An empirical analysis of open source software developers' motivations and continuance intentions

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Abstract

We investigated open source software (OSS) developers' intentions to continue their involvement in future projects. The research goal was to analyze the motivations of OSS developers systematically and identify those factors that influenced their continuation. A work motivation model for OSS developers was proposed and a research model was empirically validated using data from a field survey of 148 OSS participants. The results showed that OSS developers' feelings of satisfaction and their intentions to continue with OSS development was influenced by both helping behavior and economic incentives and also that adequate motivators existed, though OSS developers did not benefit equally and there was substantial room to improve their experiences as OSS developers.
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1. Introduction

The open source community has produced a number of highly successful software products such as Linux, Apache, Perl, and Sendmail. Gartner [7] has predicted that Open Source Software (OSS) products will be well established by 2010 in at least 75% of mainstream enterprises, operating alongside traditional COTS solutions. The favorable acceptance of OSS products by business and the direct involvement of major IT vendors in OSS development have apparently transformed OSS from a public good to a mainstream, commercially viable form [11]. In contrast to traditional software, adopters of OSS seek lower cost solutions that they can modify or use as software components to build new or extended applications [1,20].

OSS is developed by loosely organized communities of participants located around the world and working over the Internet. Remarkably, most participants contribute without being employed, paid, or recruited by the organization. Although a recent trend is for companies that benefit from OSS to have some employees work on OSS, surveys have shown that the majority of participants are volunteers [22]. Central to this is the question: Why do some OSS developers voluntarily contribute their time and skills freely? The answer to this was the topic of our research.

The open source community is often described as a gift instead of an exchange culture. Essentially, *gift culture* refers to behavior which contains acts of

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altruism and reciprocity: in lieu of tangible rewards, givers receive psychological benefits such as the satisfaction of helping or living up to a moral commitment [35]. Others assert that intrinsic rewards such as boosting one's ego, enjoyment, and community identification provide intrinsic motivation to those engaging in OSS development.

However, economists argue that this is unlikely to explain the enormous contributions of some participants, since there are no obvious similar patterns of behavior in most other areas of economic activity. Many beneficiaries are well-to-do and could afford to pay OSS developers. Furthermore, altruism or reciprocity has not played a major role in other industries, so it is necessary to explain why individuals in the software industry are apparently more altruistic or reciprocal [36].

Exploratory empirical research on the motivations of OSS participants has been made: Hars and Ou [16] performed a simple correlation analysis, finding a weak correlation between effort and altruism and strong correlations between effort and both building human capital and signaling employers. Likewise, Hann et al. [15] found that high-ranking OSS contributors were paid high salaries by their employers, suggesting that rank conveyed sought-after skills. The Floss Survey [6] identified many other reasons why developers were involved in OSS development, including becoming part of the open source community, promoting the open source mode of development, supporting the idea of free as an alternative to proprietary software, gaining a reputation, and having fun. The report recognized that additional research was needed to understand how these motivators influenced OSS developers.

Such arguments have not been tested rigorously using work motivation theory. Furthermore, there has been little research focused on understanding OSS developers' intentions to engage in future open source projects once they have become involved. The sustainability of an open source community relies on developers' continuous voluntary contributions. By utilizing a work motivation model based on expectancy-value theory, we tested a framework that identified factors that generally influenced OSS participants' intentions to continue their involvement in future open source projects.

2. Motivators for participation

The set of possible motivators of OSS developers is extensive, containing both extrinsic and intrinsic aspects. Extrinsic motivators are environmental factors brought by the organization to an individual, while intrinsic motivators or internal motivators are related to the needs satisfying the individual [27]. The set of all possible motivators is too extensive to include in one study. Therefore, we focused on those that appeared to have the strongest effect: the intrinsic motivator helping and the extrinsic motivators enhancing human capital, career advancement, and personal needs.

2.1. Helping behavior

Many open source researchers have argued that altruism is the primary intrinsic incentive for participants. "Altruism... is a natural part of human nature [and]... is exhibited in some manner by everyone" [32]. Based on this viewpoint, developers make OSS contributions because they would like to lend a hand to others and simultaneously give something back to those who have assisted them [30]. In such a gift culture setting, given the abundance of resources, social status is determined not by what one has but by what one gives away, such is the case in the OSS community [33].

2.2. Enhancing human capital

A number of economists and researchers regard enhancing human capital as one of several extrinsic incentives that motivate participants to engage in OSS projects. From the standpoint of labor economics, human capital as a determinant of productivity refers to personal skills, capabilities, and knowledge. Human capital involves the accumulation of investments in people through their education and on-the-job training [28].

According to Ye and Kishida [42], OSS development provides examples of excellent programming to less skilled developers. However, the learning environment involves much more than the study of excellent craftsmanship. OSS communities possess the essential qualities that Wenger and Snyder [41] identified as "communities of practice," which are formed by people, mostly practitioners, who are "informally bound together by shared expertise and passion for a joint enterprise." As a result of sustained learning over time, the members develop a shared repertoire of experience, tools and ways of addressing recurring problems. Consequently, less experienced open source participants can develop skills that are useful when they enter/reenter the labor market.

2.3. Career advancement

Lerner and Tirole suggested that participation in OSS development may advance a person's career in two