Acceptance of monetary rewards in open source software development☆

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ABSTRACT

The open source software (OSS) movement thrives on innovation and volunteer effort of developers. Scholars have expressed widespread concern about the sustainability of the OSS movement due to high levels of volunteerism. In this paper, we address a central challenge to the sustainability of OSS-developers' acceptance of monetary rewards. We strive to explain why some OSS developers accept monetary rewards and others do not. Viewed through the theoretical lens of the private-collective innovation model (Von Hippel and Von Krogh, 2003, 2006), this allows us to describe when developers will accept private financial rewards. Our main research objective is to clearly map the web of relationships between causal antecedents, and developers' acceptance behavior. Using a unique dataset that combines survey and behavioral measures, we find that – (a) intention to accept monetary rewards mediates the impact of motivational elements on developers' acceptance of monetary rewards; (b) intrinsic and extrinsic motivations positively affect their intention to accept monetary rewards, community motivation negatively impacts intention and ideological motivation does not affect the intention to accept rewards and (c) these effects are obtained even after inclusion of several control variables. The theoretical and managerial implications of our work are described.

1. Introduction

The central idea behind open source software is that greater market innovation results when developers are provided the necessary freedom to create new products (Raymond, 1998; Ghosh, 1998). Developers work in loosely organized communities built on the private-collective innovation model, i.e., a "best of both worlds" scenario where programmers make private gains while contributing to the collective good (Von Hippel and Von Krogh, 2003, 2006) through "freely revealing" the source code for the product (Von Krogh and Von Hippel, 2006). Open source software "democratizes" the innovation process (Von Hippel, 2005) by making code freely available through diverse licensing arrangements (Krishnamurthy, 2003). The extensive and free distribution of the code allows a large group of individuals to examine and use software leading to a more reliable and robust product (Bonaccorsi and Rossi, 2003;

Rossi, 2004). Unlike proprietary software, the open source software movement is characterized by a "diversity of project structures, diverse employment arrangements, co-existence of corporations and communities and co-existence of the creative and commercial elements" (Krishnamurthy, 2006). In contrast to the proprietary software regime where an organization makes a limited set of strategic choices, open source promotes multiple innovation trajectories.

The open source literature has provided different perspectives on the relative place of private vs. collective rewards to the developer. The early characterizations described an altruistic, community-minded developer interested in purely collective gains through volunteerism (Raymond, 1998; Ghosh, 1998). Of late, the focus has turned to the sustainability of the open source software movement, i.e., whether open source innovation can sustain if developers are not making private gains. Scholars have expressed widespread concern about the sustainability of the OSS movement due to high levels of volunteerism (Von Hippel and Von Krogh, 2003). It has been argued that while open source developers may derive joy from coding and might be ideologically motivated, many may "simply wish to earn a reasonable livelihood from their efforts" (Fitzgerald, 2006). In the current system where open source and proprietary software often co-exist in the same marketplace (Bonaccorsi and Rossi, 2003), corporations may be "harvesting the

altruism" of volunteer developers (Haruvy et al., 2003) leading to a system with "altruistic individuals and selfish firms" (Rossi and Bonaccorsi, 2005; Bonaccorsi and Rossi, 2004). There is a traditional free-rider problem in this situation where corporations often benefit from the source code of open source software without providing any compensation to the developers (Haruvy et al., 2008).

Financial incentives in the open source landscape (i.e., the pathways to private financial gain) are of many types. They can be categorized based on the distribution pattern (all or few), type of provider (corporation, individual), contingent or fixed and conditional or not (Krishnamurthy, 2006). Open source developers might be paid a fixed salary by a non-profit organization or for-profit corporation (Roberts et al., 2006), offered a bounty to solve a particular problem (Krishnamurthy and Tripathi, 2006) or be paid through voluntary contributions (Krishnamurthy and Tripathi, 2009). Theoretically, our view is that these differences matter in our understanding of when developers will accept private financial rewards.

The implicit assumption made by the literature thus far (e.g., Von Hippel and Von Krogh, 2003) is that when financial rewards are made available to open source developers, they will simply accept them. Put otherwise, the literature has examined the *provision of* and *not the acceptance of* these incentives. Interestingly, empirical data show that not all developers accept financial incentives when they are provided. Consider the case of Mozilla which offers a regular bounty to identify bugs in its code. A news story reports that 10–15% of participants turn down the financial rewards.[1] This is a poorly understood phenomenon and ties directly to the sustainability of the OSS movement. The implications for the private-collective innovation model (Von Hippel and Von Krogh, 2003) when many developers do not accept financial incentives are considerable. In effect, it switches from the private-collective innovation model to simply the collective innovation model (Osterloh and Rota, 2006) when this happens. Therefore, our work helps deepen our understanding of the relative place of private and collective rewards in the open source ecosystem.

This research is also managerially relevant. Understanding why OSS developers do not accept incentives will afford companies, non-governmental organizations (NGOs) and policy makers an opportunity to rethink their strategies. For one, companies are investing considerable amounts in this arena with the hope of attracting developers. These companies assume that developers will be attracted to these financial rewards. However, if there is systematic self-selection due to acceptance behavior, results might be different from what was intended or predicted. If acceptance behavior effects are massive, the resulting self-selection might jeopardize the network externality that companies might be counting on for rapid product development and diffusion (Bonaccorsi and Rossi, 2003; Dahlander, 2007; Bitzer et al., 2007).

In order to deepen our understanding, we begin with a short qualitative study. We find there is considerable diversity of opinion on how developers should be compensated. Not surprisingly, the fiercely independent open source developers themselves do not agree on one optimal arrangement. Table 1 summarizes open-ended responses to the question – "How should open source developers be paid?" This is based on survey data we gathered from OSS developers.

Interestingly, one respondent explicitly argues that open source developers should not be paid. This confirms our intuition that not all developers are likely to accept all financial incentives. Based on our analysis, we identified ten themes from the qualitative data – no compensation, voluntary monetary rewards, plurality

of methods, rewards in kind, subscription, salary/bounty, pay-for-service, contextual support, consensus-based decision and software sales.

It is beyond the scope of this paper to analyze the developers' relationship with these nine different types of financial incentives. We focus on one of the identified sources of payment – voluntary monetary rewards. Our research interest in this paper is to identify developers' acceptance behavior as central to the discourse on OSS sustainability and to clearly map the web of relationships between causal antecedents, and acceptance behavior. We examine how motivations drive developers to accept voluntary monetary rewards for their work on OSS projects.

Through this paper, we make the following contributions – (1) we identify acceptance behavior as requiring special attention within the open source literature, (2) we propose a scale to measure the intention to accept financial incentives, (3) we identify the impact of various established motivational components on acceptance behavior, and (4) we provide an empirical study using a dataset that combines attitudinal and behavioral variables from multiple sources to answer our research questions.

2. Literature review

OSS developer motivation is an issue that is of great interest to researchers. The current literature has identified several motivational components that drive open source software developers – intrinsic, i.e., originating from the act of participation (Lakhani and Von Hippel, 2003; Lakhani and Wolf, 2005), extrinsic, i.e., originating from external rewards (Lerner and Tirole, 2002, 2005), ideological, i.e., stemming from a strong belief structure in the values and norms underpinning OSS development methodology (Stewart and Gosain, 2006) and community, i.e., deriving from a strong sense of identification with the open source community (Hertel et al., 2003; Jannsen and Huang, 2008). These diverse motivational components are not necessarily mutually exclusive and may co-exist within a developer (Franck and Jungwirth, 1999; Krishnamurthy, 2006; Roberts et al., 2006). The main focus of this stream of literature is to understand how developers' motivations drive their participation/effort on OSS project which in turn affects overall performance and effectiveness of developers and projects. A summary of main findings from this stream of literature is provided in Table 2.

Generally speaking, the link between motivation and effort is well established in various literatures. While the literature is advanced in the identification of motivational components, the focus has been on the relationship between these components and effort/performance at either the individual or team level. While we know about how these motivations affect software-related performance, we do not know much about the link between these components and behaviors related to financial incentives, e.g., it is not clear what motivates some developers to accept some types of financial rewards in some situations. We aim to address that gap in this research.

The fundamental tenets of open source software are rooted in the principles of sharing freely with a virtual community of individuals (Raymond, 1998; Ghosh, 1998). These early descriptions of open source viewed financial incentives as applicable only to proprietary software regimes and considered open source as a volunteer-based system driven by ideology and freedom. Reciprocity was identified as one of the motivating factors in participation. Specifically, there was great interest in the generalized exchange model where individuals reciprocate contributions by strangers (Ekeh, 1974; Kollock, 1999; Lakhani and Von Hippel, 2003). Kollock (1999) argues that the General Public License (GPL) enables generalized exchange because it "creates an incentive