An empirical investigation into the adoption of open source software in Information Technology outsourcing organizations

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Abstract

Purpose – The purpose of this paper is to identify the influence of outsourcing on open-source software (OSS) and further investigate the factors that impact the adoption of OSS in global information technology (IT) outsourcing organizations serviced by Indian IT services organizations.

Design/methodology/approach – The authors developed a conceptual model that describes the factors influencing the OSS adoption by using the technology-organization-environment framework. This quantitative explanatory study used self-administered questionnaire to collect data from 482 middle and top management employees of Indian IT services organizations. The authors analyzed the data using partial least squares to test this conceptual model.

Findings – The proposed conceptual model identified the factors which play a significant role in OSS adoption such as reliability, legal concern, software costs, management support, OSS support availability and software vendor. In contrast, this study did not find enough evidence that IT outsourcing was a significant determinant of OSS adoption.

Research limitations/implications – The main limitation of the research is that it is focused on global IT outsourcing organizations (clients) serviced by Indian IT services providers (vendors). Hence, the authors cannot generalize the finding to other regions. Also, the analysis is based on the view point of employees in vendors. Views of clients' employees must be analyzed and triangulated with current evidence.

Practical implications – IT services providers can offer "OSS as a service" for its clients and help them address the gaps in support availability and achieve reduction in total cost of ownership of software.

Originality/value – IT services providers can use this research model to increase their understanding of why some IT outsourcing organizations choose to adopt OSS, while seemingly similar ones facing similar market conditions do not.

Keywords Open-source software, Diffusion of innovation, IT outsourcing, Indian IT, OSS adoption, Technology-organization-environment framework (TOE)

Paper type Research paper

1. Introduction

Open-source software (OSS) has gained significant momentum over the past two decades and has changed the way software is perceived, developed and deployed in many areas. It is often seen as a disruptive technology that has changed the rules of the industry. The sudden success and major adoption of this new and innovative

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software development strategy has raised many questions, attracted the interest of academics in a variety of disciplines and prompted interdisciplinary research (Nagy *et al.*, 2010). The increasing interests in the adoption of OSS have raised more questions including: why OSS is free and successful (Bonaccorsi and Rossi, 2003); why firms adopt open-source platforms (Dedrick and West, 2003); what is the role of commercial stakeholders in OSS evolution (Capiluppi *et al.*, 2012); what are the motivations and social practices of contributors (von Krogh *et al.*, 2012). The knowledge on OSS and its importance emphasized the adoption of OSS in organization instead of conventional proprietary and closed-source platforms. Previous studies have explored various aspects of OSS engineering, and a number of special OSS research areas have emerged such as OSS practice and methods, OSS diffusion, OSS business models and OSS communities.

Indian information technology (IT) industry is the face of modern India and has been one of the most significant growth contributors for the Indian economy. As a proportion of India's gross domestic product, aggregate IT sector revenues have grown from 1.2 per cent in 1998 to 8.1 per cent in 2014 (NASSCOM Research, 2014). Given that the primary driving force in IT outsourcing sector appears to be cost savings, it is perhaps natural that companies might eventually focus on the OSS (Agerfalk and Fitzgerald, 2008). Gartner report highlighted that IT outsourcing organizations are compelled to look at OSS alternatives, as concerns around security, performance and technical support are increasingly addressed, and India-based IT services providers must evolve to capitalize on this OSS trend (Raina and Wurster, 2013). In this study, we explore the role of outsourcing in OSS adoption and develop a conceptual model for OSS adoption in global IT outsourcing organizations (clients) serviced by Indian IT services providers (vendors). Data collection and statistical analysis was conducted at the organizational (clients) level. The scope of this study included Indian IT services providers that are members of the National Association of Software and Service Companies (NASSCOM), the industry association for the IT-Business Process Management (BPM) sector in India and their clients.

In the next section, the relevant literature is presented, and the theoretical framework adopted in this study is discussed in detail. This is followed by a description of the study's overall research design and methodological issues. The paper continues by presenting the study's main findings, before highlighting future research areas.

2. Related work

OSS is defined as software released under the terms of a license that basically allows the licensee to use, modify and redistribute, either gratis or for a fee. Ever since the drive started against the closed-source proprietary software, there are two major movements in the industry – free software movement and open-source movement. These are like two political camps within the free software community. For the purpose of this study, both free software and OSS would be considered and would be broadly termed as OSS.

Technology adoption is the process of adopting a technology in a given organization or a group (Fitzgerald *et al.*, 2012). One type of technology adoption is software adoption, which stresses the soft concept of technology (Rogers, 2010). OSS adoption refers to a

process in which the organization associates itself with OSS in one or many forms, such as the following:

- using OSS development practices;
- participating in the existing OSS development;
- providing OSS products;
- using OSS tools; or
- deploying OSS products.

The classification was derived based on the work done by Hauge *et al.* (2010) and adopted for this study.

2.1 Organizational adoption of OSS

OSS has changed the way organizations develop, acquire, use and commercialize software (Ayala *et al.*, 2011). Over 75 per cent of the IT organizations leverage non-trivial elements of OSS technology in their mission-critical IT portfolios, including cases where they might not be aware of OSS (Driver, 2012). Indirect adoption of OSS from third-party vendor solutions exceeded direct adoption by at least some order of magnitude in most typical scenarios. Most of the closed-source vendors have passed the stage of rejection and denial of open-source and, instead, have turned to open-source as a key part of their software development strategies, drawing on its technical quality, low cost and favorable licensing terms (Natis *et al.*, 2008). For example, industry market leaders (such as IBM, Oracle, SAP and Microsoft) have OSS technology assets embedded within most of their products (Driver, 2012).

Golden (2009) emphasized six key factors as OSS adoption drivers, which include agility and scale, quality and security, breaking vendor lock-in, cost, sovereignty (getting unlocked from products of other countries) and innovation.

2.2 OSS adoption in Indian IT outsourcing context

Indian companies have been less adventurous and stuck to proprietary software made by companies like SAP, IBM and Oracle (Mendonca, 2013). However, Indian companies are increasingly moving to OSS after recognizing the cost benefits and flexibility it offers over proprietary software. A falling rupee, which increases licensing costs, is likely to hasten the trend (Mendonca, 2013). Gartner report states that OSS traction is rising in India, and its use has become more strategic for internal usage, as well as for client-facing systems (Raina and Wurster, 2013).

Companies like HP India, Cognizant, Infosys, Wipro, MindTree, IBM India and many others took advantage of these new outsourcing opportunities and have increased their performance (Sharma and Adkins, 2005). MindTree established an open-source center of excellence and offered OSS consulting, development and implementation services (Bacche, 2010). Infosys had set-up a Linux migration practice and have migrated complex systems for a large petroleum industry client and a leading peripheral manufacturer in Japan (Sharma and Adkins, 2005). Wipro had harnessed OSS to drive cost-effective solutions in financial services and messaging services markets (Sharma and Adkins, 2005). Economic slowdown and stressed profitability margins have pushed Indian IT services providers to leverage OSS (Raina and Wurster, 2013).

2.3 Previous studies on OSS and OSS adoption

Researchers explored various aspects of OSS engineering over the past decade, and a number of special OSS research areas have emerged such as OSS practice and methods (Østerlie and Jaccheri, 2007; Weilbach and Byrne, 2013), OSS diffusion (Dedrick and West, 2003; Ven and Verelst, 2011), OSS business models (Bonaccorsi *et al.*, 2006; Alexy, 2009; Rossi *et al.*, 2012) and OSS communities (von Krogh *et al.*, 2012). Reviews of the literature on OSS are given by Feller *et al.* (2006), Stol and Babar (2009), von Krogh and von Hippel (2006) and Hauge *et al.* (2010). Feller *et al.* (2006) analyzed 155 research artifacts published between 1998 and 2004 in the area of OSS. This study concluded that the OSS research literature has large gaps, and that commercial organizations are underrepresented as subjects in the research on OSS. Stol and Babar (2009) reviewed 219 publications from the four first international conferences on OSS and focused on assessing the quality of the 63 empirical studies and find that the literature needs to be improved. They concluded that OSS in organizations attracted limited attention.

There is a paucity of information in the models, theories and frameworks to explain the adoption of OSS in organizations. Hauge *et al.* (2010) in their research on adoption of OSS in software-intensive organizations have done a systematic literature review. From a population of 24,289 papers, they identified 112 papers (less than 0.5 per cent) which provide empirical evidence on how organizations actually adopt OSS and concluded that the overall rigor of the studies performed on OSS, both within organizations and in general, is furthermore not good enough, and this is identified as a key focus area for future research. Ven and Verelst (2012) investigated the organizational adoption in Belgian organizations based on the technology-organization-environment (TOE) framework. The qualitative study by Ven and Verelst (2012) identified a parsimonious list of seven factors that have an impact on the organizational adoption decision on OSS. Five of these factors were found to have an important impact on the adoption decision (i.e. software cost advantage, switching costs, reliability, presence of boundary spanners and availability of external support), whereas two additional factors were found to have a moderate impact on the adoption decision (i.e. trialability and source code availability).

2.4 Research gap

Having reviewed the previous studies in the literature, it is apparent that some major gaps exist in the OSS research with respect to adoption in corporate sector. There is a paucity of study in OSS usage in relation to adoption, and many studies were focused on the management aspect of developing software. Studies lack a robust framework that helps organizations for adopting OSS. Even though there has been an increase in commercialization of OSS, there is not much information on the details of organization participation in OSS projects. This research gap could be due to lack of active participation and response of organizations. There are very limited studies on OSS usage in the context of outsourced software engineering process. Raina and Wurster (2013) state that Indian IT providers must find ways to coexist with open-source by developing an open-source revenue model that complements their current offerings to increase their market share in OSS space.

3. Theoretical framework

OSS adoption in organizations is a form of technology adoption (Gurusamy and Campbell, 2011). Much of the technology diffusion literature focuses on the adoption

decisions of individuals (Oliveira and Martins, 2011). The theoretical framework used in this study is the TOE framework developed by Depietro *et al.* (1990). The TOE framework is an organization-level theory, which represents one segment of the innovation process – how the enterprise context influences the adoption and implementation of innovations (Baker, 2012). The main contribution of this framework is that it encourages the researcher to take into account the broader context in which adoption takes place. In the OSS context, several studies like adoption in the Australian public sector (Gurusamy and Campbell, 2011) and assimilation of open-source server software in Belgian organizations (Ven and Verelst, 2011) implemented the TOE framework. In each of the empirical studies that test the TOE framework, researchers have concurred that the three TOE contexts influence adoption. However, these researchers used slightly different factors for the contexts based on the specific domain that is being studied (Baker, 2012).

4. Conceptual model and hypothesis

Based on the results of the literature review, a conceptual model was developed. This conceptual model, shown in Figure 1, describes the factors that are hypothesized to be influencing the adoption of OSS and is based on the TOE framework.

4.1 Technological context

Technological aspect of the model subsumes the innovation attributes identified by Rogers (2010) that influence the likelihood of adoption.

4.1.1 Reliability. The supporters claim OSS to be more reliable than proprietary software, as the source code is open and freely available for scrutiny for all. For instance studies (Ven and Verelst, 2011; Tiwari and Pandey, 2012) indicated that increase in reliability of the OSS would enhance the adoption rate among users, whereas the

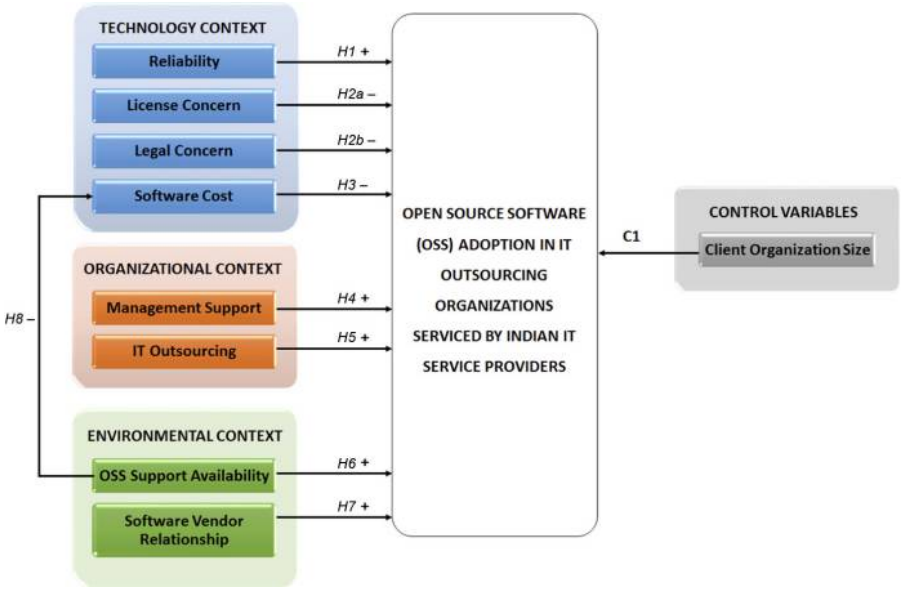

Figure 1.
Conceptual model for the adoption of OSS

opponents of OSS claim that OSS is unreliable, as the source code of OSS is available and the potential threats can easily be incorporated (Tiwari and Pandey, 2012). The study by Dedrick and West (2003) claims that even in larger organizations, reliability played a significant role. This leads to the following hypothesis:

H1. IT outsourcing organizations that perceive OSS to be reliable will exhibit a larger extent of OSS adoption.

License and legal concerns around OSS have increased with its growing use. Organizations are concerned by the complications that emerge when various OSS components, governed by different licenses, are used in the same software system (Hammouda *et al.*, 2010). Previous studies (Fitzgerald and Bassett, 2004; Fitzgerald and Suzor, 2005) confirmed this line of thought and stated that there are concern with legal and licensing issues. Gartner highlights the need for IT services providers to provide the highest levels of legal support for issues around OSS licensing, intellectual property (IP) and copyright (Raina and Wurster, 2013). Hence, we proposed the following hypotheses:

H2a. IT outsourcing organizations that perceive less concern related to OSS licensing issues will exhibit a larger extent of OSS adoption.

H2b. IT outsourcing organizations that perceive less concern related to OSS legal issues will exhibit a larger extent of OSS adoption.

Another factor that was relevant to the adoption of OSS is *software cost*. The body of literature states that the less expensive the technology, the more likely it is that it will be adopted (Rogers, 2010). This is consistent with the observation that a high cost could be a barrier to adoption for those organizations with limited financial resources (Ven and Verelst, 2011). The *software cost* and risk model determines the total cost of ownership of using open-source (Woods and Guliani, 2005). Several studies conducted in the past (Dedrick and West, 2003; Spinellis and Giannikas, 2012; Ven and Verelst, 2012) perceived OSS as less expensive and influence adoption. We, therefore, formulated the following hypothesis:

H3. IT outsourcing organizations that perceive OSS to be less expensive will exhibit a larger extent of OSS adoption.

4.2 Organizational context

Adoption propensity is influenced by formal and informal intra-organizational mechanisms for communication and control. The resources and innovativeness of the organization also play a role.

Within the organizational context, *management support* was an important factor. To ensure that the OSS adoption was planned, it should be part of a strategy where (top) management, developers, operations and support were involved in the decision-making process (Hauge *et al.*, 2010). It was, furthermore, considered important to assess the benefits versus the costs in each specific case. Management support was considered to be important in risk-free development environments. Several studies have confirmed the importance of management support in the adoption of the innovation (Glynn *et al.*, 2005; Hauge *et al.*, 2010). Ayala *et al.* (2011) recommended that organizations need to ensure that their high-level managers and employees support the OSS adoption. This led to the following hypothesis:

H4. IT outsourcing organizations in which management support is high will exhibit a larger extent of OSS adoption.

Outsourcing was originally confined to peripheral business functions and mainly motivated by a cost-saving logic, but now it has been developed into a routine strategic management move that affects the heart of the competitive core of organizations (Hoecht and Trott, 2006). However, there is a move from traditional outsourcing to strategic outsourcing with multiple partners and short-term contracts. Most outsourcing vendors indeed deliver incremental innovation to client firms. Results suggest that joint venture contract and strong client–supplier relationship lead to radical innovation (Oshri *et al.*, 2011). We, therefore, formulated the following hypothesis:

H5. IT outsourcing organizations in which IT outsourcing is high will exhibit a larger extent of OSS adoption.

4.3 Environmental context

A firm's strategic IT decisions are made based on industry characteristics such as competition, relations with buyers and suppliers, as well as the stages of the industry life cycle (Depietro *et al.*, 1990).

Several studies have suggested that the *availability of support* is an important concern in the adoption of OSS. Morgan and Finnegan (2007) have found that a lack of support is an important barrier to the adoption of OSS, especially for large organizations. Similarly, Li *et al.* (2011) state that the availability of external support did have an influence on the intention to adopt OSS. While commercial support services from small and local organizations became increasingly available for well-known OSS products, long-term viability of these providers are questionable (Ven and Verelst, 2011). Previous studies supported these findings (Glynn *et al.*, 2005; Ven and Verelst, 2011; Li *et al.*, 2011; Spinellis and Giannikas, 2012). Hence, we proposed the following hypothesis:

H6. IT outsourcing organizations that perceive support for OSS to be available will exhibit a larger extent of OSS adoption.

4.3.1 Software vendor. Studies in the field of OSS have concluded that structured vendor support should be in place to complement the existing IT support structures (Dedrick and West, 2003). Organizations have created dependency on particular vendor(s) that sold products or services (Yu, 2013), and this would influence OSS adoption. Further, the study by Ven and Verelst (2012) also complemented these findings. Hence, we formulated the following hypothesis:

H7. IT outsourcing organizations that have a relationship with a vendor who is offering OSS will exhibit a larger extent of OSS adoption.

4.3.2 OSS support availability versus software cost. In the adoption of OSS, the total cost of ownership may be influenced by the availability of the external support (Ven and Verelst, 2011). The organization has to evaluate various service providers to assess, and this process requires time, effort and financial resources. This statement is in line with the study of Li *et al.* (2005), where the availability of the external human capital for OSS support will reduce switching cost. We, therefore, proposed the following hypothesis:

H8. IT outsourcing organizations that perceive support for OSS to be available will perceive the software costs involved in adopting OSS to be lower.

5. Research method

This paper's main research objective is to study the OSS adoption in IT outsourcing organizations serviced by Indian IT services providers. More specifically, our research questions aim to examine which factors and to what extent each of these factors influence the OSS adoption. Consequently, ontologically, the paper considers the IT outsourcing organizations as the unit of analysis. The aim of the present study is to prepare a quantitative validation of the conceptual model presented in Figure 1. We conducted a field study using the survey method. The section below provides details on the operationalization of the constructs included in the conceptual model, validation of our measurement instrument and data collection process.

5.1 Construct operationalization

The quantitative component of the questionnaire that aimed to determine an outline of the research situations by asking general questions like position, experience and geography. The questionnaire was structured such that general information was sought first before moving to questions that probed the deeper aspects. Nominal scale answers were used in the demographics section. We started the operationalization of our constructs by providing a clear definition of the theoretical concept we intended to measure in the study. The dependent variable in our model is the OSS adoption. We adapted the measuring instrument for adoption of OSS developed by Fichman and Kemerer (1997). For the independent variables, a literature review was undertaken to identify previously validated measurement items. All independent variables were modeled as reflective multi-item constructs. Each item was measured using a five-point Likert scale.

We decided to consider the impact of a control variable (*organization size*) that may account for some of the differences in the extent of adoption across organizations. Organization size has frequently been found to have an impact on the adoption of new technologies (Fichman, 2000). Large organizations are generally more likely to have more resources, which facilitates the adoption process. On the other hand, it is possible that smaller organizations will be more likely to adopt OSS. Organization size was measured as the total number of employees that worked in the organization (Ven and Verelst, 2011).

5.2 Instrument validation

The questionnaire was pre-tested by experts working in IT, which included an OSS researcher, Project Manager and Delivery Manager. They systematically analyzed the response task for each question, and changes were made to the questionnaire based on experts' feedback. Scales used for questions and groupings of questions were assessed by a statistical consultant, which ensured that the data captured would be effective and valid.

5.3 Data collection

The sampling frame for this study consisted of the global IT outsourcing companies (clients) serviced by Indian IT service companies (vendors) who are members of the NASSCOM. Participants for this survey are employees of these Indian IT service

companies (vendors) and include Head of Business Units, Delivery Mangers, Project Managers, Developers/Testers, Analysts and IT support staff. Employees were asked to respond to the survey in the context of the clients (global IT outsourcing companies) they serve.

Given that the population of this research is 3,695, as per NASSCOM Research (2012), which is less than 10,000, a smaller sample size can be used without affecting the accuracy. The adjusted minimum sample size based on a 95 per cent confidence interval (CI) with 5 per cent margin of error was found to be 348. The sample was constructed based on the following:

- convenience sample of top five Indian IT service companies that accounted for over 23 per cent of IT industry revenue in 2012 (Corporate Announcements, 2012; NASSCOM Research, 2013); and
- random sample of 300 Indian IT service companies from NASSCOM member directory.

The data were supplemented with vendors from our knowledge and vendors appearing in the media. Participants' e-mail addresses were collected from Indian IT services company Web sites, as well as from other social networking forums like LinkedIn®, Google+. The participants were also contacted through phone to collect e-mail address to send an invitation. The list contained contact information of 14,040 employees from 106 vendors from the Indian IT service industry. We used SurveyMonkey®, an Internet-based survey management tool, to conduct the online survey.

Of the 14,040 employees that were sent an invitation, mails for 241 participants (1.7 per cent) bounced; 329 participants (2.4 per cent) explicitly declined to participate; and 1,321 participants responded, which corresponds to a survey completion rate of 9.4 per cent. Given that the survey was available in public forums and some of the participants may have forwarded the invite, responses may have included representation outside the target sample. A detailed analysis was done to identify responses from non-NASSCOM vendors, irrelevant/incorrect responses and duplicate responses. This process ensures that the participants who answered the questionnaire were part of the designated sample frame. In total, 167 (1.2 per cent) responses were marked invalid, and 1,154 (8.2 per cent) useful responses were carried forward for next stage of analysis. The unit of analysis for this study is at organization level, i.e. at global IT outsourcing companies (client) level.

5.4 Data screening

This research employed expectation maximization (EM) for correcting for missing values. EM is an effective technique that is often used in data analysis to manage missing data. All variables except annual turnover of the client were on ordinal scales with five or fewer intervals; thus, extreme value outliers do not exist. For annual turnover of the client, box plot was examined for outliers and found three respondents with exceptionally high values; however, there was no theoretical basis for removing them. Thus, they remain simply as high responses. Since, nearly all the variables are based on Likert-type scales, there is no need to exclude variables based on skewness, unless they exhibit no variance (Rhemtulla *et al.*, 2012).

Demographics of the final sample are displayed in Table I.

		(%)
Client organization size		
Very small (< 100 employees)	11	2.3
Small (101-1,000 employees)	50	10.3
Medium (1001-10,000 employees)	131	27.2
Large (10,001-100 employees)	212	44.0
Very large (> 100,000 employees)	78	16.2
Total	482	100.0
Geography (principal office of client)		
Asia Pacific	49	10.2
Europe	129	26.7
North America	251	52.1
Rest of the world	53	11.0
Total	482	100.0
Client sector		
Banking/financial services/insurance	108	22.4
Construction and utilities	22	4.6
Health care	34	7.1
Hi-tech/telecom	75	15.6
Media, publishing and entertainment	8	1.7
Manufacturing	42	8.7
Retail	43	8.8
Travel and transportation	16	3.3
Others	134	27.8
Total	482	100.0
Degree of OSS adoption		
Extensive usage/adoption	86	17.8
Sporadic usage/adoption	320	66.4
Nil - OSS is NOT used/recommended	76	15.8
Total	482	100.0
Respondent's position		
Top management level	4	0.8
Managerial level	258	53.5
Non-managerial level	203	42.1
Others	17	3.5
Total	482	100.0
Total industry experience of respondents		
< 2 years	5	1.0
2-5 years	7	1.5
5-8 years	131	27.2
8-12 years	194	40.2
12-20 years	138	28.6
> 20 years	7	1.5
Total	482	100.0

Table I.
Demographic characteristics of final sample

6. Empirical analysis

This study adopts partial least squares – structural equation modeling (PLS-SEM) for data analysis. PLS-based SEM was chosen considering that the application of covariance-based SEM requires a strong theoretical foundation, whereas PLS does not require such a strong theoretical foundation (Ven and Verelst, 2011). PLS regression is a latest technique that generalizes and combines features from multiple regression and principal component analysis. It helps to estimate the set of dependent variables from a large set of independent variables (i.e. predictors). Analysis using PLS was conducted in two stages as follows:

(1) in the first stage, the measurement model was evaluated to assess the reliability and validity of the measures; and

(2) in the second stage, the structural model was evaluated to determine the nature of relationships between the constructs.

6.1 Measurement model

Multi-collinearity test was conducted to ascertain the correlation of independent variables. Variable inflation factor (VIF) for all of the independent variables was tested simultaneously. The VIFs were all less than 5.0 (Hair *et al.*, 2011), indicating that the independent variables are all distinct.

Convergent validity specifies that items that are indicators of a construct should share a high proportion of variance (Hair *et al.*, 2011). Individual item reliability was assessed by investigating the indicator's weight (relative importance) and loading (absolute importance) of the items on their respective construct. Refer to Table AI in Appendix for item loadings and cross-loadings values. Examination of results showed that all the indicator weights are significant, and hence, there is empirical support to keep all the indicators (Hair *et al.*, 2011). Internal consistency of multiple indicators was examined using Cronbach's standardized alpha. A Cronbach's alpha of 0.70 was considered as the acceptable benchmark for determining the internal reliability of scale items (Nunnally and Bernstein, 2010), although this may be relaxed to 0.6 in exploratory research (Hair *et al.*, 2010). Table II shows that six of the eight factors extracted from the factor analysis have Cronbach's alpha values greater than 0.6, which satisfies the reliability test. Cronbach's alpha is not applicable for two factors (legal concern and IT outsourcing), as it has a single item. Table II also shows that composite reliability (CR) was above 0.70 recommended in the literature (Hair *et al.*, 2011), indicating the internal consistency reliability. In addition, the average variance extracted (AVE) was

Construct	Cronbach's alpha	AVE	CR
Reliability (RELIB)	0.677	0.617	0.820
License concern (LICNSE)	0.784	0.828	0.906
Legal concern (LEGAL)[a]	–	1	1
Software cost (SWCST)	0.714	0.639	0.826
Management support (MGTSUP)	0.721	0.609	0.854
IT outsourcing (ITOUTG)[a]	–	1	1
OSS support availability (OSSSUP)	0.606	0.458	0.709
IT services provider (SWVEN)	0.798	0.714	0.882

Note: [a] Construct have single items

Table II. Convergent validity statistics

above 0.50 (Hair *et al.*, 2011; Chin, 1998), except for OSS support availability (OSSSUP), which was close at 0.460. However, as this factor is minimally correlated with the other factors in the model, and because the Cronbach's alpha (0.606) was greater than 0.6 and CR (0.706) was greater than 0.7, this was retained. These results provide support for convergent validity.

We ascertained discriminant validity by verifying that the square root of the AVE is higher than all the inter-construct correlations (Chin, 1998). As Table III shows, this criterion was satisfied. A second means for investigating discriminant validity was by examining the cross-loadings. The results from the PLS factor analysis are shown in Table AI in Appendix. Each item loads higher on the construct it intends to measure than on any other construct (Chin, 1998). In addition, the loadings in each construct block are higher than the cross-loadings of the construct with items from other constructs. As a result, both tests indicated that the model has a sufficient level of discriminant validity.

As the data collection was based on a single survey, recommended procedural and statistical remedies suggested by Podsakoff *et al.* (2003) were applied to minimize and control common method bias. Harman's single-factor test was conducted to test that neither one single factor emerged that accounted for the majority of the variance in the model nor one factor accounted for more than 50 per cent of the variance. Principal axis factoring without rotation revealed seven distinct factors with eigenvalues above 1, explaining 57 per cent of the variance. The most prominent component accounted for 19 per cent of the variance. In addition, marker variable procedure, as suggested by Lindell and Whitney (2001), was applied. Marker variable (OSS component selection criteria), which was theoretically dissimilar to the other constructs in the model, was added. The maximum correlation with marker variable was with software vendor (0.177), and this was less than 0.300. Maximum shared variance with the marker variable was less than 3.2 per cent (0.177 squared), and none of the other correlations were near the 0.900 threshold. Thus, there was no evidence that a common method bias exists in the study.

6.2 Structural model

A structural model is used to capture the linear regression effects of the endogenous construct upon one another (Hair *et al.*, 2010). It has the ability to specify the pattern of the relationships among the constructs. The model was assessed using PLS based on three following criteria:

(1) path coefficients (β);

(2) path significant (p-value); and

(3) variance explain (R^2).

Bootstrapping procedure was performed using 5,000 resamples and construct-level sign changes to assess the significance of the path coefficients. As the paths were unidirectional in nature, a one-tailed t-test was used (Teo *et al.*, 2003). Similar to the previous studies (Fichman and Kemerer, 1997; Teo *et al.*, 2003; Ven and Verelst, 2011), three different models were estimated, namely:

(1) the theoretical model;

(2) the control model; and

(3) the full model.

Table III.
Discriminant validity of major constructs

Construct	RELIB	LICNSE	LEGAL	SWCST	MGTSPT	ITOUTG	OSSSPT	SOFTVEN	OSSADP	SIZE
RELIB	**0.785**									
LICNSE	−0.106	**0.910**								
LEGAL	−0.028	−0.008	**1**							
SWCST	−0.223	0.585	0.007	**0.799**						
MGTSPT	0.140	−0.154	−0.492	−0.272	**0.780**					
ITOUTG	0.016	0.002	0.075	−0.038	−0.039	**1**				
OSSSPT	0.227	−0.379	−0.185	−0.596	0.372	0.068	**0.677**			
SOFTVEN	0.106	−0.107	−0.114	−0.089	0.181	−0.005	0.187	**0.845**		
OSSADP	0.159	−0.136	−0.259	−0.22	0.376	0.042	0.247	0.227	**1**	
SIZE	0.069	−0.038	0.025	−0.06	−0.038	0.032	0.037	−0.038	−0.095	**1**

Note: The bold values in the diagonal elements represent the square root of the AVE

An evaluation of these three structural models is shown in Table IV. It can be seen that the R^2 value of OSS adoption in all models is significant. Next, the impact of control variables in the model was assessed to check whether there was a substantial increase in the explained variance in the dependent variable, by calculating the corresponding F-statistic for including additional variables into the model. Results show that the full model is superior to both the control model and the theoretical model: it explains 95.6 and 3.8 per cent more variance, respectively. In addition, both F-statistics are highly significant ($p < 0.001$). Hence, the full model offers a better explanation of OSS adoption than the theoretical model.

The finding of structural model is shown in Figure 2. The R^2 value of OSS adoption, the dependent latent variable of main theoretical concern, is 20.8 per cent. The primary evaluation criteria for the structural model are the R^2 measures and the level and significance of the path coefficients. Because the goal of the prediction-oriented PLS-SEM approach is to explain the dependent latent variables' variance, the key target constructs' level of R^2 should be high. The judgment of what R^2 level is high depends, however, on the specific research discipline (Hair *et al.*, 2011). Although R^2 results of 0.20 are considered high in disciplines such as consumer behavior, such results would be considered weak in marketing research studies (Hair *et al.*, 2011). This study of OSS adoption in IT outsourcing organizations is a form of consumer behavior research [Perner (2010) defines consumer behavior as study of individuals, groups, or organizations and the processes they use to select, secure, and dispose of products, services, experiences, or ideas to satisfy needs and the impacts that these processes have on the consumer and society]. This means that our model is able to explain a relatively high portion of the variance in the dependent variable.

The evaluation criteria for confirming each hypothesis was the use of t-values for each path loading. The cut-off criteria used was a t-value greater or equal to 1.645 for an alpha level of 0.05 (Hair *et al.*, 2010). Examination of the significance of the path

No.	Hypotheses	Full model	Theoretical model	Control model
H1	Reliability → OSS adoption	0.083*	0.076*	
H2a	License concern → OSS adoption	−0.009	−0.008	
H2b	Legal concern → OSS adoption	−0.120*	−0.119*	
H3	Software cost → OSS adoption	−0.108*	−0.104*	
H4	Management support → OSS adoption	0.240***	0.246***	
H5	IT outsourcing → OSS adoption	0.058	0.055	
H6	OSS support availability → OSS adoption	0.086*	0.082*	
H7	Software vendor → OSS adoption	0.143**	0.147**	
H8	OSS support availability → Software cost	−0.596***	−0.596***	
C1	Size of the organization → OSS adoption	−0.092*		−0.095**
	R^2 OSS adoption	0.208	0.200	0.009
	R^2 software cost	0.355	0.355	
	F	13.862	14.871	4.338
	Significance	0.000***	0.000***	0.038*
	Increase in R^2 OSS adoption		3.85 per cent	95.67 per cent

Table IV.
Evaluation of structural models

Notes: → Has impact on; significance: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

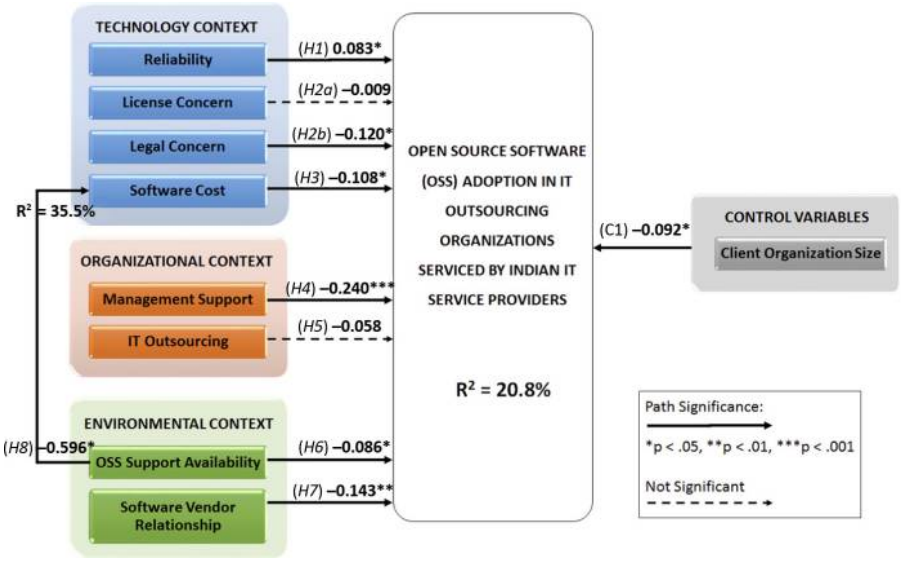

Figure 2.
PLS structural model results – full model

coefficients shows that seven of the nine hypotheses were supported. The impact of reliability (*H1*), legal concern (*H2b*), software cost (*H3*), management support (*H4*), OSS support availability (*H6*) and software vendor (*H7*) was found to be significant. *H8* explores the relationship between OSS support availability and software cost and was supported as well. The R^2-value of software cost is 35.5 per cent, which is also highly significant. The impact of license concern (*H2a*) and IT outsourcing (*H5*) on OSS adoption were not found to be significant. With respect to the control variables, the path coefficient of client organization size is negative and significant meaning that small organizations are more likely to adopt OSS.

7. Discussions

This study is one of the first to conduct a comprehensive quantitative investigation into the factors influencing the adoption of OSS in IT outsourcing organizations serviced by Indian IT services providers.

A total of 86 IT outsourcing organizations (17.8; 95 per cent CI 13-19 per cent) within the survey sample had extensive adoption of OSS. However, 320 IT outsourcing organizations (66.4; 95 per cent CI 62-71 per cent) had only sporadic adoption of OSS. In contrast, 76 IT outsourcing organizations (15.8; 95 per cent CI 14-21 per cent) did not adopt OSS at all. This states that 84.2 per cent (95 per cent CI 75-90 per cent) of IT outsourcing organization adopt OSS (either extensive or sporadic) in the study sample. This finding is in line with a Gartner study (Driver, 2012), which states that 75 per cent of IT organizations leveraged non-trivial elements of OSS in their mission-critical IT portfolios as of 2010, and this is expected to grow to 95 per cent by 2016.

The PLS analysis shows that the conceptual model explained a large proportion of the variance in the OSS adoption stage reached by IT outsourcing organizations. This suggests that the factors that were found to be significant in this model are important determinants of the adoption of OSS. Five of the factors (i.e. *reliability, legal concern, software cost,*

management support, OSS support availability and *software vendor*) were found to have an impact on the OSS adoption. In contrast, this study did not find enough evidence that *license concern* and *IT outsourcing* were a significant determinant of OSS adoption.

Reliability is a function of delivering business value. Although products leveraging OSS might be cheaper, it will not be effective unless it is perceived to be highly reliable. Missing features, scalability or performance issues can put the business at risk. Lack of reliability could be one reason, where IT outsourcing organizations have adopted OSS for less than 2 per cent of mission-critical applications in our study.

Management support in the organization was indeed found to be the most important factor in the adoption of OSS. This suggests that management team in the organization who are familiar with OSS will suggest the use of OSS when appropriate in the organization, based on their own experience. With respect to the adoption of OSS, it is possible that some section of employees does not always consider OSS as a viable alternative. However, when management team is able to demonstrate its potential, decision-makers may become convinced. Also, management support will help in providing additional investment for research, training, trial, etc., which will indirectly influence OSS adoption. A top-down mandate will force line managers/procurement managers to consider OSS alternatives in decision-making.

Another factor that was relevant to the adoption of OSS is *software cost*. Cost is an important factor in business, and lower total cost of ownership because of OSS has a direct influence on adoption. The adoption literature states that the less expensive the technology, the more likely it is that it will be adopted (Rogers, 2010). This is consistent with the observation that a high cost could be a barrier to adoption for those organizations with limited financial resources.

OSS support availability was another important factor in adoption. Lack of enterprise-level support is a major risk to business, and commercial grade support is critical to ensure adoption. Support will include both internal knowledge and external commercial grade support. Results show that OSS support availability also influenced software cost, and the findings seem to be consistent with Ven and Verelst (2011), which found that the availability of external support can help lower the switching cost from proprietary systems and, in turn, the overall software cost.

Lack of support for *license concern* reveals that organizations may have in-house experts to advice on the appropriate usage of OSS and, hence, do not see it as an inhibitor for OSS adoption. Also, the permissive licenses encourage adoption without leakage of proprietary enhancements done on top of the chosen OSS.

IT outsourcing does not have any significant impact on OSS adoption. Although some of the objectives like cost savings can be achieved through outsourcing and open-source options, this finding seems that outsourcing strategy and open-source strategy are completely different and not correlated. The possible explanation could be that IT outsourcing decisions are taken by procurement divisions of the organization, and OSS adoption decisions reside with technology units. This is consistent with the qualitative study on the adoption of OSS in IT outsourcing organizations where IT outsourcing was not found to have an impact on the OSS adoption (Ramanathan and Iyer, 2015). Also, the management support in the procurement divisions of IT outsourcing organizations may not have been high to enforce the OSS options with this outsourcing service provider. The management support within IT services providers may not be high to invest/build capabilities to propose/provide value to its clients (IT outsourcing organizations).

7.1 Research contributions

There are three key contributions in the areas of OSS adoption and IT adoption arising from this research.

The first contribution is the conceptual model (Figure 1). The conceptual model was based on the TOE framework with relevant concepts from diffusion of innovation theory, transaction economics theory and agency theory. Such conceptual models are important for many reasons including:

- conducting a structured analysis of issues relevant to an emergent research phenomenon;
- developing valid explanations of the relationships between concepts of a research phenomenon; and
- identifying most relevant issues within a complex research phenomenon (Mijinyawa, 2008).

Researchers developing the conceptual frameworks of OSS adoption (especially in outsourcing context) can benefit from extending the scope of their analysis of the literature by using valuable lessons from this model.

The second contribution is the empirical research model (Figure 2) that provides a structural definition of generalizable factors for OSS adoption in outsourcing context. This is an original contribution, and this study appears to be the first to develop an empirical theory of OSS adoption in IT outsourcing organizations serviced by Indian IT service providers. Thus, the findings contribute to bridge the gap of general paucity of studies in context of open-source in Indian IT industry.

The third contribution is the list of OSS products used by IT outsourcing organizations (Table AII). The study captured an exhaustive list of OSS products used by IT outsourcing organizations and were categorized into 12 groups based on the type of the OSS tool/application. IT service providers can use this list to identify the categories and list of key products to service their clients.

7.2 Practical implications

This study has two significant practical implications for the IT industry as well as government policymakers.

The first implication is for the IT industry. Indian IT service providers have not embraced OSS in a big way. The conceptual framework (Figure 2) can be used by them to better frame their strategies to service their clients. This model can be applied in developing an evaluation instrument for predicting the success factors influencing OSS adoption in an organization. In addition, this can serve as a reference model for IT service provider to understand the factors and their influence on the adoption of OSS within an IT outsourcing organization. IT service providers can use this research model to increase their understanding of why some IT outsourcing organizations choose to adopt OSS, whereas seemingly similar ones facing similar market conditions do not. IT service providers can establish an OSS Centre of Excellence (with *management support*) and offer "OSS as a shared service" for its clients. Leveraging the Centre of Excellence, IT service providers can offer certified OSS products (higher *reliability*) and alleviate the concerns related to *legal/license* issues. This will help to address the gaps in *support availability* and achieve reduction in total cost of the ownership of software for clients (lower *software cost*).

The second implication is for policymakers. Government of India has recently mandated every company (above specific financial strength criteria) to spend 2 per cent of the average net profits for corporate social responsibility (CSR) initiatives (KPMG, 2014). CSR rules refer to spend related to employment enhancing vocation skills. Government policymakers could consider including spend toward OSS community as part of this initiative. This would develop the skillset of freelance developers in India (*OSS training*). In addition, this would help them to contribute, earn money and, subsequently, increase employability chances (*lob creation*).

7.3 Limitations and future research

The main limitation of our research is that it is focused on global IT outsourcing organizations (clients) serviced by Indian IT services providers (vendors). Hence, we cannot safely generalize our finding to other regions. Also, the analysis is based on the view points of employees in Indian IT services providers. Views of global IT outsourcing organizations' employees could be analyzed in future and triangulated with current evidence. We decided to use the TOE framework as theoretical base. However, the use of a stronger theoretical framework could have provided a richer insight in our data. Therefore, it would be interesting for future studies to try to build on the results from this study and study the adoption of OSS using a strong theoretical foundation.

While the study encompasses OSS in general, the factors influencing adoption for specific OSS types like open-source server software (e.g. Linux), open-source desktop software (e.g. an office suite such as OpenOffice.org) or open-source enterprise software (e.g. ERP and customer relationship management [CRM] software such as SugarCRM) is likely to have a different impact. Therefore, future studies could determine whether our results are also applicable to all types of OSS.

8. Conclusion

This research addresses the organizational adoption of OSS in IT outsourcing organizations. Although OSS has received much attention in the literature, it remains unclear whether common perceptions and widely claimed advantages of OSS have an impact on the organizational adoption decision. To investigate this issue, we have developed and tested a conceptual model that describes a number of factors which were hypothesized to influence the adoption of OSS. We collected data from 482 middle and top management employees of Indian IT service companies (vendors) across 106 IT services providers to test our hypotheses. Employees were asked to respond to the survey in the context of the clients (global IT outsourcing companies) they serve. We analyzed the data using PLS to test this conceptual model. The results showed strong support for our conceptual model and the proposed hypotheses. The set of identified factors was able to account for a large portion of the variance in the adoption of OSS. Our results suggest that the adoption of OSS is driven primarily by the top-down push from management and availability of enterprise-level OSS support. Our findings suggest further that IT outsourcing strategies do not have significant impact on OSS adoption. The conceptual model developed in this study could provide a solid foundation for future studies investigating the organizational adoption of different types of OSS in outsourcing context. Thus, the present study concludes that the proposed model is recommended for the IT services organizations to understand OSS adoption in their clients (IT outsourcing organization) and can help to enhance their strategies.

Notes

1. Reversely scored item.
2. Item developed specifically for this study.
3. Item removed based on assessment of measurement model.
   Items were measured using a 5-point Likert scale.

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Appendix. Measurement items

Reliability (*RELIB*) (McKendrick, 2006; Ajila and wu, 2007):

- OSS adoption decision-making process was influenced by "Performance".
- After OSS adoption the primary benefit of its use was "Better Performance".
- With regard to achievement of "Quality goals", how would you rate the implemented OSS.
- "Security" was a main limitations in OSS adoption[3].
- OSS adoption decision-making process was influenced by "Easier Integration"[3].

License (*LICNSE*) *and legal* (*LEGAL*) *concern* (Walli *et al.*, 2005; McKendrick, 2006):

- OSS adoption decision-making process was influenced by "Licensing Options"[1].
- After OSS adoption the primary benefit of its use was "More Licensing Options"[1].
- Rate the following items in terms of the degree to which they have hindered client's organization from using and maximizing the business value in OSS adoption – "Addressing Managers' fears of legal problems"[1].

Software cost (*SWCST*) (Walli *et al.*, 2005; McKendrick, 2006; Ajila and Wu, 2007; Ven and Verelst, 2011):

- OSS adoption decision-making process was influenced by "Cost Savings"[1].
- After OSS adoption the primary benefit of its use was "Cost Savings"[1].
- With regard to achievement of "Budget goals", how would you rate the implemented OSS[1].
- What is your opinion with regard to the cost of usage of OSS on the following issues? - "Reuse of OSS helps in lowering the cost of development"[1], [3].
- What is your opinion with regard to the cost of usage of OSS on the following issues? "OSS component reuse helps in reaching the market faster, thereby increasing our profits"[1], [3].
- "Cost" factors were more important for the selection of OSS[1], [3].

Management support (*MGTSUP*) (Walli *et al.*, 2005):

- OSS use/adoption is across the entire corporation[2].
- Rate the following items in terms of the degree to which they have hindered client's organization from using and maximizing the business value in OSS adoption – "Getting the CEO/President backing".
- Rate the following items in terms of the degree to which they have hindered client's organization from using and maximizing the business value in OSS adoption – "Getting senior IT management's backing".
- Rate the following items in terms of the degree to which they have hindered client's organization from using and maximizing the business value in OSS adoption – "Getting functional manager's backing (e.g. Sales head)".
- The client adopts Top-down approach in implementing OSS[2], [3].

IT outsourcing (*ITOUTG*):

- In client's organization what per cent of IT business is outsourced globally?[2].

OSS support availability (*OSSSUP*) (Walli *et al.*, 2005; McKendrick, 2006):

- "Maintenance/support difficulty" was a main limitation in OSS adoption.
- "Enterprise support not as robust as commercial" was a main limitation in OSS adoption.
- Rate the following items in terms of the degree to which they have hindered client's organization from using and maximizing the business value in OSS adoption – "Finding internal/external resources to develop/install".
- Rate the following items in terms of the degree to which they have hindered client's organization from using and maximizing the business value in OSS adoption – "Finding internal/external resources to maintain OSS".
- Indicate your level of agreement with the following statements in terms of usability of the OSS product you are currently using in your company – "I believe that OSS is sufficiently supported by vendors/providers"[2], [3].

Software vendor (*SWVEN*) (Li *et al.*, 2005; Rentocchini and tartari, 2010):

- Indicate your level of agreement with the proposed statements w.r.t Software vendors (e.g. Service Providers, Product vendors etc.) – They play a positive role in OSS procurement decisions.
- Indicate your level of agreement with the proposed statements w.r.t Software vendors (e.g. Service Providers, Product vendors etc.) – They indicate certain OSS to supplement their product[2].
- Indicate your level of agreement with the proposed statements w.r. t Software vendors (e.g. Service Providers, Product vendors etc.) – They provide some OSS along with their product[2].
- Adopting OSS in the organization helps reduce dependence on firms producing proprietary software[3].

Survey Results – Item loadings and Cross loadings

OSS Products used by IT Outsourcing Organizations

The table below provides a list of OSS tools mentioned by the participants in survey including inputs in free text comments.

Table AI.
Item loadings and cross-loadings in PLS factor analysis

Construct	RELIB	LICNSE	LEGAL	SWCST	MGTSPT	ITOUTG	OSSSPT	SOFTVEN	OSSADP	SIZE
RELIB1	**0.884**	−0.136	−0.021	−0.245	0.109	−0.008	0.212	0.092	0.132	0.084
RELIB2	**0.907**	−0.113	0.002	−0.231	0.098	0.03	0.23	0.101	0.15	0.039
RELIB3	**0.498**	0.048	−0.07	0.017	0.146	0.016	0.05	0.046	0.083	0.04
LICNSE1	−0.128	**0.912**	−0.024	0.61	−0.135	−0.009	−0.367	−0.125	−0.126	−0.042
LICNSE2	−0.063	**0.908**	0.01	0.453	−0.145	0.012	−0.322	−0.068	−0.122	−0.028
LEGAL1	−0.028	−0.008	**1**	0.007	−0.492	0.075	−0.185	−0.114	−0.259	0.025
SWCST1	−0.169	0.575	0.01	**0.934**	−0.232	−0.026	−0.536	−0.064	−0.202	−0.018
SWCST2	−0.18	0.57	−0.001	**0.948**	−0.263	−0.033	−0.57	−0.096	−0.218	−0.075
SWCST3	−0.241	0.128	0.011	**0.383**	−0.14	−0.039	−0.261	−0.046	−0.07	−0.062
MGTSPT1	0.348	−0.224	−0.032	−0.430	**0.432**	0.067	0.379	0.106	0.244	−0.009
MGTSPT2	−0.022	−0.068	−0.496	−0.124	**0.872**	−0.079	0.214	0.141	0.302	−0.085
MGTSPT3	0.076	−0.063	−0.524	−0.141	**0.858**	−0.058	0.313	0.143	0.308	−0.032
MGTSPT4	0.079	−0.142	−0.402	−0.19	**0.868**	−0.032	0.264	0.164	0.301	0.012
ITOUTG1	0.016	0.002	0.075	−0.038	−0.039	**1**	0.068	−0.005	0.042	0.032
OSSSPT1	0.219	−0.428	0.013	−0.634	0.208	0.057	**0.857**	0.122	0.159	0.062
OSSSPT2	0.088	−0.084	−0.307	−0.192	0.346	0.061	**0.601**	0.181	0.244	−0.036
OSSSPT3	0.102	−0.044	−0.422	−0.121	0.416	0.01	**0.530**	0.134	0.174	−0.002
SOFTVEN1	0.097	−0.068	−0.092	−0.057	0.128	0.045	0.162	**0.828**	0.206	−0.001
SOFTVEN2	0.076	−0.091	−0.077	−0.039	0.119	−0.023	0.152	**0.892**	0.168	−0.052
SOFTVEN3	0.091	−0.112	−0.117	−0.124	0.207	−0.04	0.158	**0.813**	0.195	−0.047
OSSADP	0.159	−0.136	−0.259	−0.22	0.376	0.042	0.247	0.227	**1**	−0.095
SIZE	0.069	−0.038	0.025	−0.06	−0.038	0.032	0.037	−0.038	−0.095	**1**

Note: Bold means that in that row that is the highest value

Category	OSS name
Development tools/frameworks	Maven, Spring, SVN, JIRA, Bugzilla, Eclipse, jQueryVS, Android SDK, Findbugs, gSOAP, mono, NetBeans, Subversion, Hudson, Trac, GNU compiler, Qt, EXT JS, PuTTY, Apache Jersey, JQGrid, Apache Struts, UML Pad, Apache cocoon, Jenkins, Struts, JBoss Rich Faces
Operating systems	Variants of Linux (Red Hat, Ubuntu, SUSE, Fedora)
Infrastructural and servers	Apache (including Apache Axis, Apache Axis Server, Apache HTTP Server, Apache Tomcat), Glassfish, Hyperic HQ, JBoss, Jetty, Log4net, Quartz, Tapestry
Database components/servers	MySQL, Hibernate, PostGre SQL, MongoDBassandra, Hadoop
Testing tool	Selenium, SOAP UI, Jmeter, TestLink, Cobertura, Apache J Meter, WSTS, Load Storm
Networking and monitoring	Grim Read, Hadoop, Nagios, Sysinternal, WebNMS, Zenoss, netSNMP
Desktop and office productivity	Notepad++, Open office, Chrome, PSPad, Mozilla
Middleware	JBoss Drools, Fuse, JBoss BPM, Mule, SugarCRM
Reporting/analysis	Pentaho, BIRT, Jaspersoft
Content management	Drupal CMS, OpenCMS
Security	Cryptophane, KeePaas DB
Others	Talend, Asterisk, ChangeMan DS, Free Radius, Wink, True Zip, FileZilla, WinScp, Blender, AutoMapper, 7-Zip, Ruby on Rails, Wireshark, Ninject

Table AII.
List of OSS products used by IT outsourcing organizations

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