hand changes the team's motive towards producing results for the sponsor. They also actively seek, without success, someone on the mailing list who could reprogram some OpenOffice.org code so that their tool could be integrated. Recruiting can be seen as a temporary motive for participating in Lingucomponent. Eventually they have to recruit a trainee student from their university to learn how to do it. They manage to release a version of their Portuguese grammar checker for Windows. Now they are working on a version for Linux.

Path 5: Participation inspired by studies to participation inspired by need expressed by compatriots and spare time to participation inspired by future collaboration in work context.

A computational linguist from Germany works for a small company that specializes in information retrieval (e.g., thesaurus search). The company uses the Apache 'Lucene' search engine as the back-end for its products. He contributes to Lucene in his free time. He reads the OpenOffice.org German NL mailing list and finds that there is a need for an open source web-interface allowing people to collaboratively collect synonyms of the German language. As a student he has the time and starts his own open source project 'Open Thesaurus', because he was familiar with MySQL, HTML and PHP, and because "nobody is going to do it if not me".

As a result of his own project, he contributes a German thesaurus licensed under the GPL to the Lingucomponent project. The starting point for him is that the source must be open if he is to contribute to it or use it. Simultaneously after office hours, he writes 'LanguageTool', an English grammar checker that can be adapted for other languages. He ports LanguageTool to the Java programming language, and starts actively maintaining and developing it after a two-year pause. Meanwhile he is appointed 'content developer' in Lingucomponent. He speaks at the OpenOffice.org conference in 2005 about the linguistic tools of Lingucomponent. He also does bug-reports and fixes and helps the maintainer of the German spell checker in cleaning up the word lists. He would like to integrate a German grammar checker into OpenOffice.org. The intertwining of work and 'hobby' can be clearly seen in this narrative and in the following excerpt:

> I prefer working mostly on my own and then integrate my stuff into other projects…the fact that you get to know people who have a clue about special topics is really useful. For example, the maintainer of the German spellchecker currently helps at our company with an important project. She also added support for German to my LanguageTool project. Also I'll give a talk at a German conference about computational linguistics. This might not have been possible without the fact that OpenThesaurus is integrated into something as well-known as OpenOffice.org.

The motive of recruiting people with specific knowledge to his own projects as well as his company's projects can be identified. Moreover, his multiple parallel activities/technologies and people are linked to each other in indirect but inseparable ways transcending the boundaries of worker and volunteer.

Path 6: Participation inspired by family-reasons and unemployment to participation inspired by compatriots and professional future prospects to participation as a job description.

A doctor of civil engineering (geomechanics) from France decides that he does not want to pursue a career abroad owing to family reasons. He starts looking for a job in the software business because he has some experience in programming. He is employed for two years by a software firm. While unemployed he bumps into FLOSS and OpenOffice.org. He joins the French Native Language project, and contributes an on-line line converter called

'OpenOffice.orgconv', because he is invited to by others, and because he wants to improve his programming skills:

> When unemployed I started looking at OpenOffice and started programming and helping on the project [French NL]…. I started on the French lingua community. So, I started as a newcomer, so I asked questions and… How to install…And then some people asked: We need this, we need this. And I wanted to do some programming and I started look at macro and APIs. And so I understood some things so I began to help and said: Oh, I'll create this, I'll create this…And that's why I begin with it…

After this the leader turns to him with problems related to installation of the French spell checker. He provides a solution by recoding some OpenOffice.org code and writing a dictionary installation macro ('DicOpenOffice.org') for OpenOffice.org. Then he proposes his engine on the Native Language Confederation list, where the tool is accepted as part of OpenOffice.org.

With the help of the Lingucomponent leader, DicOpenOffice.org is made a default tool of OpenOffice.org and hence can be used outside the French NL community. He uses the tool to verify that the dictionaries sent to Lingucomponent are installable. Eventually he is employed by a software company that supports open source software. His job is to promote OpenOffice.org and oversee its connection to the company's content management framework. Hence, he continues contributing to the French NL and via this to the Lingucomponent project:

> …and now I have a new job I continue to program and to be involved in OpenOffice because it's a part of my job.

This last narrative showed how a change in professional orientation and succeeding unemployment leads this tool provider to volunteer and develop his programming skills in OpenOffice.org, eventually obtaining an OpenOffice.org-related paid job.

Conclusions

This study aimed at developing a more detailed, dynamic and content-specific approach to studying FLOSS contributors' motivation than has been the case in previous studies. Two sensitizing concepts were introduced and offered as indicators of the complexity and developing human motives for participating in evolving FLOSS collectives. 'Types of contribution' was suggested as a way towards understanding how an individual is connected to a collective activity through his/her contribution and 'personal paths of participation' for understanding how the individual's life history and unique motives combine to his/her participation. The results of the analysis shed critical light on such simplifying explanations such as 'hacker ethic' or 'hobbyism' or the static intrinsic–extrinsic distinction in explaining the motivations of FLOSS contributors. Instead of motive categories, we find complex and changing *patterns of motivations* that are tied to changing objects and personal histories prior to and during participation. Despite the fact that viewing motivation as a unique process is not new (e.g., Vroom, 1964; Maslow, 1954), this analysis showed that the process was not linear: it was the source and product of a combination of contingency and emergence as well as active seeking for new opportunities in personal and professional growth.

The analysis of 'types of contributions' showed that instead of working together

on a common code base, as is usually the case in FLOSS, the Lingucomponent contributors worked alone with their own code-bases or text-files. Hence, it is not enough simply to observe submitted code to the shared code repository. Only one Lingucomponent contributor submitted code to the actual code base of OpenOffice.org. However, a group of people making tool announcement on the mailing list seemed central to the project because their contributions added use-value to the OpenOffice.org office suite. Although most of these 'tool providers' did not contribute code directly to the project's code base, their plug-in and independent tool contributions can be seen as essential for the development and diffusion of the OpenOffice.org suite. While the project's division of labor turned out to be highly specialized, this analysis showed that the contributors were attached to an expanding object of activity. They contributed to enhancing OpenOffice.org's language capabilities so that it can diffuse to countries and language regions lacking needed economic and /or (computational) resources. The collective object proved complicated and hard to grasp, because it was not a shared base of code (Lingucomponent module), but rather the emerging network of the FLOSS language technology system.

The analysis of the tool contributors' personal paths of participation on the other hand showed that each had a unique set of motives related to their respective life situations: studies; profession as a researcher; sabbatical; unemployment; own use of linguistic aids; mother tongue/bilingualism; family reasons; and/or larger societal and economical concerns. My finding that personal need for software drives development is in line with earlier research (e.g., Shah 2006; Weber, 2004). This study shows that in some cases this motive was at play in the early stages of participation as a kind of entry point to the project (see also Shah, 2006). Often, the need for linguistic writing aids was met by one's own contribution. This event made it possible to catch *motivation in movement*, the transition of this tool-motive into another (e.g., helping native language compatriots while simultaneously rehearsing leadership skills and knowledge on OpenOffice.org). To those who did not use OpenOffice.org, the point of entry was professional: the motives were to recruit people for one's own projects; to work on an emerging research object; to get funding; to publish results (moral and economic obligation); to produce linguistic aids for their compatriots and/or benefit languages and countries lacking computational/economical support. One tool provider wanted to enhance his programming skills and capabilities in the advent of unemployment and professional re-orientation, eventually obtaining an OpenOffice.org related job. Two tool providers indicated an unspecified need (passion/obsession) to engage, among others, in activities involving computers. In one case this unspecified need found its object via his spouse. Participation was in most cases related indirectly or directly to their occupation or field of research expertise, or resulted in an OpenOffice.org-related job. Indeed, the process of motivation is a messy thing that is hard to neatly reduce into categories. Reflecting on the tool providers' patterns of motives indicates that human motivation is not reducible to either 'homo ludens', 'homo economicus', or 'homo sociologicus', but entails a complicated mix of them all.

The findings indicate that the boundaries between work and hobby within the individual's participation path are blurred and shifting. Hence the distinction between work and hobby seems artificial. Professional development often required expanding and extending oneself across

different social practices, thereby blurring and shifting the boundaries between work and hobby. More generally, temporal employment and project-like work challenges the individual to use all the means available in pursuit of his/her career. Doing something passionately and playfully, just for fun (Himanen, 2000) is a gross oversimplification of people's motivation. Presumably, all work can be rewarding and fun, but also entail periods of frustration. On the basis of this study, the validity and usefulness of the concept 'volunteer' in FLOSS language technology is questionable.

FLOSS motivation research that leans on predetermined motive categories tends to reinforce existing hacker ethic discourses, and such categorizations leave no room for unexpectedness and contingency. All in all, the marked differences in methods and findings call for critical evaluation regarding the direction to be taken and research design in FLOSS motivation research. While this study is limited by small sample size, a focus solely on language technology, and the time-consuming difficulty of tracking biographical data, the results could be of value in formulating future survey questionnaires. However, many cases are not required to understand that motivation is a unique complex evolving process in which the material and the social are inseparable. Though the results may not be generalizable outside OpenOffice.org, the sensitizing concepts or 'theory-methods package' (see Clarke & Leigh Star, 2007; Fujimura, 1992) outlined in this study could be used for the purpose of analyzing contributor participation in other FLOSS projects and internet-mediated peer-production collectives in general.

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Notes

1. I obtained 214 hits on Google for search words "FLOSS open source motivation" in her Phd thesis's chapter on motivation qualitative study. Out of these, Shah's study was the only explicitly qualitative motivation study.
2. Interestingly, an earlier version of the paper introduces the intrinsic-extrinsic distinction as a potential source for understanding motivation (see http://pascal.case.unibz.it/retrieve/2743/shah3.pdf).
3. NL leaders and other NL contributors who did not contribute any tools were left out, as this group was already represented in the tool provider category. Newcomers were excluded because only one of them succeeded in getting in and because the issue of joining in will be analyzed in another article. The few expressers of support were left out because they had no intention of contributing and the few end-users asking for help and making requests were not included because most of them visited only once and only half got a response. The question of involving the end-user in FLOSS will be examined in another article. The few occasional answer suppliers were

left out because I could not find enough information on them via the Internet. Sun's paid staff were left out bacause they could not be regarded as volunteers.

4. IT-companies: programmers, linguists and consultants (13); Universities: researchers, teachers, professors & PhD students from departments of computer science; mathematics; and linguistics (16); Non-profit software localization projects: programmers, linguists and translators (4); One part-employed engineer (1); Non-identifiable (7).

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