

Title: Governance Mechanics and Contributor Incentives in Open-Source Software: Balancing Community and Corporate Interest

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1. Abstract

This critical literature reviews two main concepts within the scope of Open-Source Software (OSS), governance mechanics and contributor motivations. We will be discussing the formal and informal governance mechanics that are crucial for directing and sustaining OSS communities identified by the literature. Next this review will analyse the intrinsic and extrinsic motivations of OSS contributors and the most effective incentive structures. Using the lens of the main concepts this essay will examine corporate intervention into OSS projects. We will examine the literature's perspectives on corporate involvement in OSS projects. By examining these themes, this review will be able to create a nuanced understanding of interactions between the governance, motivation, and corporate influence of OSS systems. Using these insights to emphasise the importance of balance in fostering vibrant and sustainable OSS ecosystems.

2. Introduction

2.1 What is Open-Source Software (OSS)

Open-source software (OSS) is a community-based approach to developing technology. Traditionally, OSS projects give the rights to change and distribute software to anyone who wishes to engage with the project. The ethos of OSS is the lack of restrictions enables rapid development and evolution of the software according to (Lakhani and Wolf, 2005). (Mäenpää 2018) describes that there are variations on the licenses based on the level of control the project wishes to give to its community.

2.2 Origins and Evolution of OSS literature

The origins of a conceptual separation of OSS from traditional development is often linked to the Bazaar model from (Raymond, 1998). his idea of creating a software development structure is similar to a market with hundreds of different stalls, owners and products. This melting pot of ideas with separate ownership contrasts with traditional development ideas like business hierarchies and department structures.

This concept is currently realised with Internet communities on platforms such as GitHub. GitHub allows for this “digital bazaar” to engage people from all over the world on these projects. OSS projects characteristically have open development tools and source code, along with easily accessible repositories like GitHub to facilitate unrestricted access. It is important to note that while (Raymond, 1998) is a foundational work for OSS, it is quite largely based on anecdotal evidence and personal experience with his work on Linux. Yet this has not stopped it being one of the most referenced papers on OSS.

Another very foundational work we will be touching on in this paper the book “Intrinsic Motivation and Self-Determination in Human Behaviour” by Edward L. Deci and Richard M. Ryan. (Deci and Ryan, 1985) wrote on intrinsic and extrinsic motivation incentives which became a cornerstone of the motivational theory papers we will address later in this essay. When reading into their motivation analysis of the incentive structures, they downplay the extrinsic factors and highlight the intrinsic structures. We will see this trend identified as we go through the literature.

2.3 Main Themes of the Essay

In this essay I address two main themes of OSS Governance mechanics and OSS Contributor motivations. It will examine the literature through these themes alongside examining how authors deal with corporate influence and strategy in OSS. This is followed by a critical analysis of these themes and how they interconnect.

2.3a OSS Governance Mechanics

We will be exploring the literature on governance for OSS projects. Governance structures within OSS are crucial as they are used to direct and control the work of the community. They can be described as the tools to correct the flow of development, innovation and collaboration. This can be broadly defined into either formal or informal control mechanisms. (Lakhani and Wolf, 2005),

3.2b OSS Contributor Motivations and Incentives

According to the foundations laid by (Lakhani and Wolf, 2005), the contributor motivations for engaging with OSS are a sense of community, monetary or career advancement opportunities or seeking social approval or status within OSS communities. These pull factors to OSS projects are a blend of tangential and diverse incentives that are either intrinsic or extrinsic.

This paper is based on motivational theory, and in it you can see the influence of (Deci and Ryan, 1985) on how they highlight intrinsic motivation over the extrinsic incentive structures. This paper relies on self-reported data as it was a web-based survey from OSS developers and only pulled from a single platform SourceForge.net which may pose biases for the data.

3. Governance of OSS Projects

3.1 Introduction

The OSS governance mechanics are the tools and processes used to curate the development, maintenance and sustainability of OSS projects. OSS organisations are often unique due to the contributors not being formally employed by the organising body as described in (Krishnamurthy, 2006). Therefore, OSS projects must implement governance structures to control the project and its outcomes. (Krishnamurthy, 2006) describes his ideology of governance is to create a diverse community of contributors.

These governance tools function as mechanisms for dealing issues like managing contributions, conflict resolution and decision making. This paper is grounded in motivational theory traced from (Deci and Ryan, 1985) that tackles the balance between the intrinsic and extrinsic motivations. Once again, we see extrinsic factors outweigh intrinsic factors in importance to contributor motivation.

3.2 Formal vs. Informal Control Mechanisms

The OSS projects range from structured communities with tight rules to more relaxed open communities. (Xu and Lin 2011) discusses how the two overarching OSS governance types, formal and informal mechanisms, grew from traditional project management philosophy. They argue these "Modes" of control are used to direct the project's outcome can be categorised into outcome control, clanship control and self-control. This paper is based in organisational control theory that stresses the balance of these government mechanisms. This is a balance of Formal and Informal mechanisms echo throughout the papers on control mechanisms.

3.3 Formal Control Mechanisms

In (Chakraborti, 2023) they describe the communities internalisation of formal policies as not linear. Additional formal mechanisms struggle to integrate into the practices and culture of OSS communities. We see further emphasis on the gap between day-to-day informal governance and the formal governance structures emphasised by project leadership. We also see limited scope on the projects evaluated in this paper as they are only taken from the Apache software foundation incubator. This limits the variation in governance mechanisms as they could have received similar advice.

For (Xu and Lin, 2011) formal mechanisms should be used for outcome control, directing the project to its final goals. Therefore, they call for stronger formal control mechanisms to provide clear processes for how the project should operate and who is given the ability to make decisions.

(De Laat, 2007) brings up three forms of OSS governance: spontaneous governance, internal governance, and governance towards outside parties. His description of spontaneous governance covers the informal Governance through social controls using community norms and volunteer collaboration. This is one of the cornerstone papers in regard to organisational theory in OSS. It takes into account the future and progression of OSS communities and how they could react to these governance mechanisms. (De Laat, 2007) especially takes into account the adaptability of those models being taken outside of OSS governance.

3.4 Informal Control Mechanisms

Informal control mechanisms rely on social norms like peer reviews or a reputation system that incentivizes users to act in the benefit of the community. (O'Mahony, 2007) in their paper discuss how contribution management via peer review can be key tools for community management and code quality control.

(O'Mahony, 2007) breaks the characteristics of community management into five key principles: transparency, meritocracy, consensus, inclusivity and autonomy. The stronger the project adheres to these principles the freer development culture in your community and more self-balancing informal governance. This paper delves into what discussed and goes far more into the informal governance and community managed frameworks for OSS projects. It provides a practical application for these principles in other OSS communities. However, it lacks empirical data and serves as more of an exploration of these theories. Therefore, it is more of a conceptual analysis of some of the existing community-based literature.

Governance structures are often created from within the community rather than being established top down and are often less rigid and function far more like a human social group. (Xu and Lin, 2011) would describe this as Clanship control, using the groupthink and social norms to enforce a sense of belonging and mutual accountability. which encourages diverse contributions and also individual self-policing. With these self-control mechanisms, users manage themselves and their individual goals. It is interesting that in contrast (O'Mahony, 2007) would be less structured with informal mechanisms compared to (Xu and Lin, 2011), which would give informal mechanisms a strict structure and applications.

3.5 Hybrid Governance Models

In (Xu and Lin, 2011) also argues for a balanced approach and states that the control mechanisms are key in aligning the individual goals of the project. Leveraging the strength of those individual formal and informal mechanisms to build a more balanced sustainable approach in developing an

OSS project. For example, a project might use formal mechanisms for licensing and contribution guidelines while relying on informal peer reviews for quality control.

De Laat (2007) highlights how formal mechanics of rules, roles and conflict resolution can be further divided. The difference is separating the governance of outside actors from the internal actors. This is due to his focus on the external co-opting of OSS projects and the interactions between the communities and entities like businesses and governments. This is a unique perspective and touches more on the openness of OSS projects which we are not touching on in this literature review. It is noticeable we have not seen this separation in any other of the papers grounded in governance theory.

However, (Kendal, 2019) in contrast with the other two papers sees companies' interactions with OSS communities through a post-colonial lens, arguing that corporate interaction with OSS communities must have a balance of collaboration and control. The melding between the two structures would create Homi Bhabha's concept of a "Third Design Space," in which you facilitate a hybrid environment where both corporate and community interests can coexist.

The balance of cooperation and tension would allow for contemporary design practices and control to exist together and address their concerns in OSS governance by attempting to mitigate the interactions between companies and communities like a coloniser and the colonised. The postcolonial metaphor encapsulates the dynamics of a community under threat of conquest which many open-source communities find themselves in through corporate interests.

(Shaikh and Henfridsson, 2017) highlight the importance to curate your governance structures based on the specific OSS project properties. The diverse nature of OSS governance structures emphasises how it is important to understand the community and user base of potential OSS projects in order to choose what mechanism to use..

(Shaikh and Henfridsson, 2017) organisation and coordination approach seeks to map out several new coordination processes, it describes authoritative structures that open-source projects can be based on (autocracy, oligarchy, federation, meritocracy). They demonstrate how the level of detail and examination of these control structures has progressed since the earlier writings. Once again this study is limited in its scope as it only studies data based on Linux. Now to examine papers on what governance mechanics actually curate with contributor motivations.

4. Contributor Motivations

4.1 Introduction

OSS contributor motivations are key in engaging contributors to projects and creating long term sustainability for OSS projects. The origins of the two main pull factors being intrinsic and extrinsic factors come from foundational work by (Deci and Ryan, 1985).

They divide intrinsic factors into enjoyment-based factors and community participation factors. These intrinsic and extrinsic contributor motivations can appear as anything from a sense of community, monetary or career advancement opportunities or seeking social approval or status within OSS communities.

4.2 Enjoyment-Based Factors

The enjoyment based intrinsic motivators are incentive structures that give rewards based on finding personal satisfaction and fulfilment in the process of contributing to OSS projects. The Paper by (Gerosa et al, 2021) examined 242 OSS contributors and found that Fun, Altruism, and Kinship are cornerstones of OSS participation by 91%, 85%, and 80% of contributors.

In (Gerosa et al, 2021) we see the modern ideological transformation of extrinsic motivators into pull factors that motivates contributors into becoming intrinsically motivated contributors, describing the phenomenon of experience contributors shifting towards altruism.

(Lakhani and Wolf, 2005) found in their research that while find that both intrinsic and extrinsic factors play significant roles, their study revealed that the enjoyment-based intrinsic pull factors were the strongest motivational source, followed by user needs and then reputation. Highlighting how the intrinsic incentive structures are still as strong as they were 16 years ago.

Alternative enjoyment can come from developing and learning skills by contributing to OSS projects and getting peer reviewed on your work. In (Gerosa et al, 2001) found that 93% of the contributors liked learning and building their skills. In comparison to (Lakhani and Wolf, 2005), there is an increase in the strength that social and reputational incentives have in the frequency of contributions. This is contribute this to social coding platforms like GitHub and the ease of self-organising on places like Reddit. It is far easier to build a community now than it was in 2005.

4.3 Community Participation

Early writings on OSS intrinsic motivation like (Hars and Ou, 2002) point to the selfishness of open-source contributors and the rooted desire within the individuals who want to help others. Hars and Ou (2002) emphasize the importance of personal satisfaction in engaging contributors. Altruistic or community focused rewards from interactions with OSS projects can give contributors a personal connection or sense of community.

The social interactions, collaborations, and recognition from peers were highlighted as strong pull factors. That is a great initial paper that touches on the preliminary stages of the separation between intrinsic and the extrinsic incentive structures. (Hars and Ou 2002) focus is to identify factors for later study and does lack examination of the long-term impact of these motivations on OSS project sustainability. The extrinsic motivations are incentive structures that give external rewards to the contributors of the OSS project.

4.4 Career Advancement and Monetary Gain:

(Roberts, Hann, and Slaughter, 2006) is a famous paper in the motivational theory branch of OSS research. This paper found that paying contributors had a positive effect on their output. This branched away from the traditions of the time which highlighted the extrinsic motivators. They differentiated the effects that different motivators had all contribution levels. It also described early performance ranking and reputation systems which became immensely popular in OSS communities. This longitudinal study brought out great understandings of the interplay between motivations and their impact on performance. There was data is limited to Apache project data source which is not ideal. <https://pubsonline.informs.org/doi/epdf/10.1287/mnsc.1060.0554>

This contrasts with (Krishnamurthy, 2006) that covers mechanisms for businesses to get contributors with things like bounties (rewards for specific tasks), future employment or given a retaining salary as an external consultant but fails to analyse their effectiveness in the same depth.

4.5 Recognition and Prestige:

(Roberts, Hann, and Slaughter, 2006) analysed the strength of impact on community recognition on OSS contributions regarding repeat contributions. Contributors who received recognition from the community were more likely to continue contributing, showing a clear correlation in the effectiveness of extrinsic incentives in sustaining OSS projects.

4.6 Hybrid approaches and the Private-Collective Innovation Model

(Krishnamurthy, 2006) goes into detail on the intrinsic and extrinsic motivations of OSS developers, stressing the need for both incentive structures to sustain a long-term OSS project. Hybrid models would go on to be the dominant solution in the literature.

An example of a good hybrid model is the private-collective innovation model, proposed by (Von Hippel and Von Krogh, 2003). This model design uses both private and collective incentives. They divide incentives differently, private incentives being for direct personal benefits e.g. improving skills and career/monetary rewards, and collective incentives being focused community altruism. This model's contributor behaviour expects contributors to seek personal goals (private incentives) while also adding to the collective interest (collective incentives).

This creates a suite of pull factors that guarantees returning contributors for a long-term project. In (Roberts, Hann, and Slaughter, 2006) they found no evidence of strong intrinsic incentives inhibiting the strength of extrinsic motivators, so this does track throughout our previous reviewed literature.

6. Corporate Strategy and Contributor Motivations

Corporate OSS strategy seeks to co-opt or control the development of OSS projects. Firms seek to use OSS projects by controlling the, contrasting OSS's ideology of freedom of collaboration and community. (Gott, Ghinea, Bygstad, 2012) discusses the increasing number of corporations using OSS development as a key strategic piece of their product development. This contrasting paper focuses on the organizational theories. It is interesting how this paper discusses how companies express a moral obligation to take on OSS projects, suggesting a cultural shift on how they view their role in the open-source ecosystem.

Understanding how corporate strategy interacts with the governance structures and contributor motivations crucial for the sustainability and success of corporate OSS projects. The contributor motivations are entwined with the corporate strategy and the governance structures implemented. Businesses have multiple reasons to get involved in OSS projects. study the incentives for corporate reach in OSS projects.

(Gott, Ghinea, Bygstad, 2012) find key benefits including innovation, cost savings, and market positioning. Business should have inbuilt Intrinsic incentives to capture anyone you bring in through extrinsic incentives. In (Gerosa et al. 2021) they found that contributors originally engaging with extrinsic motivations grew to have intrinsic motivations overtime which we saw echoed in earlier literature.

7. Synthesis and Critical Analysis

OSS governance mechanics and contributor motivations interact with corporate OSS strategy in a myriad of ways. These components of the literature review are deeply interconnected as they each shape and influence each other. All of the authors stress the need for balance. This is a constant theme that permeates the literature on striking a balance between control and freedom. To create a strong and long-lasting governance system for an OSS project you have to balance the formal and informal mechanisms. These have to be tailored to the specific circumstances of the project. Contributor motivations have to be understood and then nurtured, especially with their evolving nature.

Make sure to keep in mind what type of contributors you are trying to attract and how you can keep them for the long-term. Building out a sustainable community with both vibrance and direction requires care. Corporations have a lot to benefit from engaging with OSS projects, but they have to keep in mind that they have the ability to destroy as easily as they can benefit.

The papers analysed discussed the importance of the intrinsic factors and informal governance mechanisms in maintaining a community. Extrinsic Incentive structures and informal governance tools can be effective at controlling people but also serve as a point of alienation that can drive people away from your project. The literature stresses the social element primarily because that is what makes an OSS project a community. This would be a great topic of further study as society becomes more online.

In conclusion, the synthesis of these themes underscores the intricate dynamics at play in OSS development. By addressing the complexities of governance, motivation, and corporate engagement, OSS projects can harness the benefits of open innovation while preserving their core values of collaboration and community. This balanced approach is key to fostering a vibrant and sustainable OSS ecosystem.

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