

Motivating job design as a factor in open source governance

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Abstract Successful open source software (OSS) projects can be considered as examples of how ambitious work results can be achieved in web-based collaboration even when monetary incentives are low or absent. While former explorations of motivational processes in OSS projects primarily focused on person-oriented aspects such as motives, interests, and expected benefits of contributors, job-related factors have been largely neglected. After discussing the limitations of a person-oriented focus, a research perspective is suggested that concentrates on job design and work context in OSS based on frameworks from work psychology. A theoretical analysis is presented discussing job characteristics of successful OSS projects as potential explanations of the high motivation of OSS contributors. Compared to a person-oriented perspective, the results of a job-oriented approach might be better transferable to other projects (both OSS and “closed source” software development) and provide guidelines for the governance of successful web-based collaboration.

Keywords Job design · Open source software · Tele cooperation · Volunteerism · Web-based collaboration · Work motivation

1 Introduction

Successful open source software (OSS) projects such as Linux, Apache, or Mozilla have drawn considerable attention in the last years because they challenge the basic

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“economic man” perspective, demonstrating that many highly skilled experts are willing to invest considerable time in complex work projects even though monetary rewards and/or formal organization are rather low or absent. According to recent surveys, the software developers involved spend on average between 14 and 18 h per week for OSS projects (e.g., Hertel et al. 2003; Lakhani and Wolf 2005). And even though many OSS contributors are employed in commercial software companies, a major part of the work is still contributed for free.

Of course, such voluntary work engagement is not a new phenomenon and was shown previously, for instance, in social movements (e.g., Omoto and Snyder 1995). However, the success of various OSS products in comparison with products developed by commercial software companies, together with the economic value of OSS products, have made OSS related voluntary work engagement highly salient. Moreover, most of the OSS related work is realized using platforms on the Internet so that successful OSS projects can be seen as effective—and particularly motivating—examples of distributed (“virtual”) collaboration in electronic networks. Indeed, it is remarkable that many OSS projects work under conditions of relatively high anonymity that usually decrease motivation in collaborations (e.g., Karau and Williams 1993). Insights from successful OSS projects are thus not only relevant for other, newly evolving OSS initiatives, but might also provide innovative impetus for the governance of proprietary or “closed source” software development (CSS). Moreover, the recent popularity of “open content” systems on the Internet, such as the self-organizing encyclopedia Wikipedia, demonstrates that the success of self-managed and user-centered Internet projects is not limited to highly specialized (male) computer-enthusiasts (“hackers”), but is also possible with more “ordinary” people. Therefore, OSS as well as open content projects might provide strategic advice for organizations that are striving to motivate their employees to contribute to organizational knowledge management systems. However, what are the specific lessons to be learned from successful OSS projects that might be used to increase work motivation in CSS or other web-based collaborations?

2 Person-oriented factors of voluntary work engagement in OSS

Initial research endeavors to understand the motivation of contributors to OSS have mainly focused on *person-oriented factors*, such as individual motives and interests for being engaged in OSS (e.g., Gosh 2005; Hars and Ou 2002; Hertel et al. 2003; Lakhani and von Hippel 2003; Lakhani and Wolf 2005; Lerner and Tirole 2002, 2005; Raymond 1999). The results of this work reveal that most software developers in OSS projects are not driven by altruistic motives but follow rather selfish interests. For instance, OSS developers seek to have better software solutions for their own work, strive to gain reputation among their peers, want to learn new skills in order to improve their career options, or simply enjoy writing code. Moreover, it has become clear that there is not one main motive for being engaged in OSS projects, but various interests that depend on the personality of the contributor. In fact, it is considered one of the strengths of the OSS phenomenon that such projects

can appeal to multiple types of contributors (Feller et al. 2005). The different motives and interests have been categorized into various taxonomies, distinguishing immediate and delayed incentives (e.g., Lerner and Tirole 2002), extrinsic and intrinsic motives (e.g., Hars and Ou 2002), motives for joining and motives for staying in OSS projects (e.g., Gosh 2005), or multiple expectancy x value concepts that take into consideration the subjective importance of the OSS goals, reactions from friends and family, materialistic gains and losses, and identification with the OSS community (Hertel et al. 2003). Moreover, Lakhani and Wolf (2005) have recently distinguished four broader motive clusters or “types” of developers in OSS projects that seem to be similar in size: (1) those who are mainly driven by enjoyment and learning opportunities, (2) those who need the software code to satisfy non-work-related user needs, (3) those who engage in OSS projects for work-related reasons and career concerns, and (4) those who feel obligated to the OSS community and believe that software should be free.

Indeed, assessments of OSS contributors based on their self-ratings of these motives, and correlation analyses with performance indicators, have gained valuable insights into the motivational dynamics within OSS projects. However, when trying to transfer these person-oriented insights to CSS and other web-based collaborations, various difficulties arise. First of all, most of the motives and interests described are not unique to OSS projects. Seeking task enjoyment and learning opportunities are also relevant in CSS companies, as are interests in reputation and career advantages. And even felt obligations due to organizational identification and commitment are not unusual phenomena in the corporate world. As a consequence, it is unclear which of the motivational mechanisms observed in OSS governance are innovative to provide new impetus for other software development projects. For instance, although identification with small subsystem teams has been found to be a significant predictor of programmers’ work engagement in the Linux project (Hertel et al. 2003), similar team identification might be an even stronger predictor of motivation and performance of programmers’ in CSS projects. If this is the case, increasing team identification would be of limited use for managers striving to stimulate an OSS-like enthusiasm among their programmers. In order to find motivational processes that are unique to OSS governance, it is important to contrast the profiles of OSS developers with profiles of developers in CSS projects who work on similar products (operating system, business application, etc.) and have similar functional roles (programmer, analyst, maintainer, user support, etc.; e.g., Goldstein 1989).

Secondly, understanding the motives and interests of OSS contributors does not guarantee that these effects can be replicated in other work contexts. Although many contributors to OSS projects are employed in CSS companies, it is still conceivable that OSS projects attract a certain “type” of developer with different values, interests and political opinions than the average CSS developer. Moreover, those developers engaged in both OSS and CSS projects might be motivated by different incentives in each of the different work contexts (e.g., intrinsic task enjoyment vs. extrinsic monetary benefits), and even develop different self-concepts for the different work contexts (a “hacker self” and a “money-maker self”). Consequently, persons who are highly engaged in OSS projects might not be very

interested in typical CSS incentives. Interestingly, whether receiving payment or not does not seem to have much effect on the motivational indicators of developers in the Linux kernel project (e.g., Hertel et al. 2003). On the other hand, the average CSS developer might not be very sensitive to motivating factors provided by OSS governance, for instance, because they do not appreciate a high degree of self-organization.

Thus, issues of person-environment fit (person-organization fit as well as person-job fit) might limit the practical use of person-oriented insights from OSS governance for other work contexts. Trying to attract developers with motivational profiles typical for OSS projects might not be compatible with the culture and governance policies of CSS companies. Organizational changes in order to enable a more OSS-like culture might be connected with unexpected costs (e.g., additional coordination costs, loss of employees who appreciate a more hierarchical structure, etc.) that level out potential gains of such endeavors. Parallel structures might be an alternative way to integrate OSS-type projects in CSS companies, but also risk role conflicts and perceived unfairness due to different work conditions and incentives. Together, a pure person-oriented focus of motivation research in OSS projects provides only limited suggestions for the governance and motivation management in other work contexts.

3 Job-oriented factors of voluntary work engagement in OSS

An alternative and perhaps more promising approach in deriving strategic impetus from OSS governance might be a *work-oriented* perspective, which focuses on features such as job complexity, task interdependence, autonomy, and feedback opportunities instead of person-related factors. Unfortunately, I am not aware of any systematic job design analyses of OSS being available to date. In addition to a better understanding of the dynamics in OSS projects, comparing OSS work features with work features of CSS projects developing similar products might provide interesting suggestions for the improvement of CSS governance. In such analyses, it will be desirable to have both OSS and CSS work features assessed by the same persons in order to control biases due to different frames of reference (e.g., developers with different standards, expectations, motives, etc.) and/or multilevel effects (e.g., the increase from low to high autonomy might have different meanings in OSS and CSS projects). This could be accomplished either by objective job analysis measures, by external (trained) observers, or by job-related ratings of developers working in both OSS and CSS projects. Please note that developers engaged in both OSS and CSS work might not only differ from average CSS developers but may also not be representative for the OSS developer community, e.g., because they might represent only those developers with pragmatic interests (“I don’t care where the software comes from as long as it works.”). Therefore, subjective job analyses should also include developers engaged only in OSS, as well as developers engaged only in CSS.

Important for this research are reliable measures and tools for job analyses that are embedded in a theoretical framework. Such frameworks are provided by work

psychology (e.g., Morgeson and Campion 2003, for a review) and have been already used successfully for task analyses in CSS (e.g., Goldstein 1989; Lending and Chervany 1997). For instance, the Job Characteristic Model (JCM) developed by Hackman and Oldham (1980) specifies five crucial task components that determine the motivational potential of work conditions: (1) skill variety (variety of skills needed for accomplishing the task), (2) task identity (completeness of the work process from an obvious beginning to an end), (3) task significance (impact of the work for others), (4) autonomy, and (5) feedback from the task. The first three factors are assumed to compensate each other and are thus formally expressed as additive components, whereas the last two factors are conceptualized as pre-conditions for a high motivational potential of a task and are thus formally expressed as multiplicative components. According to the JCM, the perception of the different task conditions causes certain states in the performing person, i.e., a feeling of meaningfulness, the experience of responsibility for work outcomes, and knowledge of the actual work results, which in turn should affect the levels of work motivation and job satisfaction.

Interestingly, the five JCM components correspond nicely to central motivational processes discussed in the OSS literature. For instance, Gosh (2005) and Lerner and Tirole (2005) argued that OSS is attractive because it provides a large variety of learning opportunities that might be higher than in many CSS companies. Moreover, I would argue that the higher individual control of developers to choose tasks that exactly match their expertise and capability provides a better learning environment and more opportunities for “flow” experiences (Csikszentmihalyi 1990) compared to standard CSS contexts. Both aspects correspond to the JCM component of skill variety. Task significance should also be higher in OSS projects due to a strong emphasis on prosocial values within many projects (helping others to solve problems), and because an important goal of OSS projects is to provide goods that are available to all people. Task identity might be perceived as low in OSS projects, given that these often have a *modular* structure (Moon and Sproull 2002). However, this modular structure might be a precondition of perceived task identity at a *lower* level, providing identifiable subprojects for which developers are fully responsible from the beginning to the end of the development process. In contrast, developers in CSS companies depend more often on their supervisors’ interference and advice (Lerner and Tirole 2005) which decreases the experience of task identity and personal responsibility. Together, higher degrees of skill variety, task significance, and task identity might cause higher feelings of meaningfulness of work in OSS as compared to CSS projects.

Autonomy as the fourth JCM component should also be higher in OSS projects when compared to CSS work, given that the former projects are self-organized and not based on formal authority. Although OSS projects are not free from hierarchy (e.g., the perception of Linus Torvalds as “benevolent dictator” of the Linux community; cf. Moon and Sproul 2002), decision making in OSS is assumed to be based more often on mutual agreement as compared to CSS (e.g., Raymond 1999). Moreover, the modular structure of OSS projects enables developers to have high process-related autonomy in “their” sub-projects. High degrees of autonomy, in turn, should cause higher perceived responsibility for work outcomes.

The fifth JCM component, feedback from the task, should be rather similar in OSS and CSS projects because the basic work activities (writing code, debugging, etc.) are more or less the same. However, OSS projects quite likely provide higher degrees of social feedback from other developers compared to CSS projects (see below).

Together, most of the five JCM work components are expected to be higher in active OSS projects when compared to CSS projects, and thus might explain a motivational advantage of OSS projects independent from person-oriented factors. Moreover, person-oriented factors such as learning interests or cognitive capabilities can be integrated in this framework as moderators (cf. Hackman and Oldham, 1980: ch. 4). This different perspective provides clear advantages for the generalizability of findings *across work conditions* (not across persons), mapping concrete opportunities for job (re-)design in other contexts.

The basic JCM framework has been further developed and extended (e.g., Wall and Jackson 1995; Karasek et al. 1998) by adding components related to physical task demands (e.g., technology used, ergonomic aspects; cf. Morgeson and Campion 2003; see also Brodbeck 2001) and the social environment (e.g., being part of an attractive community, social support and feedback). These additional aspects may also be prevalent at higher levels in OSS compared to CSS projects, for instance, because the communication technology in OSS projects is often less sophisticated and thus more reliable (cf. Moon and Sproull 2002), because OSS projects might be seen as a very attractive “cool” hacker community, or because feedback from other OSS developers is probably more immediate, rich, and constructive than the usual supervisory (or customer) feedback in CSS (cf. Weinberg 1998). Of course, the higher level of social feedback in OSS is only to be expected in active OSS projects with sufficient traffic. In newly started or in declining projects, developers often get no feedback at all on their patches and postings.

Of course, the described assumptions have yet to be confirmed by empirical research. However, results from research in progress (Jendroska D and Hertel G, Unpublished) indeed suggest higher perceived levels of job characteristics in OSS as compared to CSS projects, particularly for autonomy, task identity, and feedback, implying a greater perceived task complexity in OSS projects. Moreover, the differences in perceived task complexity between OSS and CSS seem to be more crucial than differences of social factors (e.g., social support, feedback from others). Similar results were found in initial studies of contributors to the open content project Wikipedia (Schroer and Hertel 2006), suggesting that learning opportunities and significance of the work for others are important motivators that are mediated by feelings of mastery (information self-efficacy) and indicators of “flow” experiences. Moreover, perceived levels of task-related autonomy, task significance, and feedback from other participants were correlated positively both with higher engagement for Wikipedia (e.g., time spent improving articles) and with higher satisfaction with the engagement. These results correspond to results reported in studies on web-based knowledge sharing in business companies (e.g., Hollingshead et al. 2002).

4 Summary

The main argument of this contribution is that the explorations of motivational mechanisms underlying the OSS phenomenon have focused predominantly on person-oriented aspects while job-related factors have been neglected. The focus on person-related aspects is understandable, given that one of the first questions about OSS might be: What *kind of persons* are doing all this voluntary work? However, the implications of such a focus for the governance and motivation management in other projects are somewhat limited. Instead, a job-oriented focus might provide insights that are more applicable across different collaboration projects. Based on theoretical frameworks from work psychology (e.g., Hackman and Oldham 1980; Morgeson and Campion 2003), specific motivating features of the task and work environment in OSS projects might be explored in order to derive suggestions for an improvement of OSS and other web-based collaboration projects. The following job characteristics are promising candidates for such improvements:

- Task complexity and the experience of personal challenges
- Opportunities for active learning and feelings of mastery
- Significance of the work for colleagues, for the company/community, or for society
- Individual autonomy and responsibility
- Project-related self-coordination and community management
- High time and decision control
- Opportunities to customize software tools to personal needs (cf. Franke and von Hippel 2003)
- Opportunities to match task difficulties to personal expertise
- Frequency, quality, and timeliness of feedback from the task as well as from others (colleagues, users, etc.)
- Social support from other project members
- Lean and reliable collaboration tools

The advantage of this approach for the governance and the management of motivation in other contexts is that strategies do not depend so strongly on recruiting the “right” people, but on the right *design* of the job and its context conditions. Person-oriented aspects are not neglected in this approach, but are considered as moderating factors that alter the impact of task characteristics on motivation instead of determining motivation directly. Examples of such person-oriented moderators are developers’ expertise, learning interests, need for structure, power needs, or career orientation. Moreover, boundary conditions such as roles and functions within software development (programmer, analyst, maintainer, user support, etc.) must be considered (e.g., Goldstein 1989).

If confirmed by empirical research, such a job-related perspective provides a better scope for creating motivating conditions both in new OSS projects as well as in OSS companies based on lessons learned from successful OSS projects. The comparison between OSS and OSS governance is fruitful because it provides a broader range of potential strategies compared to a research strategy that focuses only on OSS companies. For instance, OSS projects might have developed higher

degrees and/or different combinations of job characteristics (e.g., autonomy) that cannot be found in CSS companies to date. Moreover, comparisons with other self-managed projects on the Internet, such as the Wikipedia project, provide information on the generalizability of these principles outside of the field of software development. Given that many companies are implementing global knowledge management systems that require considerable voluntary engagement from their employees (e.g., Osterloh et al. 2002), these results might provide valuable guidelines and fresh ideas for improvements.

However, it should be noted that these improvements are not “for free”, but can require substantial changes in the organizational structure and culture. Moreover, work-related values and expectations of employees might change considerably in the process. Consequently, these organizational changes should be considered thoroughly, the main questions being: (a) are OSS-like governance principles compatible with the product requirements, and with the general management structure and culture of the organization, and (b) do the needs and interests of the current employees fit to OSS-like governance principles.

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