Impact of Financial Benefits on Open Source Software Sustainability

Research-in-Progress

Arzoo Atiq
University of Auckland,
New Zealand
a.atiq@auckland.ac.nz

Arvind Tripathi
University of Auckland,
New Zealand
a.tripathi@auckland.ac.nz

Abstract

In recent years, the success of open source software (OSS) has attracted proprietary software firms, who now actively participate, and sponsor OSS development. Though researchers agree that for the progress of OSS projects, financial support, rewards, and incentives are critical if not essential, we are yet to understand the dynamics of compensation structures/policies and their impact on the long-term sustainability of OSS projects and communities. In this research, we aim to explore the role of developers' perceived asymmetry in compensation in OSS projects. Using grounded theory procedures to code and analyse the textual responses from the developers, we find a mixed opinion on whether the perceived asymmetric distribution of project's financial resources, helps or impedes the progress of an OSS project. We find that fair-terms, transparency and effective communication practices are essential to the sustainability of OSS projects, even with perceived asymmetric compensation. Future research aims to develop a comprehensive theory of the role of rewards in open source software development.

Keywords: Open Source Software (OSS), Compensation/Rewards, GTM, Project Management

Introduction

Thriving under the paradigm of open innovation, open source software (OSS) has gained unprecedented popularity in last decade in both private and public sector. Open source software refers to programs where source code is openly accessible for modification as opposed to proprietary software such as Windows and Microsoft Office (Hecker 1999). In this paper, we focus on the dynamics of OSS development highlighting the factors that are crucial for their sustainability. Advancements in Internet, sharing technologies and platforms in recent years, have further made it easy for OSS projects to attract a culturally diverse volunteer workforce from all over the globe. However, sustainability of OSS depends on volunteer contributions from software developers. Earlier research in open source focussed on explaining developer’s motivations behind volunteer contributions, but more recently, scholars have questioned the long-term sustainability of OSS if developers don’t make any private gains (Fitzgerald 2006) in OSS, and have examined reward/compensation structures in OSS ecosystem (Krishnamurthy and Tripathi 2006, 2009).

In recent years, the success of open source software (OSS) has attracted proprietary software firms, who now participate and support OSS development in various ways. For example, firms such as Google, Microsoft, Facebook, etc. allow their employees to contribute to OSS projects along with volunteer developers. These paid contributors have been assimilated in OSS communities and have played a significant role in record growth of open source software. Besides paid contributors, companies also offer sponsorships, support community conferences, travel costs and hardware, just to name a few. These sponsorships and other external resources allow projects to move forward at a faster pace and help them sustain in a competitive software market. While these sponsorships create a plethora of reward/payment
options (Krishnamurthy and Tripathi 2006) for OSS developers (volunteers), they also create some challenges for OSS projects.

Since the current model of OSS development depends on this volunteer workforce, who are ideologically motivated (Stewart and Gosain 2006), introducing compensations/rewards that are not transparent and community oriented, may alienate volunteers and threaten the sustainability of OSS communities (Frey and Goette 1999; Fitzgerald 2004). As volunteers’ motivation to associate with, and contribute via these communities is vital (Roberts et al. 2006) to the sustainability of OSS development (Von Hippel and Von Krogh 2003; Von Hippel 2005; Von Krogh et al. 2003), it is critical to explore the reward mechanisms that would be acceptable in OSS communities and impact of these rewards on the OSS development ecosystem.

While not all the developers are enthusiastic about introducing rewards/compensation to OSS ecosystem (Krishnamurthy et al. 2014), a large percentage of developers are open to the concept and intend to accept rewards/compensation for their contribution to OSS projects (Atiq and Tripathi 2014), if rewards are not controlling (Krishnamurthy et al. 2014). These OSS developers believe that “compensation enables them to put more time in a project” and therefore, facilitate progress and long-term sustainability of open source software development. We posit that participation of industry-sponsored developers on OSS projects along with the volunteer workforce might have influenced OSS developers’ perception and intention towards rewards/compensation in open source software ecosystem. However, to the best of our knowledge, research on compensation/rewards in OSS is still vague (Hann et al. 2013) and it lacks a theory grounded in data.

For a community that champions collective rewards over private rewards, it is critical to understand developers’ perception about rewards/compensation in OSS ecosystem which could play a key role in the long-term sustainability of the OSS community. There have been instances when sponsorships have allowed OSS projects to hire developers for certain tasks and move the project forward. However, many in the community consider this as unfair, paying some developers to work alongside volunteer workforce. Therefore, we ask OSS developers the following question- What happens to open source projects where only some people get financial benefits? In other words, we intend to examine the impact of perceived asymmetry in compensation/rewards on success or sustainability of OSS projects. Developers perceive asymmetry in compensation/rewards when they believe that funds/resources available to a project have to be distributed unequally/unfairly. Since the volunteer workforce is critical for OSS development, we argue that understanding the drivers and consequences of their perceived asymmetry, if any, is critical to the success of any OSS project.

The review extracts two major streams from the literature; one stream that examined the motivations of programmers behind developing open source software and the other literature stream studies the compensation structures’ dynamics that would keep up the motivation of OSS developers.

**Literature Review**

**OSS Developers**

The research community has shown great interest in open source software development. Much of the extant literature on OSS is largely focused on examining developers’ motivation- why would so many developers donate their time and energy to the creation of an open source product? The current thinking is that the motivation of a developer could be broadly classified as intrinsic (i.e., deriving from the simple act of participation- e.g. fun, creativity, flow, freedom) and extrinsic (i.e., tangible rewards) (Lakhani and Wolf 2005). Extrinsic rewards include maximization of future career prospects, peer recognition, and development of job-related skills (Lerner and Tirole 2002a). Overall, the literature suggests that developers are driven by volunteerism (Raymond 1998, Ghosh 1998, Von Hippel and Von Krogh 2003), enjoyment of coding (Roberts et al. 2006), ideology (Stewart and Gosain 2006), and financial incentives (Fitzgerald 2006). These studies provide a stable foundation towards the recent work which is exploring the sustainability of OSS communities. Therefore, the research in open source has evolved from a private-collective model of innovation (Von Hippel and Von Krogh 2003) to understanding that OSS developers need to “earn a livelihood” (Fitzgerald 2006) for long-term sustainability of open source software.
As more and more proprietary software firms participate, sponsor, and offer their developers for OSS projects, many of their employees are attracted to OSS, find synergies and voluntarily join OSS communities. These employees contribute to OSS projects in the evening after they finish their paid jobs (Riehle et al. 2014). Drawing from Self-determination theory (SDT), researchers argue that OSS communities attract developers because they provide autonomy and sense of belonging to increase competency (Ryan and Deci 2000). Therefore, we argue that it is critical to factor in the OSS community norms and ideology (Stewart and Gosain 2006) when developing rewards/compensation structures for OSS communities.

**Compensation and Rewards**

The compensation is a value exchange between a principal and an agent. The management theorists in early 19th century devised the initial compensation mechanisms (Wang and Kaarst-Brown 2014) for controlling employee behaviours. These mechanisms then later turned into “bureaucratic personnel mechanisms” which were directed more towards the job analysis, evaluations and promotion practices. In contrast to traditional software firms, open source software projects have different organizational structures and rely on volunteer workforce without any formal employer-employee type relationships. However, many large open source software projects such as Apache, Linux, etc. do have resources that are allocated to contributors but allocation policies vary across projects. While a few researchers have attempted to explore the nature and types of compensations in OSS ecosystem (Krishnamurthy and Tripathi 2006) and impact thereof on OSS projects success (Han et al. 2013; Wang and Kaarst-Brown 2014), others have questioned if ideologically driven volunteer workforce would accept compensation/rewards (Krishnamurthy et al. 2014). Though researchers agree that for progress and completion of OSS projects, incentives are critical if not very essential (Alexy and Leitner 2011; Wang and Kaarst-brown 2014), we are yet to understand the nature and types of rewards/compensation structures that would keep up the motivation of OSS developers and sustainability of OSS projects (Fang and Neufeld 2009).

Human resource management researchers have examined the compensation from socio-psychological theories, organizational theories and economic theories and suggested compensation as a well-known strategy, for attaining, retaining and developing IT employees (Werner and Ward 2004). Organization structure and governing policies in open source software projects/teams are very different compared to traditional organizations. Therefore, open source software projects surviving on volunteer workforce can be classified as high-risk because monitoring and performance measurement are often less attainable (von Krogh et al. 2012) and thus, require different compensation policies and structures (Wang and Kaarst-brown 2014). Similarly, in sponsored open source projects, where both paid employees of the firms and volunteer workforce work together, it is critical to manage the team dynamics and keep volunteers’ motivations up in for success of these projects and thus require different compensation/reward structures. A fair and transparent compensation/reward structure may motivate volunteer workforce, which in turn leads to project success. Project success refers to the completion of the project or a prospering project (Atiq and Tripathi 2014).

In the open source environment, financial incentives or rewards can be differentiated in many ways. For example, 1) based on the distribution pattern- paying all or only a few of them; 2) types of providers- a corporation or an individual, as these will lead to different project dynamics and outcome; 3) commission-based or flat, types of compensation patterns (Krishnamurthy et al. 2014), just to name a few. Recent studies have established that intrinsic motivation of OSS developers declines over time and therefore indicates that there is a need to study the drivers which keep up the momentum of OSS developers for project progress and success (Fang and Neufeld 2009). Despite a large number of studies in this area relevant to information systems discipline, few have explored what type of participation is compensated and type of compensation acceptable to OSS community. Moreover, whether the distribution of compensation or reward has any effect on developer’s motivation to continue with the project? If yes, then to what extent this is desirable and when unequal compensation becomes demotivating. We do not know how rewards or compensation affect the dynamics of OSS developer communities. This work focuses on developers’ expectation about the fair and transparent usage of project’s monetary resources. Previous literature suggests that developers are driven by volunteerism (Raymond 1998, Ghosh 1998, Von Hippel and Von Krogh 2003) but even intrinsically motivated developers are open to accepting rewards if
Financial Benefits in OSS Sustainability

rewards are not controlling (Krishnamurthy et al. 2014). Extending this literature, we aim to explore the impact perceived asymmetric rewards/compensation in OSS projects.

**Research Design**

Our aim is to explore how developers’ perception of asymmetric compensation/reward structures in an open source software project that they are associated with, can influence their contributions, and in a broader sense, the sustainability of the open source software project and associated community. There is a little research exploring developers’ perception about the nature of financial rewards in OSS, let alone the impact of these perceptions on the long-term sustainability of OSS projects. Since our aim is to build a theory to deepen our understanding of rewards and compensation in OSS, we employed qualitative approach. OSS developers were asked an open-ended question, “*What happens to open source projects where only some people get financial benefits?*”

We contacted developers who were associated with a wide range of OSS projects hosted on Sourceforge.net development platform. Sourceforge was selected because it is one of the largest repositories of OSS projects.

We followed the grounded theory method (GTM) to analyse usable responses from 321 OSS developers who explicitly stated their idea about the role of rewards for OSS development. The basic purpose of selecting GTM in this investigation was to theorise the developers’ opinion on the role of rewards in OSS communities. In this segment, the steps taken during analysis are detailed as qualitative inquiry emphasise on the reflexivity of the process of analysis and research.

Here it is important to emphasize that the research followed only GTM procedures and not the whole GTM process as these procedures were applied on already collected data and the data is not collected till a saturation point is reached as stated in GTM. The limitation of not collecting the data till a certain saturation point is overcome by collecting an ample number of responses. Subsequently, these questions were coded using grounded theory procedures outlined by Strauss and Corbin (1994). The reason of using GTM procedures is to formulate a compensation theory in OSS ecosystem.

**Data Analysis and Research Process**

There are four basic elements of grounded theory method, i.e., open coding, constant comparison, memoing and theoretical coding (Allan 2007; Straus and Cobin 1990). For conducting the grounded theory analysis, we follow two sets of guidelines. At a macro level, we follow the guidelines proposed by Urquhart et al. (2010), i.e., open coding. At a micro level, for the identification of the concepts, we follow the constant comparison method guidelines proposed by Boije (2002) and Allan (2007). Following Urquhart et al. (2010) and Allan (2007), we open coded the data with an open mind searching for the underlying conceptual issues. Codes are linguistic labels selected by the researcher to name each underlying concept embedded in each sentence of the response (Allan 2007). After the open coding period, we conducted the constant comparison for each code. Specifically, each code emerged from open coding was compared with all previous codes to search for similarities, connections, and patterns (Strauss and Cobin 1990). We grouped the codes that share commonalities and named each group or category, referred to as concepts. Next, we describe the research process.

The analysis used Nvivo 10 for the organisation of codes, categories, and themes. Figure 1 is an example and describes our data analysis approach. Both of the excerpts attempt to explain what characteristics of a project will make it survive when financial incentives to the developers are unequal? Accordingly, the three excerpts are directed towards project size where from the excerpts, we took out the open code. Then, in the next round, we brought the open codes within one focused code, project size. This excerpt was added to the project success category. When responding to our open-ended question, most of the respondents alluded unequal compensation to project success (failure) or sustainability of the OSS projects. Therefore, we define Project sustainability as the main category. The main category ‘*Project sustainability*’ is interpreted from the analysis which suggests that even the variability in financial benefits can result in OSS project’s success when the project size is large.
Thus, using a rigorous process of open coding, focused coding, and categories formation for each excerpt from the developers, we arrived at a list of 106 open codes through constant comparison. Later these codes were grouped into three major categories as depicted in Table 1 (competing factor, project, developer). The first column is the focused code, which started the analysis. The last column is an example of the excerpt, from which open codes were interpreted. Then the relevant codes grouped together to form categories. The second round of grouping together the relevant codes resulted in 80 codes. The categories were then further categorised based on major themes emerging from the data (project sustainability is facilitated by vs project sustainability is impede by).

Next section formulates our findings based on the themes that are created from the analysis.

**Findings**

From our analysis described above, we arrived at focused codes of project and people. Thus, project and people are the key factors which lead any OSS project towards progress (success) or failure. Project sub-factors and people sub-factors are noted in the study when asymmetry causes problems for any OSS venture; big or small.

The progress or success of any OSS project depends on developers’ motivation along with many other factors. In turn, there are some factors that affect developers’ motivation for continued contribution and completion of the project. Our preliminary analysis indicates how fair and transparent usage of project’s monetary resources are critical for developers and motivate them for their continuing contribution to the OSS projects. Our data analysis reveals that often financial benefits in OSS projects are asymmetric, at least from developers’ perspective.

**Sustainable Project**

It is imperative to mention here, that sustainable project in our analysis refers to a project that continues to make progress by attracting developers and their continued participation. Our preliminary analysis shows that project size and project management play very important role for the sustainability of a project, especially in projects where developers’ perceived reward distribution is asymmetric. As one developer (in our dataset) indicated,

> “It (project management) improves continuity and keeps people excited because there are always improvements.”
> “Project benefits from having any developer getting help to continue their work”

According to our data, in large projects the difference in financial incentives does not lead to failure of a project. However, if the project size is small, not interesting to the developers, asymmetry in any type of benefit can be detrimental for the project.

> “if project is weak and barely interesting for the community, it usually becomes closed;”
> “if the project is large enough, it’ll probably work out.”
### Table 1: Initial Theorising of Asymmetrical Financial benefits

<table>
<thead>
<tr>
<th>Focused Code</th>
<th>Relationship</th>
<th>Category</th>
<th>Relationship</th>
<th>Category</th>
<th>Open Codes</th>
<th>Excerpt Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymmetry in Compensation</td>
<td>facilitate</td>
<td>Project Progress (Sustainable Project)</td>
<td>Depends on</td>
<td>Competitive spirit</td>
<td>Intrinsic- Fun/Learning And Extrinsic- Rewards</td>
<td>“and that developer are not generally competing against each other”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Developers</td>
<td>Culture Values</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Project</td>
<td>Size- Large, Strong, Interesting, Management</td>
</tr>
<tr>
<td>impede</td>
<td>Project Sustainability (or Project Fails)</td>
<td>Depends on</td>
<td>Competitive spirit</td>
<td>Only Extrinsic- Rewards, Money</td>
<td>“Competing projects will be created.”</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Project</td>
<td>Size- Small, Weak Slow progress, Uninteresting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Developers</td>
<td>Demotivated Competing projects evolve</td>
</tr>
</tbody>
</table>
Three attributes essential for OSS project management found in our data are; *Transparency, fair terms, and communication*. For the success of an OSS project with asymmetric benefits distribution, project management’s above-mentioned sub-factors become crucial attributes.

Transparency means that OSS developers involved in the project development should be aware of the internal policies about incentives. Similarly, fair terms mean that the compensation and rewards policy should treat all developers equally. However, the developers who are contributing more effort can be compensated more and vice versa, but this distribution should be according to the contribution.

“*make sure the terms are fair and well known, “*

“*Depends on whether the distribution is fair or not.”*

Last factor essential for OSS project management is communication. The project sponsors should be clear in their incentives agreements and in good communication with their developers.

“*There needs to be more communication with the other members to avoid misunderstandings.”*

“*I suspect it would depend greatly on the subcommunity and project. “*

To conclude this analysis, it is safe to conclude that mutual respect among developers, better project management and maturity of the developers’ community are key factors that contribute towards sustainability of OSS projects. Moreover, data also identifies competitive spirit as an important factor that may motivate or demotivate a developer.

**Developers**

The open source developers’ work culture and their circumstances are important for project success and failures. The developers’ circumstances refer to their overall contexts such as their backgrounds, their skills, their work practices, their economic situation at a certain point and their demographics.

Work culture values are mutual respect, the level of maturity and competitive spirit. Mutual respect is the regard each developer has for other developers and the level of maturity refers to the experience and wisdom they have acquired over time. It is intuitive that mutual respect and level of maturity differ across individual and therefore, sometimes, their perception of asymmetric compensation can trigger their self-esteem or discourage them from contributing. It is also possible that unclear or unfair compensation/reward structures or policies may deter people to join a project.

“*up to the egos of the members”*

“*Depends on the level of mutual respect”*

“*No rules... as with all other human relationship matters”*

“*Depends on the maturity of the project members”*

The ‘competitive spirit’ plays a significant role in determining the future of any project, according to the OSS developers. Some developers do not compete with each other and therefore, are not concerned with the monetary or reward structures in a project. However, if developers compete for a reward, there could be some problems as can be seen from the following quotes.

“*and that developer are not generally competing against each other”*

“*The situation might be different if members of a project were competing for a reward, though.”*

“*Competing projects will be created.”*

“*most probably there will be a great upcry (slashdot) and a fork will take place..”*

If developers are extrinsically motivated and contribute only for rewards, they will leave the project if they perceive any bias in compensation policies.

We find that developers accept asymmetric compensations if they map to asymmetric developers' contributions. In other words, developers can accept the reward asymmetry knowing that not everyone
contributes equally to any software project. Some spend more time, others are more experienced and some are just ingenious. Giving an example of major open source projects such as RedHat and Mozilla, developers made an argument that in those projects unequal financial incentives did not make any difference. As some people responded,

“The compensated ones end up doing all of the grunt work :-(.)”
“There will always be certain people that are ‘worth more’ to a project than others.”
“Not all members contribute equally to an open source project.”

Developers’ situation affects an open source project because it is possible that there are new developers who can give less time to the project. Developers’ who want to work but due to their monetary situation, they cannot continue with a project where they have not been given a fair amount of compensation. In any case, there is always an element of choice for OSS developers to leave the project anytime when they feel they are not treated fairly.

“Developers work on projects based on their choice. If they don’t find it beneficial enough, there is no demand that they continue.”
“If you don’t like it, don’t do it.”

Table 1, summarises the findings elaborated above. From our interpretive study, our findings suggest that perceived unequal financial benefits do not always impede the success of the project. However, there are certain factors on that can affect the sustainability of the OSS project. First, the competitive spirit should be driven by both intrinsic and extrinsic motivations. Second, developers should have respect for other developers showing a higher level of maturity and they should follow certain moral values. Finally, we find that the project size mediates the effect of developers’ perceived asymmetric compensation on the sustainability of OSS projects. For example, large projects with an efficient management are more likely to survive even with perceived asymmetric compensation structures.

**Discussion**

Our results confirm that success and sustainability of open source software projects depend on voluntary contributions from developers. Ideological motivations are defined as belief structures that stem from values and norms underpinning the OSS development methodology (Stewart and Gosain 2006). While many developers are not in it for compensation and rewards (Krishnamurthy et al. 2014), they expect transparency, fairness, and open communication in managing project resources and donations that accrue from sponsorships/partnerships. Developers suggest a formalization of a monetary compensation policy for open source community.

From Table 1, the causal relationships formed are that,

- Asymmetry in compensation/rewards for allocated budgets in any OSS project can result in project sustainability when the competing factor is intrinsic and extrinsic, as opposed to intrinsic or extrinsic reward.
- Asymmetry in compensation/rewards for allocated budgets in any OSS project can impede long-term sustainability of the project when the competitive spirit is only driven by extrinsic motivation.
- Financial benefits can differ where developers’ culture and values permit.
- Financial incentives can vary when the project is large, well-managed i.e. communication is transparent, and terms are fair.
- Project Management is the key to OSS project sustainability.
- A small project may not survive (fail) if there is an asymmetry in financial benefits.
- Unequal financial benefits can result in slow progress of the project and thus a failure.
- Unequal financial benefits can result in demotivated developers who are capable of creating competing projects as opposed to motivated developers who facilitate OSS project progress.
Figure 2: OSS Project Sustainability depends on Project Management

The findings from this investigation as illustrated in Figure 2, suggest that financial benefits, whether distributed equally or unequally are not the major reason for project progress but project management is a key factor for an OSS project sustainability, which is plausible with software development literature (Schmidt et al. 2001). However, initial studies on OSS development, researchers found that traditional project management was not suitable in OSS ecosystem (Aksulu and Wade 2010 cited Brooks 1995 pg.590). We believe that our findings contribute to this stream of literature by adding that OSS projects can minimise the negative impact of unequal compensation policies through effective project management. Therefore, governing bodies can play a crucial role in the sustainability of OSS projects by proper project management mechanisms/policies. Our research suggests that policies that are transparent, fair and use open communication, are the key project management characteristics and essential for the success of open source software projects. Moreover, effective project management governance keeps up the motivation of OSS developers, who then facilitate OSS ecosystem sustainability. Therefore, impending upon our next reasons along with project management skills are the project size, values, and situation of OSS developers that are essential for keeping up the momentum of a sustainable OSS project.

Conclusion and Future Work

In this research, we intended to examine the impact of perceived asymmetry in compensation/rewards on success or sustainability of OSS projects. Developers perceive asymmetry in compensation/rewards when they believe that funds/resources available to a project have been distributed unequally/unfairly/asymmetrically. Since the volunteer workforce is critical for OSS development, we argue that understanding the drivers and consequences of their perceived asymmetry, if any, is critical for the success and sustainability of any OSS project.

Our findings suggest that OSS projects where only some people get financial benefits may fail if they are mismanaged. Accordingly, there is a mixed opinion on whether this variable fund's distributions help or hinders the progress of an OSS project. From our empirical research, we suggest that fair-terms, transparency through effective communication are essential to OSS project sustainability, even if the governing agency have a policy of unequal financial benefits. Our results challenge the prior work (Aksulu and Wade 2010 cited Brooks 1995 pg.590) where project management was not seen as a crucial element for the success of OSS projects. One possible reason behind these contrasting results is that induction of compensation/rewards via corporate partnerships/sponsorships in OSS is a fairly new concept. We argue that this changing landscape requires a better understanding of the role of project management in open source software development.

The other reasons along with project management skills are developers’ values, their situation and project size. We find that when compensation/rewards are asymmetric, larger projects are more likely to survive compared to weaker and smaller projects (Riehle et al. 2014). Further, projects with strong developers’ motivations are more likely to survive when compensation is asymmetric. Future research aims to develop a comprehensive theory of the impact of financial benefits on OSS ecosystem sustainability which will elaborate more on how psychological and financial aspects in a reward/compensation system are dependent on each other.
References


