Governing Public-Private Tensions of Open Source Software Communities in the Higher Education Sector

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***Abstract*—Open source software (OSS) governance is essential for creating and sustaining a community-driven software. Unlike the current relevant research that focused mainly on OSS communities serving the horizontal domains, this paper aims to focus on the importance of redirecting the attention of the relevant literature towards the governance mechanisms practiced on the OSS communities serving the vertical domains; higher education applications in specific. Such applications are targeting specific users and designed by specialized developers as their requirements are more complex and require dedicated knowledge. This paper will emphasis on the role of governance in resolving public-private tensions, which are the conflicts raised between the contradictory agendas of the community members. The paper represents the preliminary findings of studying Kuali, an OSS community developed for higher education purposes. Addressing the public-private tensions in Kuali and understanding its governance practices will assist the higher education sector in sustaining community-driven software products.**

***Index Terms*— Governance, Higher Education, Open source Software Community.**

I. INTRODUCTION

THE open source software (OSS) domain is a multidisciplinary area that attracted the interests of academics and practitioners in various fields such as management, economics, innovation and software engineering and provides interesting avenues for exploration. As OSS communities generated new organizational forms [1, 2], one of the interesting avenues of research is OSS governance.

Research to date on governing public-private tensions in OSS communities focused on resolving issues related to building the community, collective action dilemmas and the conflicting interests of individuals and organizations. However, the main emphasis was on horizontal OSS products which serve a wider range of users. The objective of this paper is to focus on governing OSS communities serving the vertical domain; the higher education context in specific. Horizontal applications refer to infrastructural applications– such as: operating systems, web servers, email servers, and databases- where their requirements and design are standard to software developers. On the other hand, vertical applications are sector oriented, such as higher education and health care systems. Vertical applications consist of technical and functional requirements that are not universally understood [3] and attract different contributors and users. Accordingly, they experience different coordination mechanisms and establish different relationships with profit and non-profit organizations.

This research aims to develop OSS governance theory by conducting an empirical study on Kuali, an OSS community serving the higher education sector. Unlike the existing studies, this research will provide empirical evidence of OSS governance mechanisms adopted by a sponsored OSS project where the product serves a vertical domain, the contributors have a common basis of authority and the project adheres to a defined hierarchy.

II. OPEN SOURCE SOFTWARE COMMUNITY

OSS community[1] refers to individuals and organizations collaborating in order to produce a software product under OSS license. The software is developed to satisfy the requirements of individuals as well as organizations. It can be freely used, modified and redistributed [4, 5].

OSS community contributors are mainly geographically distributed and collaborate through the internet and utilize digital networks- such as emails, electronic forums, bug tracking, version control systems, etc. - in order to facilitate the collaboration. The role of the contributors covers the technical, administrative, functional and financial aspects of the community [6]. Contributors may also include passive users who are benefiting out of the software without contributing back, i.e. free-riders, as non-excludability is one of the main features of the OSS product [4, 7].

Although OSS community does not gain direct monetary benefits out of the product [8], it allows private interests to collaborate in order to emerge complementary services over the OSS product [2, 8, 9]; such as supporting software or hardware, training, packaging, maintenance and consultancy services.

The relation between OSS community and the commercial vendors is regulated through OSS license, which is considered as the most essential feature distinguishing OSS from other software products [2]. It ensures that the software is freely used, modified and shared. According to Open Source Initiative [10], the free availability of an OSS product does not mean that it cannot

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[1] It is worth mentioning that OSS communities are also called OSS projects, thus community and project will be used interchangeably throughout this article.

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be used for commercial purposes. OSS license allows commercializing the software without appropriating it. In other words, the license disallows placing any sort of restrictions that exclude an individual or entity from benefiting from the product.

III. THE GOVERNANCE OF OPEN SOURCE SOFTWARE COMMUNITY

OSS communities emerged as social movements [2, 8, 11] initiated by individuals who were counter to proprietary software firms [11]. Today, firms are essential users and contributors in the OSS community and they consider these communities as credible partners for collaboration [8]. In addition, large information technology industries are considering OSS when formulating and implementing their market strategies [2]. For example, IBM and Sun Microsystems are recognized as active firms in supporting and releasing OSS projects [7].

The dispersed community, the diversity of sponsors and stakeholders, the conflicting interests of contributors, the uncertainty of the scale and outcome of the products, and the openness nature of the OSS created challenges on selecting the suitable governance mechanism for the OSS community.

The relevant research did not provide a precise definition of OSS governance [12], as it was defined in terms of processes, structures and values. However, scholars agreed that governance is essential for creating and sustaining a community driven software. The main purposes of OSS governance are to: 1) resolve the coordination issues between the members in general, and the contradictory agendas of the contributors in specific, 2) resolve decision making and leadership issues, 3) attract and retain contributors, and 4) decide on the future direction of the project and how the community can be sustained [12-16].

The main focus of this paper is on governing the contradictory agendas of the contributors, which is referred to in this article as public-private tensions. *Public* refers to the interests of the OSS product and community, while *private* refers to the interests of the individuals and organizations participating to the community. The aim of this research is to clarify the role of governance in resolving the conflicts resulting from the process of fulfilling different goals and integrating them to achieve the common objective of the community.

IV. LITERATURE REVIEW

As one on the main objectives of this paper is to attract the attention of scholars towards governing vertical OSS communities, it is worth presenting the current studies relevant to this research area.

A. Governance in OSS: a literature review

The OSS governance literature categorized OSS projects into autonomous and sponsored projects [13, 17, 18]. Autonomous refers to the projects founded by individuals, independent from any organizations and are self-managed, i.e. do not rely on a defined hierarchy or authority [5, 18]. On the other hand, sponsored OSS projects are the projects under the control of a profit or non-profit organization [18].

The early discussions of OSS governance focused on the collaboration mechanisms adopted by autonomous communities to manage themselves around building the OSS product [11]. Scholars argued that the OSS governance of an autonomous community is "a result of an emergent process of learning" [19:259]. It does not reflect a defined set of rules that are imposed to the community [20]; instead the community collectively agrees on the governance mechanisms in order to enhance its efficiency.

As the OSS projects developed and attracted various types of contributors, the OSS governance literature was extended to include studies contrasting the different governance modes adopted by the autonomous and sponsored OSS projects [20]. Researchers mainly explored the different governance structures and concepts adopted by the OSS communities to manage the product development process at one hand, and maintain a successful relationship with profit and non-profit organizations on the other hand [8, 14].

1) OSS governance structure

An OSS governance structure is defined as a framework that regulates the interactions between contributors [2], affects the type of participation [21] and determines the quality and success of the product [22]. An OSS community does not represent a strict hierarchy nor a completely flat structure [23]. It represents a special governance form [2]. Unlike the market structure that is based on contracts, patent and copyrights, OSS community relies on revealing the source code of the product. OSS governance structure was described in the literature as a peer-production community, network, and bazaar.

OSS communities were contrasted to commercial software firms by considering them as peer-production communities as the tasks are assigned and distributed on a self-selection and decentralized manners [14], not relying on hierarchal structures. This form of governance is more attached to autonomous OSS projects initiated and governed by individual efforts and the project development process is not restricted to timelines [24].

On the other hand, it has been discussed in the literature that despite the lack of central authority in autonomous communities, some kind of hierarchy was evident in the development of the OSS code [5]. For example, the tasks related to granting file access, fixing bugs and releasing codes, were performed in a uniformed manner. Therefore, OSS communities were described as network governance forms where the coordination mechanisms are handled by informal mechanisms and do not adhere to strict bureaucratic structures.

In contrary, Demil and Lecocq [2] argued that OSS projects do not resemble a network form. They have suggested that the nature of OSS license promoted a bazaar-like environment. The major difference between bazaar and network is that, unlike network, the identity of the agent and its previous actions are not considered as important factors for coordination. In addition, persistence is an essential attribute of network participants [25] to avoid free-riding and opportunism actions, which is not considered in the bazaar structure.

In general, OSS governance structure is a controversial topic due to the openness and non-excludability features of OSS communities. Some scholars argued that each OSS community is unique, and accordingly represents a governance structure that fulfils its requirements [23]. Others argued that OSS communities rely on a certain governance structure to start-up and manage the code

building process; however in order to sustain they adopt hybrid governance structure [2, 13, 14] to manage the complementary services as well as the core code development.

2) OSS governance concepts

OSS community started as a social movement and known to be self-managed by normative control and shared values [1, 6, 8]. Therefore, social values are considered as a precondition for any formal governance mechanism either to govern individuals within a community or organizations collaborating in productizing the OSS product [9].

The key social values that govern OSS communities are trust [26] and reputation [1, 16]. OSS community is mainly a virtual organization. Therefore, to ensure an efficient collaboration, it is essential that contributors, especially developers, trust the leadership's objectives and believe that the objectives are aligned with the collective benefits of the community.

Reputation in OSS aspect, is working towards enhancing the quality of the OSS product, and thus enhancing the reputation of the participants and OSS product, ensures the continuity of the collective collaboration. Therefore, reputation is considered as a valuable asset [27] that assists in creating an OSS community, motivating participation, and ensuring sustainability.

Ownership is another OSS concept. It is an important part of the OSS culture as it regulates who can modify the software, when it can be modified and who has the right to redistribute the modified versions. This regulation is maintained through OSS licenses and sponsorship.

Authority and control are the concepts related to leadership and decision making, which are necessary to ensure the effective participation from contributors. They are distributed into two different levels: organizational level and technical level. The organizational level focuses on coordinating between the participating actors, managing the project's future direction and resolving conflicts among participants. The technical level focuses on managing the code of the OSS, i.e. dealing with code modification and new releases.

3) OSS public-private tensions

The following is a review of the main public-private tensions discussed in the OSS literature and the corresponding governance solutions suggested by scholars.

First, the tension between OSS culture and practice is one of the earliest tensions identified in OSS communities [8]. It represents the tension between OSS ideology, or the hackers' ethos as described by Raymond [28], and the practices performed by the developers in the community. In other words, it is the tension between what the OSS developers believe in on one hand, and their actual behavior on the other hand.

Although OSS culture is based on freely revealing the source code of the software for use, modification and redistribution, developers contributing to the OSS community have various motives, especially with the increase interest in OSS development within the corporate world. One of the main practices that creates this tension is *forking*, which means reusing the source code, developing a different version and changing the direction of the project [28]. Forking does not violate OSS license, however it weakens the community especially in its early stages.

According to Raymond [28], this tension can be resolved by formal and informal procedures. The formal procedures highlight the importance of creating a balance between ownership and control in OSS projects to differentiate between official and non-official releases of the OSS project. The informal procedure is exemplified in leveraging implicit rules of OSS culture that illustrates the importance of reputation in an OSS community.

Second, the tensions between the collective interests of the OSS community on one hand and the private interests of individuals or organizations on the other hand is one of the topics that has been discussed extensively in the OSS literature. However, the main focus was on the autonomous OSS projects with voluntarily participations.

One of the solutions suggested by scholars for this tension is an adaptive governance scheme that changes as the OSS community grows [14]. OSS communities often start with a meritocracy governance mode, i.e. a centralized leadership, due to the low number of contributions at that early stage. Then, as the OSS project increases in size and attract contributors with various interests, it tends to implement different governance modes to fulfil the new requirements of the community, and accordingly balance between satisfying different interests.

Third, the tensions emerge between developers of different motives. This is referred to by Franck and Jungwirth [27] as the tension between *donators* and *rent-seekers*. *Donators* are voluntarily developers, or hobbyists, who are contributing for the benefit of the group and not expecting to receive any rewards out of their contributions, while *rent-seekers* are those who act in a self-interest manner aiming to invest from their contributions.

It is essential to reconcile the interests of donators and rent-seekers as the OSS community relies on both of them [27]. This can be done by incentivizing developers with self-interest motives in order to collaborate in more efficient manner [22]. Another solution is achieved by adding features to the OSS license which disallows contributions from turning donations into private profits without contributing to the production of the OSS [27]. As a result, rent-seeking is enabled without crowding out donators.

Fourth, OSS communities face challenges in resolving the tension between openness and ownership. OSS openness refers to the transparency and accessibility features [18] of the community. On the other hand, OSS ownership deals with the regulations and restrictions and it is exemplified by the OSS licensing and organizational sponsorship.

OSS openness-ownership tensions were discussed in the literature from developers' attraction [18, 29] and coordination [2] perspectives. The process of attracting developers while balancing between OSS openness and ownership is a challenging matter for both autonomous and sponsored projects. The suggested governance solutions rely on the community design decisions. Autonomous communities tend to rely on licenses and sponsorship to create the balance between openness and control [29], whereas sponsored communities rely on the transparency and accessibility to the code [18] to attract developers.

From coordination perspective, Demil and Lecocq [2] argued that OSS communities require a governance structure to regulate the transactions between different actors. They agreed with Raymond [11] that OSS communities represent a bazaar governance structure which is compatible with the OSS license features. Although bazaar governance is

suitable for information goods; pure bazaar is a failure due to the existence of uncertainty and weak control. Therefore, hybrid governance, which combines bazaar with hierarchy or network structures, may resolve the coordination aspect of openness-ownership tension.

Fifth, tensions between the OSS community and the commercial vendors are a result of their divergent objectives. In addition, the core resources of an OSS project reside within the community, whereas the marketing, sales and distribution capabilities reside within the firm [30].

Scholars argued that such tension is resolved by forming foundations [8], creating specific business models for OSS products [3, 7] and facilitating the value creation and capturing mechanisms in OSS projects [31].

4) *Kuali: a literature review*

Kuali project was initiated in 2004 [32] and gained the interests of scholars in areas of technology adoptions in HE [33], social sciences [34-37], finance [38] and software engineering [39].

From social sciences perspective, current research explained the organizational control mechanisms practiced in Kuali using Ouch's (1979, 1980) organizational control framework [as cited in 36]; however the findings were not supported by empirical evidence. In addition, scholars explained the factors that influenced the process of building Kuali community in its early stages [37] and discussed the challenges of in-house staffing [35].

The current research on the social sciences aspect of Kuali is either not supported by data or reflects the early stages of forming Kuali community. It is evident that the literature overlooked the public-private tensions occurring within the community and those between the community and firms.

5) *Summary of the literature review*

The literature on OSS governance mainly focused on autonomous projects and how members get to share a basis of authority and govern themselves, overlooking the governance mechanisms adopted by sponsored OSS projects which already have a basis of authority and hierarchy.

The focus of governing public-private tensions in the literature has moved away from tensions raised within the community while developing the OSS code towards the tensions beyond the boundaries of the community to govern complementary services of sponsored OSS projects. However, the main focus was on communities built around horizontal applications, such as Debian [e.g. 1, 8], Linux [e.g. 1, 11] and Apache [e.g. 1, 8].

The existing research on vertical domains compared between autonomous and sponsored OSS projects in the health care systems in terms of building the community [17]. In addition, the main focus was on the tensions raised on the developers' level with less attention given to the macro-level.

V. RESEARCH OBJECTIVES

This paper aims to explain the role of governance in resolving public-private tensions in OSS communities serving the higher education sector. The main objective is to redirect the attention of the OSS literature towards vertical domains, as the primary focus of the relevant studies was on horizontal domains.

Unlike horizontal OSS communities, vertical communities serve particular domain where participants are obliged, and paid in some cases, in order to contribute to the community as opposed to the voluntarily contribution of the participants in the horizontal domain. In addition, horizontal domains attract the interest of generic participant regardless of their profession. In contrary, vertical domain are sector oriented and include participants involved on that particular sector. Vertical domains are experiencing different coordination, motivation and collaboration mechanisms that are worth exploring.

A. *Why higher education?*

The research targets the higher education (HE) sector for two main reasons. First, the values of OSS community align with the nature of the HE institutes. This is exemplified in collaboration, knowledge sharing and capacity building.

Second, "Higher education is a small segment of the overall technology market, and the needs of the academy may not be primary to a company" [40:10]. As a result, the HE often falls into the *buy-build* dilemma when adopting an IT solution. It struggles between the cost and benefits of building their own solution or going for a commercial package [40]. Some universities went for a third option; collaboration or borrow [41]. This is exemplified in OSS solutions. The main three motives for HE sector to adopt OSS solutions are: cost, performance and control [42].

It terms of cost, OSS is not free of cost; however the cost in this case will be invested in the HE resources. With regards to performance, OSS communities require HE institutes to pool their resources, experiences and capabilities to improve their services and share the risks. Control is what is described by Wheeler [41] as *unbundling of software and support.* In other words, OSS solution unbundles the software development from the maintenance and support processes. Cost, performance and control are achieved by appropriate governance mechanisms.

By studying Kuali, the research aims to understand the governance mechanisms adopted by Kuali to build the community, attract divergent contributors and ensure sustainability.

VI. METHODOLOGY

The research and theory regarding public-private tensions in vertical OSS communities are in their early stages. Therefore, a grounded theory approach is adopted using a case study method. A grounded theory approach, as described by Charmaz [43], assists in developing theories from data and accordingly this study involved the collection of rich data to provide a clear description of people, organizations and processes related to the case study.

The case study, Kuali, consists of universities and firms that are geographically dispersed and collaborate through the internet and utilize technological tools to facilitate their collaboration. Therefore, Kuali website is considered as a rich source of secondary data, such as: mailing threads, videos, technical and functional documentations and discussion forums.

This article represents the initial findings of the study based on analyzing firms' portfolios, mailing threads, and technical and functional documentations of Kuali foundation.

VII. PRELIMINARY FINDINGS

Kuali Project is an OSS project governed by the non-profit Kuali Foundation to develop applications for higher education, by higher education. Kuali has produced several OSS projects, mainly: financial system, research system, student information system, payroll system, library system, smart phone framework, and a middleware application to integrate all Kuali applications together.

According to Kuali Foundation [32], the community consists of HE institutes (i.e. universities and research centers), non-profit organizations and commercial vendors that collaborate to produce OSS products as well as complementary services to support the community. Contributors are categorized into different levels, such as members, partners and adopters. Each has certain privilege to benefit from the community besides having the OSS products of Kuali freely available for all levels to use, modify and distribute.

Although there exist OSS projects in higher education communities other than Kuali, (e.g. Sakai, UPortal, Moodle), Kuali has been selected for its features that are considered as rich data for research. Kuali consists of multiple standalone projects where each has its community, life cycle, project hierarchy, mailing lists, documentation and complementary services. The contributing universities have the option to freely download Kuali OSS products from Kuali website; however 74 universities and 11 commercial firms to date [32] are paying annual membership fees to contribute and benefit from Kuali community.

Kuali developers are employees working for the contributing universities and firms. Developing Kuali products is a task added to their job responsibilities. Contributing to the code development is performed within written and signed agreements. Each Kuali product has a project hierarchy and a defined work flow.

By analyzing the documentation, it is evident that there exist public-private tensions in the micro and macro levels of the community. For example, the openness-ownership tension is evident in revealing the source code of the products on one hand and setting specific licensing terns to protect Kuali rights on the other hand. The tension between donators and rent-seekers is also evident in email conversations between developers working for a university (donator) and developers working for firms that are providing software solutions (rent-seekers).

This indicates that Kuali Foundation is adopting governance mechanisms which harness the efforts of the community and the firms to succeed and sustain.

VIII. CONCLUSION & FUTURE WORK

This research has theoretical and practical implications. In terms of theory, the empirical findings will establish a new research direction in the field of OSS governance where the target community serves a sector oriented domain and inherits the governance structures and concepts of that particular sector. In practice, OSS communities are considered as a solution to the buy-build dilemma in the HE sector. It is essential to ensure the sustainability of such communities. Understanding the governance mechanisms to resolve public-private tensions will secure the collective interest of the community. It will also attract commercial complementary contributions to support the community.

The work presented in this article is part of an ongoing PhD research. Therefore the future work includes representing a detailed description of the public-private tensions experienced by Kuali community and what are the governance practices adopted by Kuali foundation to manage these tensions. Future work will also include the analysis of videos illustrating important events of Kuali community. In addition, future work will also involve a detailed description of the coding process of the grounded theory approach.

REFERENCES

[1] Markus, M.L., B. Manville, and E.C. Agres, *What Makes a Virtual Organization Work?* Sloan Management Review, 2000. **42**(1): p. 13-26.

[2] Demil, B. and X. Lecocq, *Neither Market nor Hierarchy nor Network: The Emergence of Bazaar Governance.* Organization Studies, 2006. **27**(10): p. 1447-1466.

[3] Fitzgerald, B., *The Transformation of Open Source Software.* Mis Quarterly, 2006. **30**(3): p. 587-598.

[4] O'Mahony, S., *Guarding the Commons: How Community Managed Software Projects Protect their Work.* Research Policy, 2003. **32**(7): p. 1179-1198.

[5] de Laat, P.B., *Governance of Open Source Software: State of the Art.* Journal of Management & Governance, 2007. **11**(2): p. 165-177.

[6] Nelson, M.L., R. Sen, and C. Subramaniam, *Understanding Open Source Software: A Research Classification Framework.* Communications of the Association for Information Systems, 2006. **17**(12): p. 266–287.

[7] Dahlander, L., *Appropriation and Appropriability in Open Source Software.* International Journal of Innovation Management, 2005. **9**(3): p. 259-285.

[8] O'Mahony, S., *Nonprofit Foundations and their Role in Community-Firm Software Collaboration*, in *Perspectives On Free and Open Source Software*, J. Feller, et al., Editors. 2005, The MIT Press: Cambridge.

[9] Feller, J., et al., *From Peer Production to Productization: A Study of Socially Enabled Business Exchanges in Open Source Service Networks.* Information Systems Research, 2008. **19**(4): p. 475-493.

[10] Open Source Initiative. *Open Source Initiative*. 2014; Available from: http://opensource.org/.

[11] Raymond, E.S., *The Cathedral and the Bazaar.* Knowledge, Technology & Policy, 1999. **12**(3): p. 23-49.

[12] Markus, M.L., *The Governance Of Free/Open Source Software Projects: Monolithic, Multidimensional, Or Configurational?* Journal of Management & Governance, 2007. **11**(2): p. 151-163.

[13] O'Mahony, S., *The Governance of Open Source Initiatives: What Does it Mean to be Community Managed?* Journal of Management & Governance, 2007. **11**(2): p. 139-150.

[14] O'Mahony, S. and F. Ferraro, *The Emergence of Governance in an Open Source Community.*

Academy of Management Journal, 2007. **50**(5): p. 1079-1106.

[15] De Noni, I., A. Ganzaroli, and L. Orsi, *The Governance of Open Source Software Communities: An Exploratory Analysis.* Journal of Business Systems, Governance & Ethics, 2011. **6**(1): p. 1-18.

[16] Di Tullio, D. and D.S. Staples, *The Governance and Control of Open Source Software Projects.* Journal of Management Information Systems, 2013. **30**(3): p. 49-80.

[17] West, J. and S. O'Mahony. *Contrasting Community Building in Sponsored and Community Founded Open Source Projects*. in *Proceedings of the 38th Annual Hawaii International Conference on System Sciences (HICSS'05)*. 2005. Hawaii: IEEE.

[18] West, J. and S. O'Mahony, *The Role of Participation Architecture in Growing Sponsored Open Source Communities.* Industry and Innovation, 2008. **15**(2): p. 145-168.

[19] De Noni, I., A. Ganzaroli, and L. Orsi, *The Evolution of OSS Governance: A Dimensional Comparative Analysis.* Scandinavian Journal of Management, 2013. **29**(3): p. 247-263.

[20] O'Mahony, S. and J. West. *What Makes a Project Open Source? Migrating from Organic to Synthetic Communities*. in *Academy of Management Annual Meeting*. 2005. Honolulu.

[21] Shah, S.K., *Motivation, Governance, and the Viability of Hybrid Forms in Open Source Software Development.* Management Science, 2006. **52**(7): p. 1000-1014.

[22] Singh, P.V. and Y. Tan, *Developer Heterogeneity and Formation of Communication Networks in Open Source Software Projects.* Journal of Management Information Systems, 2010. **27**(3): p. 179-210.

[23] Martinez-Torres, M.R. and M.C. Diaz-Fernandez, *Current Issues and Research Trends on Open-Source Software Communities.* Technology Analysis & Strategic Management, 2014. **26**(1): p. 55-68.

[24] Moore, P. and P.A. Taylor, *Exploitation of the Self in Community-Based Software Production: Workers' Freedoms or Firm Foundations?* Capital & Class, 2009. **33**(1): p. 99-119.

[25] Jones, C., W.S. Hesterly, and S.P. Borgatti, *A General Theory of Network Governance: Exchange Conditions and Social Mechanisms.* Academy of Management Review, 1997. **22**(4): p. 911-945.

[26] Gallivan, M.J., *Striking a Balance between Trust and Control in a Virtual Organization: A Content Analysis of Open Source Software Case Studies.* Information Systems Journal, 2001. **11**(4): p. 277-304.

[27] Franck, E. and C. Jungwirth, *Reconciling Rent-Seekers and Donators–The Governance Structure of Open Source.* Journal of Management and Governance, 2003. **7**(4): p. 401-421.

[28] Raymond, E.S., *Homesteading the Noosphere.* First Monday, 1998. **3**(10).

[29] Stewart, K.J., A.P. Ammeter, and L.M. Maruping, *Impacts of License Choice and Organizational Sponsorship on User Interest and Development Activity in Open Source Software Projects.* Information Systems Research, 2006. **17**(2): p. 126-144.

[30] Dahlander, L. and M. Magnusson, *Relationships between Open Source Software Companies and Communities: Observations from Nordic Firms.* Research Policy, 2005. **34**(4): p. 481-493.

[31] Morgan, L., J. Feller, and P. Finnegan, *Exploring Value Networks: Theorising the Creation and Capture of Value with Open Source Software.* European Journal of Information Systems, 2013. **22**(5): p. 569-588.

[32] Kuali Foundation. *Kuali Foundation*. 2014 08/05/2014]; Available from: https://www.kuali.org/.

[33] van Rooij, S.W., *Adopting Open-Source Software Applications in US Higher Education: A Cross-Disciplinary Review of the Literature.* Review of Educational Research, 2009. **79**(2): p. 682-701.

[34] Liu, M. and J.L. Zhao. *On Outsourcing and Offshoring in Community Source*. in *Advanced Management of Information for Globalized Enterprises*. 2008. IEEE.

[35] Liu, M., et al., *Outsourcing of Community Source: Identifying Motivations and Benefits.* Journal of Global Information Management, 2010. **18**(4): p. 36-52.

[36] Liu, M., S. Hansen, and Q. Tu. *Organizational Control in Community Source Projects*. in *SIGBPS Workshop on Business Processes and Services (BPS'12)*. 2012.

[37] Liu, M., C. Hull, and Y. Hung. *Antecedents of Community Source Network Formation: The Case of Kuali*. in *46th Hawaii International Conference on System Sciences (HICSS)*. 2013. Hawaii: IEEE.

[38] Liu, M. and J.L. Zhao. *Real Options Analysis of The Community Source Approach: Why Should Institutions Pay for Open Source*. in *Proceedings of the First China Summer Workshop on Information Management*. 2007.

[39] Liu, M.L., H.J. Wang, and J.L. Zhao, *Technology Flexibility as Enabler of Robust Application Development in Community Source: The Case of Kuali and Sakai.* The Journal of Systems and Software, 2012. **85**(12): p. 2921–2928.

[40] Brooks, L. *Considering Open Source: A Framework for Evaluating Software in the New Economy*. EDUCAUSE Center for Analysis and Research (ECAR), 2007.

[41] Wheeler, B. *The Inevitable Unbundling of Software and Support*. 2004.

[42] Dolphin, I. *Open Source in Higher Education: Building a Life Raft for the Perfect Storm*. 2014.

[43] Charmaz, K., *Constructing Grounded Theory*. 2nd ed. 2014: Sage.