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# Governance of Collaborative Open Source Software: Inference from Transaction Cost Economics Model

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## ABSTRACT

Structural changes in open source software and increased involvement of commercial organizations in the development and governance of open source projects represent a departure from the ‘pure’ open source paradigm and an emergence of a new collaborative model. In this paper we call for a new perspective on open source software research that explains this latest alliance with commercial vendors. We argue that open source is about governance, not just free code. It’s the uniqueness of a governance model that differentiates successful collaborations. The transformation of OSS bazaar-like process to a more structured development, while maintaining the bazaar product could not be achieved successfully without the establishment of an optimal collaborative governance model.

## Keywords

Hybrid governance, collaborative open source software, transaction cost economics, interorganizational cooperation.

## INTRODUCTION

Open source software’s extraordinary method of organization gave rise to a new collaborative structure that engages diverse resources. OSS is experiencing significant involvement of commercial IT vendors and other proprietary software development companies. Until recently, commercial vendors considered open source as a low profile hobbyist activity with insignificant impact on their market share. However, as OSS grew and amassed a strong following, commercial IT vendors adopted a less hostile posture that embraced the ‘movement’. Currently, giant vendors such as IBM, Intel, Oracle, and HP are participating and supporting different open source projects.

This study applies the premise of transaction cost economics and interorganizational collaboration theories of adopting cost-minimizing governance structure to open source and commercial (for-profit) organization partnerships, designed for software development transaction. Our attempt to understand the implications of such relationships is conducted on the basis that both parties agreed to form an out-of-band association in the form of ‘cooperative adaptation’, which is a departure from the classical form of alliance, in order to achieve mutual benefits and cost savings. We maintain that the impact of IT vendors and commercial organizations involvement in OSS projects calls for immediate attention and rigorous research to determine the prospect of such a special form of alliance.

## OPEN SOURCE SOFTWARE OVERVIEW

Open source software, also known as free, libre, open source software (FLOSS), is generally defined as the process of producing software products and applications by volunteer participants to create public good (von Hippel and von Krogh, 2003). Throughout this paper the term open source software will be used to denote both free and open source software<sup>1</sup>. Advocates of OSS claim it to be the “next great thing” that would revolutionize the software industry (Raymond, 2000), while those facing threat from the ‘movement’ momentum, mainly proprietary software development shops, ascribe as an intellectual property infringement.

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<sup>1</sup> Philosophical differences between open source software and free software are beyond the scope of this study. For further details, the reader is referred to respective foundations and proponents of each. Open Source Initiative is the advocate of open source software; [www.opensource.org](http://www.opensource.org). Free Software Foundation goal is to promote computer user freedom and to defend their rights; [www.fsf.org](http://www.fsf.org)

Open source is ascribed as a voluntary nonprofit community organized around a vast number of software projects. The OSS project is recognized as the entity that receives significant support from voluntary contributions represented in time, effort, and/or money. The group culture is based on shared beliefs, values, and basic assumptions associated with voluntary participation for the public good (Ott 2001, p. 288). It is reasonable to assume the OSS phenomenon is driven by economic agents performing actions that maximize their utility function. Volunteer developers would be conscious of opportunity cost of invested assets (Valentinov 2008) and project organizers would want to operate efficiently while upholding community values.

Dahlander and Magnusson (2005) argue that various relationship structures exist between open source projects and commercial companies. The symbiotic approach, where both parties gain from the alliance, might be the most effective at influencing the project members and achieving collaborative governance mechanisms. However, this approach introduces managerial challenges related to decision rights and control between the different parties. Some of the operational means of enabling governance require resolving ambiguity about control and ownership, aligning different interests, creating and maintaining a positive reputation, and investing in channels for proactive interactions. The collective transformation of open source led to the emergence of a new generation, or what's been ascribed as OSS 2.0 (Fitzgerald, 2006).

## THEORETICAL FRAMEWORK

### Transaction Cost Economics Theory

Transaction cost economics (TCE) is an interdisciplinary field that deals with the establishment of governance and institutional arrangements (Williamson, 1979). Institutional arrangement is an arrangement between economic units, which govern their cooperation and establish a structure for members' interaction (Davis, North and Smorodin, 1971). The theory explains why some products/services are produced internally within a firm (vertically integrated) with a hierarchical governance structure while others are produced and purchased on an external market. In the next subsections we present a summary of the underlying elements of TCE<sup>2</sup>.

#### *Governance*

TCE applications largely focus on governance structures. The theory predicts that transactions are embedded in governance structures that minimize vulnerability (Williamson, 1998). Gies, Ott, and Shafritz (1990) recognized governance as the function of control and administration that takes place when a group of people come together to legally incorporate under the laws of a state for a nonprofit organizational purpose (p. 178). TCE theorists argue that in interfirm cooperation settings, there might be adverse consequences to collaboration due to potential untrustworthiness and self-interest behavior of agents involved in a transaction (Williamson, 1979). Hence, having collaborating parties retain the incentive for maintaining the relationship by the establishment of governance mechanisms, also acknowledged as 'safeguards', in order to reduce transaction costs incurred by opportunism and environment uncertainty becomes an essential goal of the theory.

TCE differentiate between three general forms of governance mechanisms, namely: vertical (hierarchical) highly-specific governance (Williamson, 1979; Barney, 1999), intermediate or hybrid (semi-specific) governance (Williamson, 1979, 1985), and market (non-transaction-specific) governance (Williamson, 1979; Judge and Dooly 2006). This study is motivated by the second type of governance; explicitly semi-specific or intermediate structure for governing alliances between an open source project and profit-oriented partners. In an attempt to address the governance decision, some earlier studies maintained that the governance question is simply a factor of early selection and setting some form of socialization efforts, or a combination of both (Heide and John, 1990). Other studies recognized this form of organization as value-added partnership (Johnston and Lawrence, 1988) and strategic alliance (Webster 1992; Saxton 1997).

#### *Vertical Integration*

Vertical integration represents a restrictive form of organization favoring internal exchanges within firm boundaries. This method implies full control of resources by the organization and eliminates dependency on external entities. According to Perry (1989), transactional economies perception is one of the key determinants of vertical integration. Seemingly, the outcome of vertical integration is reducing the requirements of intermediate exchange inputs. TCE theorize that one of the

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<sup>2</sup> Due to the extensive literature of TCE across various domains, selective review related to governance in collaborative setting is presented here. We direct attention to cited sources for further details.

incentives of firm's adoption of integration of a process is to internalize transactional economies and eventually reduce its transaction costs.

#### *Asset Specificity*

Asset specificity is a characteristic of an investment's transferability from one transaction or setting to an alternative one. Recognized as a notion of sunk cost, TCE maintain that switching specific assets from one setting to a different one will result in lowering the value of these assets. Therefore, partners associated with a transaction that involves "appropriable quasi-rents" are more likely to remain in partnership and work together to attain mutual satisfactory benefits.

Distinctly, TCE research differentiates between two types of asset specificity: intangible and tangible. Intangible factors are identified by the uniqueness of skills, functions and business knowledge required for completing a particular transaction (Williamson, 1985; Young-Ybarra and Wiersema, 1999; Subramani, 2004). On the other hand, tangible assets include any form of physical or monetary contributions. It's important to point out that other forms of asset specificity might take place during the course of a transaction. For example Polanyi (1963) identified personal knowledge as an important type of idiosyncratic assets. As a consequence, the theory claims that asset specificity leads to diverse forms of governance structures, formed in response to protect such investments (Williamson, 1989). This assumption becomes an important notion in explaining why organizations adopt different forms of governance.

#### *Uncertainty*

Human bounded rationality and limited capacity to encompass all variables of decision making has an effect on degree of uncertainty present in a transaction. TCE acknowledge that hazards are due to the behavioral uncertainty appearing as a result of a combined effect of incomplete contracting and asset specificity. Therefore determination of most relevant aspects of a transaction is achieved with reasonable amount of uncertainty.

Empirical studies have shown that certain forms of uncertainty have direct influence on the choice of governance structure and subsequently transaction costs (Heide and John, 1990; Masten, Meehan and Snyder, 1991; Zaheer and Venkatraman, 1995). A multi-dimensional uncertainty construct identified in the literature includes: technological uncertainty, which involves technical level of future product change (Walker and Weber, 1984; Balakrishnan and Wernerfelt, 1986), behavioral uncertainty involving parties joined in a condition of bilateral dependency (Anderson, 1985; Williamson, 1989; Heide and John, 1990) and environmental uncertainty (Walker and Weber, 1984). The theory also involves a secondary type of uncertainty factor, demonstrated by lack of communication between decision makers that restrict access to concurrent decisions and plans made by others (Koopman, 1957, p. 147). While Williamson (1989) claims the last type of uncertainty is "nonstrategic", we argue that uncertainty due to lack of, or non-established channels of communication becomes important in transactions linking parties of corporate and community organizations.

#### *Opportunism*

Acknowledged as one of transaction cost economics behavioral assumptions, opportunism is characterized as the human trait of seeking self-interest with guile (Williamson, 1989. p. 139). The potential of a partner to default on the other or exhibit opportunistic behavior will have negative implications reflected in incurring higher transaction costs. The theory also argues that threats of significant opportunism will lead players in a transaction to opt for a governance of collaboration that safeguard against these threats. Safeguarding against potential opportunistic behavior might involve transaction costs in the form of negotiating costs, bonding costs, monitoring costs, and enforcement costs (Hill, 1990).

Strategic alliance research showed that opportunism is a particularly important problem, especially in alliances that engages members from different organizations (Judge and Dooley, 2006). In addition, several studies revealed that while it's not necessary all agents have the same level of opportunistic behavior, any perception of opportunism between the parties of an alliance would negatively impact performance (Williamson 1979; Ring and van de Ven, 1994; Saxton, 1997).

## **INTERORGANIZATIONAL COOPERATION THEORY**

While TCE represent a general framework for examining governance of joint transactions between open source and for-profit organizations, it's more informative to guide the investigation within definitive boundaries by concentrating on key activities characterized by the institutional model. Employing the interorganizational cooperation (IC) premise, within the domain of transaction cost economics, the study highlights key elements of the collaborative governance. We posit that TCE and

articulated dimensions of interorganizational cooperation behavior, together, provide a richer foundation for explaining governance issues of open source projects and commercial companies collaborative transactions.

Emphasizing the impact of interdependence between the parties involved in a transaction, IC theory argues that parties tend to cooperate when there are shared assets and dependency on each other (Williamson 1985, 1991b, Osborn and Hagedoorn, 1997). Early research investigated determinates of interorganizational cooperation (Schermerhorn, 1975) found that cooperation is more likely to take place in circumstances where organizational domains are not sensitive issues; in most cases the parties are not engaged in competing activities. Also collaboration is likely to occur where mutual goals among parties are obtainable. There are also some negative implications associated with interorganizational cooperation. For example, entities participating in interorganizational cooperation venues might suffer a loss of decision-making autonomy, experience loss or damage to their identity and image, or they might over burden their limited organizational resources (Schermerhorn, 1975).

From a transaction cost point of view, various forms of interorganizational relationship, such as joint ventures or network structures, are considered alternative forms of governance and departures from the generic organizational hierarchy (make) or market (buy) decision (Barringer and Harrison 2000). In the next section we specifically address governance and established cooperative activities in the context of managing open source-commercial organization alliance.

## **TOWARDS A NEW FORM OF GOVERNANCE**

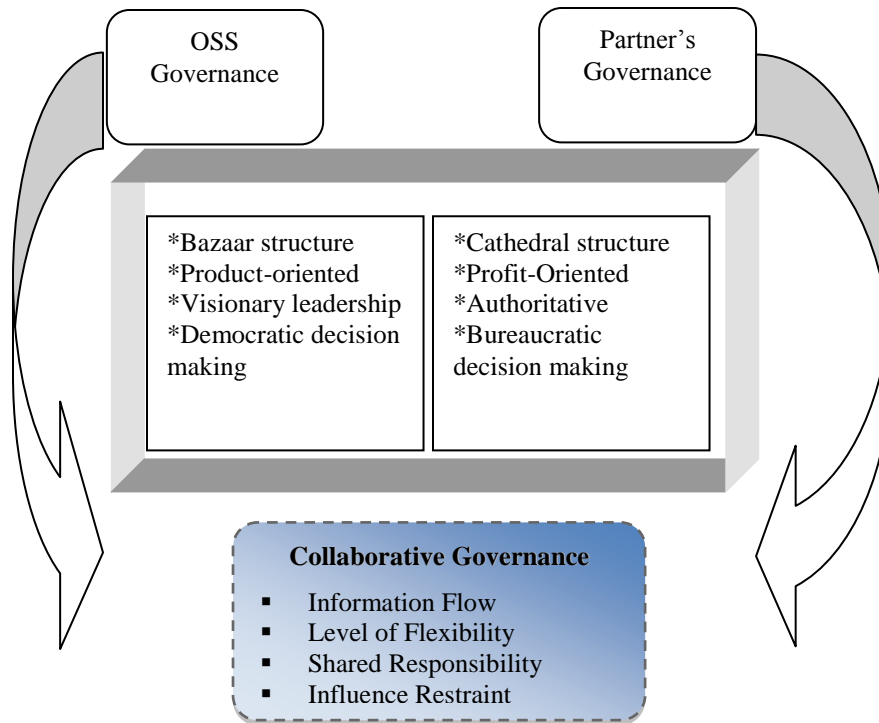
TCE assert that the principle of defining various forms of governance structures, or safeguard and control mechanisms, is to promote transaction's egalitarianism. We argue that open source is an economic arrangement. Although it appears to lack monetary incentive drivers, yet other forms of organization hold, including labor and resource allocation in order to produce public goods and services. Open source software development provision stems from the fundamental voluntary contribution notion of the public goods theory (Johnson, 2002). In particular, OSS development regime creates software products available for both original volunteer contributors, as well as, the masses.

The importance of dedicated and enthusiastic leadership is recognized as one of the major factors for ensuring focused vision and fueled innovation. In contrast to commercial software development process management, OSS project leadership role is less authoritative but more about recruiting and vetting good talent for the project and avoiding interference. Study results shown that leadership attainment in OSS projects is a factor of technical contribution and organization building (O'Mahony and Ferraro, 2007)

In a hybrid collaborative setting, the partnership between OSS and the alliance organization could be a result of the company being the initiator of the project, or the partner proprietary organization joins an existing open source development effort. Regardless of original partner leadership status, the new leadership typically has to earn credibility (Fogel, 2007). One of the objectives of collaborative software development between open source projects and commercial partner(s) is the arrangement of institutional form based on principal foundations and an interest in minimizing cost. This new configuration would lead each party to perceive themselves at an advantage point by continuing the alliance than by ending it. Although no formal contracts are defined to oversee cooperation between the two parties yet OSS-commercial vendor affiliation is governed through embedded unofficial 'self-enforcing' agreements (Telser, 1980), sponsorship and safeguards.

Extending transaction cost analysis to the "non-profit" OSS domain requires careful treatment. Nevertheless, the hybrid model attempts to define an optimal governance structure that yields meritorious results. The special control form is established to oversee exchange agreement and joint operation as a semi-specific structure. From a commercial perspective the partnership between an OSS project and business involvement is considered a special form of value-added partnership.

This study adopts a multi-dimension governance arrangement for the alliance, pertaining to information flow, level of flexibility, influence restraint, and shared responsibility. In conformity with Heide and Miner's (1990, 1992) view of alliance and domains of cooperation, we hypothesize that the degree of cooperation between the two parties involved in a hybrid mode of open source development, as opposed to pure open source or totally proprietary development, is a function of their boundaries' transparency and readiness to rationalize commitment to each other. Such practice is a first step towards achieving a justifiable cost-suppressant governance structure along with underlying building blocks. Figure 1 shows the new form of governance for collaborative OSS.



**Figure 1: Collaborative Governance Model**

### Information Flow

Software development as a transaction is embedded in governance structures that minimize vulnerability (Williamson, 1998) and create a perpetual environment for future growth and scalability. The importance of establishing bilateral communication channels is recognized in classical organizational theory to have both supplementary and complementary roles to existing channels in any organization structure (Hrebiniak and Joyce, 1984). In the absence of formal firm boundaries, open source projects undertake transparency and a free flow of knowledge and information on project mailing lists and discussion boards as mechanisms for mitigating uncertainty and potential conflicts.

As commercial vendors engage in the project, amplified levels of communication and information sharing becomes more eminent for resolving dependency and assuring complete engagement. Collaboration research shows that the alliance form of governance is influenced by the level of interdependence and requirement for information sharing (Gulati and Singh, 1998). The higher the level of interdependence and transaction complexity, the greater the amount of information sharing is needed between partners. Given that software development is a highly complex task that involves multiple dependencies across different parties, it's the control mechanism of OSS project-commercial partnership that comes into effect for managing flow and defining level of information granularity. Certainly, it's the access to information possessed by each party that reduces the degree to which information asymmetry might pose a risk to the performance of partnership. We reason that partnership form of governance will resolve the challenges for coordinating tasks between open source and commercial partners by investing in setting up economical methods that reduce coordination costs.

### Level of Flexibility

The other dimension of governance implicates strategic flexibility of relationship between OSS project and commercial partners. Previous research reveals that increased flexibility of interorganizational collaboration to be a pre-required phase for

improved efficiency and cost reduction (Chebbi, Dustdarb and Tataa, 2006). Moreover, a rapidly changing software and technology environment demands swift response and managed adaptability.

In alliance setting, flexibility, identified as the partnership's ability to cope with environment changes (Aaker and Macarenhas, 1984) and continuous adjustment to emerging states (Bahrami, 1992), stems from instituted governance mode of joint collaboration. Success of the relationship between the open source project and proprietary vendor partner commands the later to refrain from attempting to impose corporate-style structure and bear an approachable attitude towards open source's casual nature. The new formed governance should be established according to the needs of partnership, and availability of competencies and matching roles. Parallel to previous studies that found establishment of flexible arrangements to have a positive effect on alliance performance and satisfaction (Johnston, McCutcheon, Stuart and Kerwood, 2004), we argue that parties' willingness to alter agreements and priorities when unexpected events arise will positively affect satisfaction with the outcome of the partnership.

### **Influence Restraint**

Often, strategic relationships involve stakeholders that are cautious about power exploitation that could lead to the damage of the offending party's "social face" and show concern about the potential loss of future opportunities for the spoiled partner (Cook and Emerson, 1978; Luo, 2001). The fact that the party with superior power willingly abstains from exercising their veto power to override the less powerful party's shared control on project direction and key decisions is a crucial protection against power friction, potential project 'forking' and/or demise of the relationship. Several studies support the favorable implications of fair power distribution and equally shared control of the alliance. Some of the direct implications of such positive practices are reflected in improved work attitudes and behavior and organizational commitment (McFarlin and Sweeney, 1992; Van den Bos, Wilke and Lind, 1998).

A typical example of partnership influence restraint is represented by the scenario that when given the chance, the commercial partner avoids exploiting the open source project and vice versa (Heide and Miner 1992). Moreover studies on cross-organizational power sharing and use underscores the positive role of interfirm power control in promoting trust and effective coordination of partners' activities (Frazier and Summers 1986; Zaheer and Harris, 2005). We suggest that setting up well-defined limits for each party's level of power will stimulate favorable results of open source-commercial company affiliation.

### **Shared Responsibility**

Arguably, within the open source context, vertical integration would encompass full development and control of a project by open source members without relying on support or sponsorship from any commercial organization or foundation. All efforts of design, organization, implementation, and promotion of the project are exclusively under the project's internal governance. As a result of total 'vertical integration' open source grows to maintain a fuzzy set of distributed responsibilities among volunteer members. Collectively, this comes to define overall commitment to the success of open source in general. Shared values, self esteem, and altruism are key players for maintaining OSS developers renewed interest and desire for successful results.

As commercial vendors hold direct involvement in OSS projects, a new framework of responsibility would necessarily come into effect. Interorganizational cooperation literature assumes that cooperative activities of an alliance would take some form of joint decision-making process and mutual control (Mulford and Rogers, 1982). Moreover, in support of common responsibility, the theory calls for building consensus and coordinating actions of member partners (Galaskiewicz, 1985).

Because profit-oriented companies are inclined to introduce a structured model of accountability to the partnership, the new governance model will have to account for the extent to which open source projects and commercial partners distribute responsibility in a fashion that supports the alliance and build safety nets for handling future lapses. Heiman and Nickerson (2002) posit that the governance choice of an alliance facilitates identification of knowledge sources and promotes joint actions required to solve problems within a coalition setting. Commonly, resources required for particular tasks are drawn from the shared pool of open source project and commercial organization's resources

In general, acknowledging diverse stakeholders' goals and intentions of collaboration, it's legitimate to argue that the new form of OSS development requires a special control structure, well defined roles, and departure from 'bazaar-like' governance mode. Also, research shows that establishment of a special form of governance structure that is in alignment with transaction attributes has a first order effect on subsequent patterns of participation and engagement of future partners (Shah 2006). In addition, different aspects related to governance choice are found to yield dissimilar performance outcomes for transactions with diverse organizational forms (Leiblein, Reuer and Dalsace, 2002). The latest conclusion supports earlier results which identifies the influence of governance choice on partnership performance (Walker and Webber, 1984; Williamson, 1985; Heide and John, 1990). We hypothesize that satisfaction with a new form of collaboration for open source software development forms an integral part of the organizational assimilation process (Pieters, Koelemeijer and Roest, 1995). Also the moderating effect of experience with the commercial partner can provide an evaluation for making subsequent judgments about the hybrid mode viability.

## CONCLUSION

Materialization of a new model of open source software marks a transition from the bazaar process to a more structured process for producing open source products. Given recognition of the special form of collaboration between open source and commercial organization(s), it's expected that a new form of interorganizational cooperation would emerge to account for the two parties differences. In addition, it is likely that the role of transaction cost will presume another level of importance and allow for alternative interpretations within the open source context. For our research we focus attention towards the type of organizational interdependency that involves the establishment of joint, cooperative activities between open source project communities and for-profit organizations (i.e. OSS companies, IT vendors, etc...). We posit that stream line of information flow between OSS project and commercial partner, development of flexible cooperative alliance, control of power and influence of one party on the less dominant one, and promotion of shared and common responsibility yields satisfactory collaborative governance. Without these structures, we contend that the hybrid model of OSS cannot succeed. In face of failure OSS project will confront the choice of reverting back to the 'vertical' volunteer model, or being taken by the IT vendor. Our hypothesized contention requires empirical study.

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