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Barriers to Open Source ERP Adoption in South Africa

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ABSTRACT

Organizations in South Africa (SA) and other economically developing countries are not maximizing the use of Enterprise Resource Planning (ERP) Systems. While the costs associated with an ERP system implementation have always been a major factor to many organizations, Open Source Software (OSS) ERP systems are available offering the benefits of an ERP system at a reduced cost to organizations. This paper investigates the adoption factors of Open Source Software Enterprise Resource Planning Systems in economically developing countries by focusing on South African organizations. Using online surveys and a focus group discussion, this empirical study found that knowledge barriers, the lack of sizable providers (or vendors), and ironically low costs, are the adoption barriers that apply to OSS ERP systems for South African organizations. The research further suggests that many of the adoption barriers traditionally associated with OSS might be inherent to all software. The possibility of low costs being a barrier is a novel idea that was identified in this research, and further research to explore this idea is suggested. Understanding the dynamics of the market requirements is crucial for OSS ERP vendors to be able to develop effective strategies. OSS ERP vendors and OSS vendors in general can use this study as a starting point to question some traditionally held notions regarding the OSS business model.

Keywords: Adoption barriers, ERP, open source software, South Africa

INTRODUCTION

Information systems (ISs) are tools that aid companies in maintaining a competitive edge in this era of globalization. However, the absence of integrated information systems such as Enterprise Resource Planning (ERP) systems is a limiting factor for most organizations to compete globally (Bhagwat & Sharma, 2007). According to Madapusi and D'Souza (2005), information management is a particularly powerful driver of business performance in an international market where globalization is changing the rules of the game. As such, large multinational enterprises have increasingly invested in ERP systems to address the information requirements needed to be competitive in an increasingly globalized environment (Madapusi & D'Souza, 2012). ERP Systems were ranked the third (3rd) most important information technology (IT) application in the 2009 and 2010 Society for Information Management (SIM) membership survey, moving from the 14th position in 2008 (Luftman & Zadeh, 2011). This development was due to cost reductions associated with ERP systems through automation, given that business productivity and cost reduction were the biggest management concerns (Koh, Gunasekaran & Cooper, 2009; Luftman & Zadeh, 2011; Madapusi & D'Souza, 2012). ERP systems can potentially impact costs by reducing inventory levels, decreasinglead times, increasing productivity, facilitating corporate communication, improving information and decision-making capabilities, and improving customer service. Furthermore, intra-firm ERP systems enable firms to standardize, integrate, and streamline their data and process flows (Koh, Gunasekaran & Cooper, 2009; Madapusi & D'Souza, 2012). There is a high emphasis placed on ERP systems as a means to increase business productivity and reduce costs in order to be more competitive in a global business environment (Luftman & Zadeh, 2011).

Most research undertaken with regard to ERP systems and Open Source Software (OSS) has been for developed economies, and there is a paucity of evidence on whether there are any differences in open source ERP systems adoption by SMEs in economically developed and developing countries (Johansson & Sudzina, 2008). According to Johansson and Sudzina (2008), it is evident that organizations in South Africa (SA) and other economically developing countries are not maximizing the use of ERP Systems due to financial and other constraints. Despite the fact that the costs associated with an ERP system implementation have always been a major barrier to many organizations (Madapusi & D'Souza, 2005), Open Source Software (OSS) ERP systems offer the same benefits of proprietary ERP systems at a reduced cost (Ellis & Van Belle, 2009). This paper investigates the adoption barriers of Open Source Software Enterprise Resource Planning Systems in South African organizations, from whose findings may be generalized in economically developing countries.

This study intends to provide further insight into ICT professionals and academia via the adoption barriers of OSS ERP systems for economically developing countries. The main research question of the study was, "*What are the barriers to adopting Open Source Software Enterprise Resource Planning Systems for South African Organisations?*" Using the constructs from Technology-Organisation-Environment (TOE), Technology Acceptance Model (TAM) and Social Identification Theory (SIT), the barriers to adoption of OSS were investigated as well as whether these barriers are different for South African organizations, and if the barriers identified for OSS are also applicable to OSS ERP systems in South Africa; and if so, to what extent remains to be seen. For the purpose of the study, it was assumed that OSS and proprietary ERP systems offer similar functionalities. The findings from the study may enable for-profit and volunteer OSS development organizations to improve their offerings and software dissemination.

LITERATURE REVIEW

This section discusses literature from high ranking journals, published in English from the year 2000 onwards.

Open Source Software (OSS)

OSS is defined as software that is freely available and grants the rights to read, use, modify and distribute the source code for the software under the same conditions, without being discriminatory in any way (Rose, Johnston & Van Belle, 2006). OSS applications offer multiple areas of potential technological superiority including high quality, security, reliability, flexibility, stability, low acquisition cost, no vendor lock-ins, and regular upgrades (Gwebu & Wang, 2011; Mutula & Kalaote, 2010; Nagy, Yassin & Bhattacherjee, 2010; Zaffar, Kumar & Zhao, 2011). In addition, the longitudinal benefit of OSS is that it helps develop an internal knowledge base and skills set that reduce reliance on foreign software and services, resulting in cost savings on purchase and maintenance of software and creating IT jobs (Miscione & Johnston, 2010; Mutula & Kalaote, 2010).

Studies have shown that there has been an increase in the interest shown in OSS, both in the private as well as public sectors (Ellis & Van Belle, 2009; Nagy, Yassin & Bhattacherjee, 2010; Zaffar, Kumar & Zhao, 2011). The South African Government made a decision to use OSS in 2001 (Miscione & Johnston, 2010). In 2003, the South African Government became the first African country to develop a policy document which encouraged all government departments to fully support the adoption of OSS. However, limited OSS usage was found within South African Government departments (Ellis & Van Belle, 2009; Miscione & Johnston, 2010). This may be due to political influences and the risks associated with the scale and complexity of large government organizations (Johnston & Seymour, 2005). Camara and Fonseca (2007) asserted that governments in economically developing countries had a relatively conservative attitide towards risk and considered it less risky to stay with proprietary products as opposed to building or customizing OSS applications.

Albeit cost benefit being the most popular reason for OSS adoption, strategic factors as well as the barriers for OSS adoption are equally significant for OSS implementation and deployment (Johnston & Seymour, 2005; Nagy, Yassin & Bhattacherjee, 2010; Subramanyam & Xia, 2008; Watson et al., 2008). The OSS adoption barriers include: lack of awareness, resistance to change within IT, cost, a user friendly and standardized product, competition from proprietary software vendors, training and skills availability, and after sales service and support (Johnston & Seymour, 2005). Additionally, a lack of knowledge and exposure to OSS, the paucity of technical staff skilled in OSS, and OSS compatibility with the existing ICT infrastructure and legacy applications of an organization are some of the OSS adoption barriers amongst South African organizations(Ellis & Van Belle, 2009). However, "software and license costs were identified as the major technological inhibitor to the adoption of emerging technologies in organizations in economically developing countries" (Ogunyemi & Johnston, 2012).

OSS Enterprise Resource Planning (ERP) Systems

An ERP is an integrated software package composed of a set of standard functional models including but not limited to: production, sales, human resources, and finance (Koh, Gunasekaran & Cooper, 2009). OSS benefits are greater for ERP systems than for any other kind of applications due to increased adaptability, decreased reliance on a single supplier, and reduced costs (Serrano & Sarriei, 2006). Full access to the source code is of benefit when implementing an OSS ERP when the ERP needs to be

adapted to business processes and local regulations, and it reduces reliance on proprietary product builders and distributors. License and implementation costs for ERPs can be exorbitant. The cost of ERP implementations is estimated between one and six percent of a firm's revenue and this has always been a major barrier to SME companies (Madapusi & D'Souza, 2005; Nagy, Yassin & Bhattacherjee, 2010). OSS is thought to improve cost effectiveness (Ogunyemi & Johnston, 2012), however Johansson and Sudzina (2008) found that costs have a secondary role in the adoption decision making of open source ERPs in spite of the high level of attention the cost perspective receives.

Despite the stated advantages of OSS, an apparent increase in the adoption rate of OSS ERP systems, and the high costs of proprietary ERP systems, the adoption of OSS applications has been relatively limited in general (Gwebu & Wang, 2011), with an even slower uptake in South Africa (Ellis & Van Belle, 2009; Madapusi & D'Souza, 2012). Contrary to OSS ERP uptake, investment in proprietary ERP systems has continued strongly on the back of proven operational improvement and streamlined data and process flows (Madapusi & D'Souza, 2005).

Serrano and Sarriegi (2006) claimed that OSS ERP applications are different from other OSS applications. This leads to the question of whether the barriers to adopting Open Source Software Enterprise Resource Planning Systems are different from those that apply to OSS software in general. Johansson and Sudzina (2008), to a large extent, provided counter arguments for the OSS ERP benefits suggested by Serrano and Sarriegi (2006). This in turn leads to the research question: What are the barriers to adoption of ERP systems by organizations in South Africa?

ERP Adoption Factors in South Africa

The criteria for selecting ERP Systems by South African organizations include vendor (and stakeholders) evaluation, functionality of the proposed ERP system, and technical aspects of the proposed ERP system (das Neves, Fenn & Sulcas, 2004). das Neves et al. (2004) further observed that the total cost of ownership was not an important criterion and that the need to implement an ERP system was based on strategic grounds. In addition, customization of the source code frequently caused problems, and as such it is best to select a system with most or all of the required functionality, since there is a lack of both skills and technical support from most vendors (das Neves, Fenn & Sulcas, 2004). The same study showed that vendors have minimal influence on the adoption decision in a direct capacity, as the selection is often made prior to the vendors being approached (das Neves, Fenn & Sulcas, 2004). This raises questions as to whether the adoption barriers for OSS ERP systems are materially different from those faced by proprietary ERP systems.

THEORETICAL FRAMEWORK

For a technology to be adopted there needs to be approval by the possible user of the technology. Therefore, understanding what constitutes user acceptance is vital in order to study the barriers to adoption of OSS ERP systems (Ellis & Van Belle, 2009). The factors influencing user acceptance of a technology have been thoroughly researched and a number of theoretical frameworks have been developed in an attempt to explain the variables influencing the intention to use a specific technology (Venkatesh et al., 2003). The theoretical framework adopted for this study is a combination of Technology-Organization-Environment (TOE), Technology Acceptance Model (TAM), and Social Identification Theory (SIT), from which appropriate constructs as potential barriers to OSS ERP adoption were identified. These frameworks offered various variables to the mainstream adoption of

OSS; the aim was to incorporate all variables to OSS adoption into a single framework which would comprehensively cover all the barriers to OSS adoption.

Technology-Organization-Environment (TOE) Framework for Technology Adoption

An organization functions along three dimensions of technology, organization, and environment (TOE), which influence the organization's ability to adopt or reject new technology (Depietro, Wiarda & Fleischer. M., 1990). The Technology-Organizational-Environment (TOE) framework has been used to understand how organizations adopt technology for many years (Morgan & Finnegan, 2007).

The Technology dimension includes the factors of cost, reliability, compatibility, complexity, and performance expectancy. Human and financial resources, innovativeness, and competitiveness are factors in the Organizational dimension. The Environment dimension encompasses the factors of industry, competition, government, suppliers, and customers (Dedrick & West, 2003; Ellis & Van Belle, 2009; Miscione & Johnston, 2010). These factors may negatively or positively influence the decision to adopt a technological innovation. Dedrick and West (2003; 2004) adapted the TOE framework from the original framework of De Pietro, Wiarda and Fleischer (1990) to specifically focus on OSS adoption.

The TOE framework lacks focus on the individual level, but individuals influence barriers to OSS adoption based on factors such as personal rejection, personal resistance or fear, and insufficient skills or experience (Goode, 2005). Cultural issues such as uncertainty avoidance, power distance, and individualism can also affect OSS adoption (Qu, Yang & Wang, 2011). This emphasizes the need for the individual to be considered.

Technology Acceptance Model (TAM)

There is a possible discrepancy between individual technology adoption and organizational technology adoption (Venkatesh et al., 2003). It is evident that individuals' perceptions of a software system influence their adoption and usage decisions (Gwebu & Wang, 2010). As decisions are ultimately made by individuals, the end user perception of technology is potentially significant (Johansson & Sudzina, 2008). Gallego, Luna and Bueno (2008) developed a model for user acceptance of OSS applications based on the technology acceptance model (TAM) of Davis (1989). The TAM advocates that two behavioral constructs: perceived usefulness (PU) and perceived ease of use (PEOU), determine the intention of an individual to use a specific technology and the subsequent usage behavior of the technology (Gwebu & Wang, 2011), and are included under "Individual" in Table 1.

Social Identification Theory (SIT)

Gwebu and Wang (2010) felt it important to understand OSS adoption from an individual's perspective. TAM has some shortcomings when it is applied to OSS compared to proprietery software, which it was originally designed for (Gwebu & Wang, 2011). One difference is that OSS adoption is voluntary, and not influenced by subjective norm pressure but rather the OSS communal nature. As such, Gwebu and Wang (2011) argued that social theories that encompass the effect of the community on OSS adoption be incorporated into a model. Therefore drawing from the Social Identity Theory (SIT) and TAM, Gwebu and Wang (2011) developed a model for OSS acceptance advocating that behavioral intention to adopt is a key variable in determining future behavior and is a function of social identification (SI), personal innovativeness in IT (PIIT), perceived usefulness (PU), and perceived ease of use (PEOU) (Gwebu & Wang, 2011).

Adoption factors for OSS Based on TOE, TAM and SIT

Most studies have used the TOE, TAM, and SIT irrespectively in OSS adoption research for both economically developed and developing countries. Appendix A summarizes the findings of some previous studies on the adoption factors of OSS with the focus on relevant constructs to this study:

RESEARCH METHODOLOGY

The aim of this study was to determine the adoption barriers of OSS ERP in a economically developing country context, using South African organizations. Various studies on enablers and barriers to OSS adoption exist, yielding theories on factors affecting OSS adoption, and the formulation of propositions to analyse the causal effects (e.g. Gwebu & Wang, 2011; Ellis & Van Belle, 2009). The focus for these theories and literature has been on OSS adoption in general, but there is a dearth of literature on OSS ERP adoption in particular. Furthermore, this research investigates OSS barriers in a new context in an attempt to unearth new understandings of the barriers associated with OSS ERP in economically developing countries, South Africa in particular. Consequently, the study used deductive and inductive methods to test the constructs of existing theories in this new context and add to the existing body of theory through critical literature review and analysis of research findings (Ellis & Van Belle, 2009; Saunders, Lewis & Thornhill, 2009). The empirical data for the study was collected in November 2011.

The study engaged a mixed method (qualitative and quantitative) approach to incorporate both inductive and deductive approaches in the theory development of OSS ERP adoption; the Inhibitor Determination Methodology (IDM) was used (Debreceny et al., 2003). The IDM research method is multi-stage and multi-method and was derived from technology adoption studies (Chwelos, Benbasat & Dexter, 2001; Iacovou, Benbasat & Dexter, 1995) by Debreceny et al (2003) to uncover inhibiting adoption factors in complex and unstable environments with so many actors like the ERP environment. The IDM model has four (4) phases as shown in Figure 1:
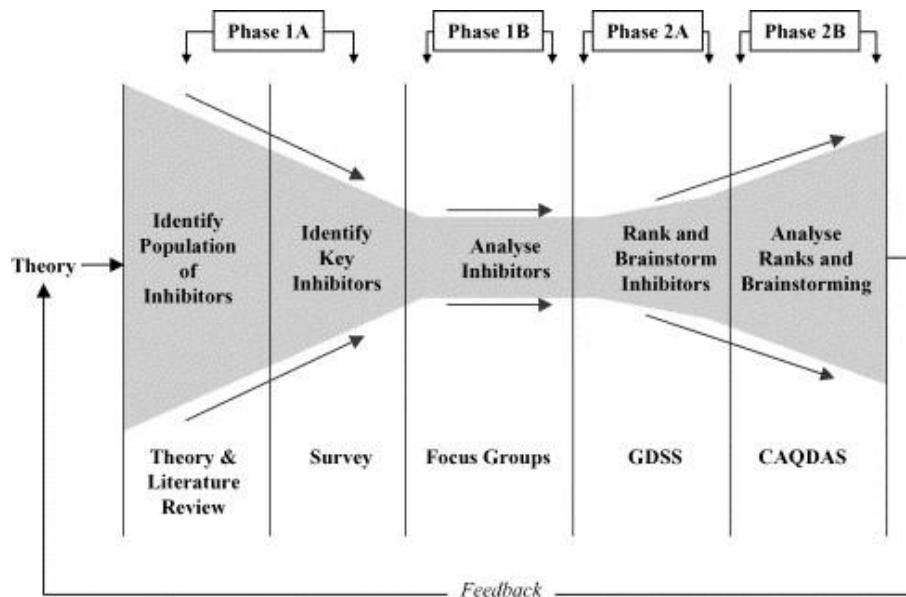

Figure 1: Research design—Inhibitor Determination Methodology (IDM) (Debreceny et al., 2003)

Phase 1A: Identify the population of inhibitor factors through a literature review and questionnaire survey.

Phase 1B: Focus groups of relevant practitioners and decision-makers rank and analyze the key inhibitors identified in Phase 1A.

Phase 2A: Group Decision Support Systems (GDSS) - facilitated groups of IS practitioners and decision makers ranked the factors associated with each prime inhibitor identified in Phase 1.

Phase 2B: The same GDSS groups commented through synchronous topic discussion on the highly ranked factors identified in Phase 2A.

In this study potential inhibitors were identified from the literature after reference to the theoretical and current professional literature. Data for the study was gathered through an online survey using a researcher-designed questionnaire with the concepts from the literature review. The data from the online survey was further ranked in focus group discussion by knowledgeable stakeholders such as senior managers in IS firms. For the online survey, each factor in the Likert Scale questions was analyzed separately and in some cases item responses were combined to create a score for the group of items. The Likert Scale data was ordinal as it was categorized into four groups; Strongly Disagree = 1, Disagree = 2, Agree = 3, and Strongly Agree = 4. The survey data was further simplified by combining the four response categories into two nominal categories: agree and disagree. Thematic analysis was used for the open ended questions data, and the Delphi method was used to analyse the data from the focus group discussion resulting in a final list of barriers in a ranked format. The arguments formulated by the participants around the position and validity of the respective adoption barriers were recorded and formed part of the findings.

The sample of respondents was selected from MBA alumni of the University of Cape Town's Graduate School of Business, and secondly relevant individuals in the researcher's network. This helped to focus on individuals that were either professionals and/or decision makers within South African organizations. For focus group discussions, participants were selected based on their understanding of the South African ICT, OSS and ERP landscape and understanding of the needs of the end consumers of ERP systems. The focus group comprised two senior managers in IS firms, two CIO's of large commercial organizations, and two consultants of proprietary ERP systems.

In the literature review, 22 constructs were identified as potential adoption barriers and some were reworded for the context of ERP OSS adoption. These were grouped under four dimensions, namely, Technology, Organization, Environment, and Individual; and were used to design the questionnaire for the online survey as listed in Appendix B.

RESEARCH FINDINGS AND ANALYSIS

There were 158 survey respondents from a broad spectrum of industries ranging from agriculture, auto industry, mining, retail, financial services, to manufacturing. The coefficient of the correlation between the numbers of respondents for the respective industries was 0.9268. An unpaired t-test on the industry variables showed that the respondents were a good approximation for the industries represented, as the P-values were greater than the chosen significance level of 0.05. The organizations represented were

generally mature organizations, with 91% older than 5 years. Large organizations were more prevalent in the sample, having more than 250 employees, and between 50 and 250 employees making up 54% and 14% of respondents respectively. Small organizations find no need for an ERP, or simply cannot afford an ERP, as was confirmed by 13 of the respondents. The bias towards medium-large organizations was not considered to be material as this appears to be the potential market for OSS ERP systems since the decision to implement such systems was mostly based on strategic needs. Accordingly, the sample was seen to be representative of South African organizations for the purpose of investigating the barriers to OSS ERP adoption.

Understanding of Open Source Software (OSS)

Sixty-six percent of the respondents were able to explain their understanding of OSS. The main descriptive characteristics identified included: availability of source code, a community of developers, reduced (or zero) costs, and fewer licensing restrictions. Half of the respondents described OSS as software that is freely available and grants the rights to read, use, modify, and distribute the source code for the software under the same conditions, without being discriminatory in any way (Rose, Johnston & Van Belle, 2006). Some half-truths were also present; these included OSS developers provide free maintenance, it is compulsory to share the source code of improvements, and that there were no licenses involved.
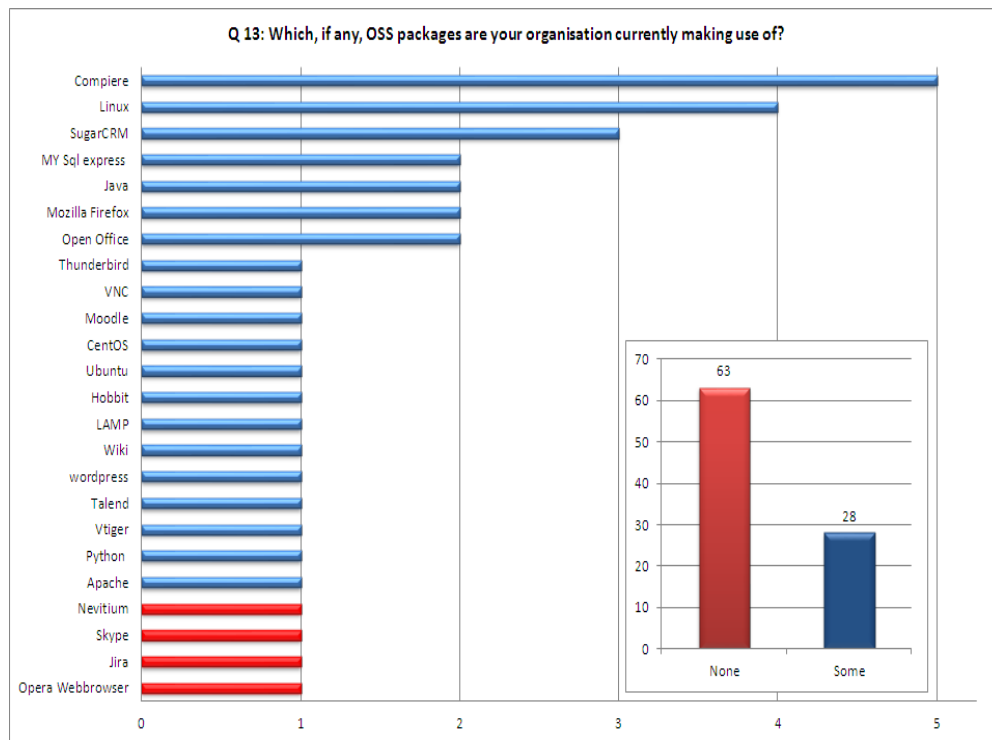

Figure 2: OSS packages being used in respondents' organization

Four respondents recognized that there are OSS vendors that offer services such as training, consultation, customization and support at a cost, and three of the respondents indicated that they associate OSS with little or no dedicated support. These findings correspond with the finding of Johnston and Seymour (2005) that training and skills availability, as well as after-sales service and support are OSS adoption barriers in South Africa. Only 28 respondents were able to list any of 37 OSS

packages used in their organizations, and 63 indicated that they were not aware of any OSS packages being used in their organizations. Figure 2 shows the OSS packages the respondents' organizations are using. The horizontal scale represents the number of times a package was mentioned. These results suggest that the organizational uptake of OSS is generally low, or alternatively contains a lack of awareness.

Enterprise Resource Planning (ERP) Systems

Thirty-three respondents indicated that their organizations did not have an ERP system, and 20 of the respondents did not know which ERP system, if any, was present at the organization they represented. The ERP systems known to the respondents and the number of times each was listed are shown in Figure 3. Products that were only listed once were consolidated under others. Compiere was the only OSS ERP package listed, with SAP and Oracle being the most prominent systems.
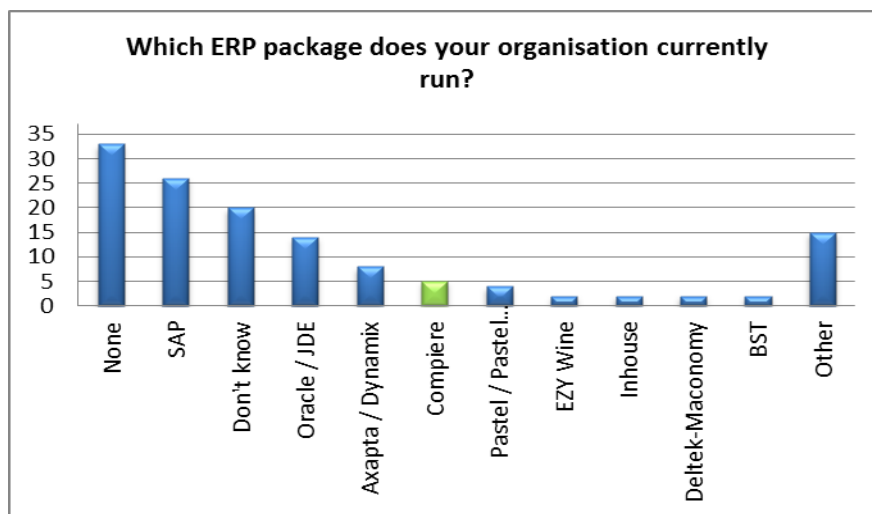

Figure 3: ERP Packages Owned by SA Organizations

When asked to list OSS ERPs they were aware of, only 23% responded, with 14 listing Compiere, 7 open Bravo, 6 OpenERP, 2 Adempiere, and 2 listing OpenTaps. There appears to be a lack of awareness of OSS ERP systems; this is similar to the observation made regarding OSS in general. It is interesting to note that open Bravo and Adempiere forked off of Compiere, and these three products were listed 23 times, compared to the next highest OSS ERP (OpenERP), which was listed 6 times.

The general perception was that OSS ERP packages are at the same quality levels as proprietary ERP systems. Only 16% of the respondents indicated that they perceived OSS ERP systems to be of inferior quality to proprietary ERP systems. Several authors support the perception of high quality of OSS systems (Gwebu & Wang, 2011; Mutula & Kalaote, 2010; Nagy, Yassin & Bhattacherjee, 2010; Zaffar, Kumar & Zhao, 2011).

Analysis of OSS ERP Adoption Barriers

The barriers to adoption of OSS can be analyzed based on the TOE framework and the individual factors to determine the factors contributing to rejection rather than adoption.

Technology

Sunk costs (S5), Reliability (S6), Compatibility in terms of employee skills levels (S9), and Lack of Technical knowledge (S13) stood out in Figure 4, which is rating the adoption barriers, as indicating potential barriers. The data suggests that quality (S7), software compatibility (S8), Bias (S11), and complexity (S12) can be dismissed as barriers because of their low rating.
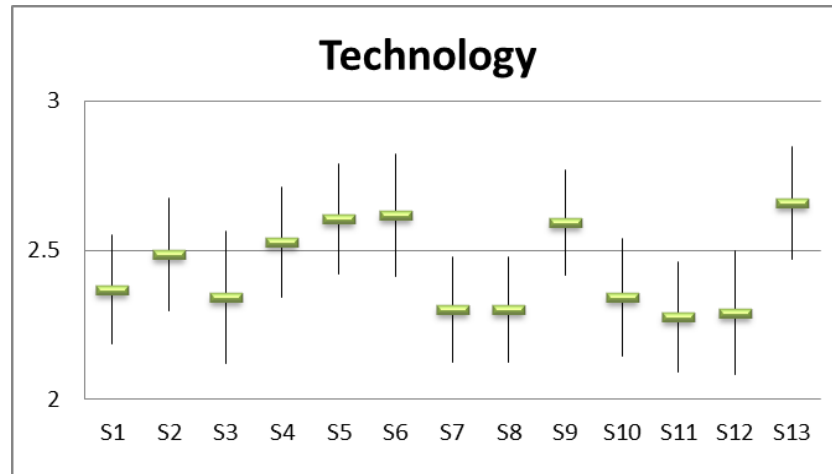

Figure 4: Average ratings for technology adoption barriers

On Total Cost of Ownership (TCO) (S1-S5), the respondents did not see costs as a major barrier. Sixty one percent of respondents disagreed that support costs (S1) were a barrier to adoption, and switching costs (S2 and S3) were found to be a potential barrier according to 53% of the respondents. Most of respondents (54%) disagreed that it is much more cost effective in the long run to maintain an OSS ERP package (S4). Over 60% of respondents indicated that their organizations will not implement an OSS ERP system due to sunk costs (S5). The members of the focus group initially ranked sunk cost from the second most influential barrier to the least. It was agreed that sunk cost is not a barrier to OSS ERP adoption only, but that it was a generic adoption barrier, not OSS specific.

Contrary to the literature that found reliability as not having such a big impact on the adoption decision (Ellis & Van Belle, 2009; Miscione & Johnston, 2010), there was a 56% agreement on reliability and security capabilities of OSS ERP (S6). Findings on quality (S7) do not support those for reliability. Nearly 63% disagreed to some extent that they will "*not implement an OSS ERP because we perceive its performance to be weak relative to proprietary alternatives*". Quality was also not raised as a concern by any of the respondents in the open ended question. While the findings and the literature seem to disagree for OSS in general, there appears to be agreement that reliability (S6) is an OSS ERP adoption barrier.

About 52% respondents agreed that compatibility was a barrier. This was, however, not due to inter software or legacy system compatibility (S8 and S10) but rather compatibility with the skills set (S9) in the organization. Less than 6% of respondents indicated a lack of skills or compatibility in the open ended question. The findings are in contrast with the literature that compatibility with current applications is a major concern in the adoption decision (Dedrick & West, 2003; Qu, Yang & Wang, 2011). This could be due to ERP systems being more internally focused and documents that are produced, e.g. invoices and reports, not needing editing by external parties.

Nearly 26% of respondents expressed some form of bias (S11) as an adoption barrier in their organizations in the open ended question. This related to the skill sets of the people in the organization and/or more well-known products that were seen as the industry standard. A total of 57% of respondents, however, disagree that applications provided by Microsoft, Oracle, SAP and Apple are much better than any of the OSS packages. The agreement was that bias as an adoption barrier is not necessarily specific to OSS ERP systems.

Complexity (S12) was not seen as an adoption barrier to OSS ERP systems by over 58% of respondents. This is in contrast Ellis et al's (2009) and Johnston et al's (2005) findings that the perception in South Africa is that OSS is complex and problematic to deploy. In general, ERP systems are complex, difficult, and time consuming to implement (S13). As such there is no particular difference between OSS and proprietary ERP systems.

One respondent indicated that the relatively low cost of OSS ERP systems could lead to organizations questioning the overall quality of the product. In the focus group discussion it was argued that the impact was related to the perception of quality and legitimacy of the product and also the opportunities released by additional capital for developing infrastructure and creating brand awareness through marketing. One group member summed up the forum discussion as follows:

> *"This really sums up the challenge of any OSS solution- End user's need to be aware of the solution, the availability, the track record, etc. and the vendor needs strong local partners to implement. This has been covered well in the infrastructure space with the likes of companies like Red Hat and Red Hat's many partners in the country. As one goes higher up the stack, this starts to change, and ERP is very high up the stack."*

Organization

The organizational dimension appeared to have much more of an underlying impact on the adoption barriers than the technology, as can be seen in Figure 5. IT capital Budget and lack of well-known OSS ERP brands on the market (S14 and S16) were the only factors that appeared not to be adoption barriers. The other organizational factors, IT staff time (S15), Innovativeness of the organization (S17) and Worker experience with new platform (S18-S21) were all leaning towards indicating potential barriers.

Similar to the literature, the available budget (S14) was not that relevant to the adoption decision, but the available time was a factor impacting the adoption decision (Miscione & Johnston, 2010). Only 9% of the respondents referred to cost as an adoption barrier factor. This affirms that the need to implement an ERP system was based on strategic grounds, which diminished the importance of TCO as a criterion (das Neves, Fenn & Sulcas, 2004). A total of 58% found that the skill levels and required time (S15) available in their organization are too little for an OSS ERP implementation. Time was also a factor when acquiring a proprietary ERP system.

The majority, 51.31%, of respondents disagreed that their organizations "*will not implement any OSS ERP because there are no well-known brands in the market*" (S16). Nearly 77% of respondents indicated that their organizations prefer to select tried and tested IT solutions (S17) when implementing new technology. Given that the mode was "Agree" for both statements, it appears that innovativeness of South African organizations is a barrier to adoption. A total of 18% of respondents indicated the conservative nature of their organizations as an adoption barrier in the open-ended question. This concurs with the literature that found the attitude of organizations in economically developing countries

as relatively conservative towards risk (Câmara & Fonseca, 2007). These organizations considered it less risky to stay with proprietary products.
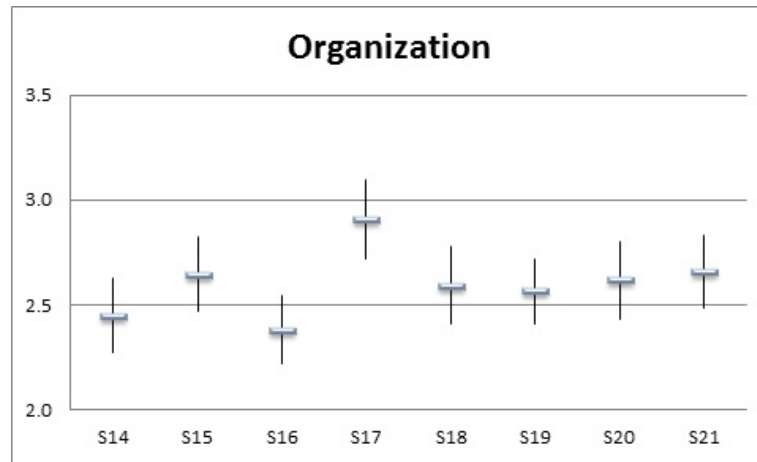

Figure 5: Average ratings for organizational adoption barriers

The survey indicated that there was a lack of boundary spanners in South African organizations. All four of the statements (S18-S21) relating to boundary spanners had "Agree" as a mode. Just over 11% of respondents indicated factors relating to boundary spanners as an adoption barrier in the open-ended question. It was found that the lack of boundary spanners definitely served as an adoption barrier for OSS ERP systems in South Africa. The biggest impact of boundary spanners was on the lack of awareness; this was also ranked as the most influential adoption barrier to OSS ERP systems in South Africa by the focus group.

Environment

The environmental dimension had factors with the strongest feedback in terms of a specific adoption barrier in the form of Support Infrastructure (S22 and S23) as illustrated in Figure 6. The others, Availability of Skilled IT Workers (S24) and Availability of External Support Services (S25 and S26) appeared to be potential barriers. Legitimacy or the long-term viability of OSS ERP platforms (S27) was the only factor that that appeared not to be an adoption barrier.

After sales support was seen as very important when deciding to implement any new technology by 51% of respondents who "Strongly Agreed" with the statement (S22). The fact that 58% of respondents were not aware of any OSS ERP providers in their area (S23) would suggest that the support infrastructure was an adoption barrier. Even though it was not by a great margin, the majority of respondents did find the OSS ERP online community as a "great" alternative to the traditional support models (S24). A lack of knowledge of partners (service provider or vendors) and the consequent lack of support was the reason given by the most respondents, 35 %, when asked why their organization would not adopt an OSS ERP system. As such, support infrastructure is an adoption barrier.

The focus group agreed that the lack of knowledge of partners is an adoption barrier and ranked it as the second most influential. The consensus was that the number of providers both in a particular area as well as across the country was more important than the size of the OSS ERP providers. Nearly 79% of

respondents agreed with the statement (S25) that if "*there are large enough vendors for an OSS ERP that can support the system [they] will consider the system on par with any other solution.*" For both of the statements (S25 and S26) the modes of the respondents' feedback were "Agree". However, there was a 50/50 split between the respondents that agreed that they are not that concerned with the level of customization and that the package must just be good enough to start out with, and those that did not agree. The availability of external support services was found to be an adoption barrier.
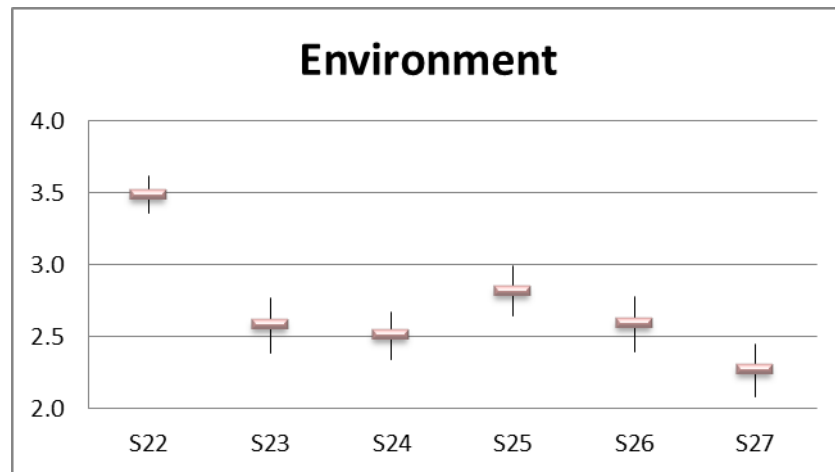

Figure 6: Average ratings for environmental adoption barriers

The long-term viability of OSS ERP platforms was not seen as a major adoption barrier as 63% of respondents "Disagreed" or "Strongly disagreed" with the statement (S27) that they "*do not perceive an OSS ERP solution to be viable in the long-term*". In addition, approximately 7% of respondents expressed some form of concern relating to legitimacy in the open ended question regarding OSS ERP adoption barriers. Furthermore, a complete lack of product awareness was found amongst South African organizations. Only 23% of respondents could name any OSS ERP system available. Slightly contradictory to this was that 42% disagreed with the statement (S23) that they were not aware of any OSS ERP providers in their area. This could potentially be attributed to the fact that there were 34 proprietary systems listed amongst the responses when respondents were asked which OSS ERP packages they were aware of which in itself indicates a lack of product awareness.

Individual

In general, the individual adoption factors (S28 to S36) of the respondents leaned towards the negative side, and this manifested in a potentially low adoption propensity towards OSS (S36) as indicated by the red marker in Figure 7. The correlation between PEOU and the intention to adopt OSS was not so strong. Both of the modes for the two statements (S28 & S29) associated with PU were "Disagree". On average, 59% of respondents did not perceive that OSS will give them greater control of their work or make them more productive. The coefficient of correlation between PU and the indication of the intended use of OSS in the next six (6) month was also very low at 0.08. Respondents were relatively split over the PEOU with just 51% of respondents perceiving OSS relatively easy to use (S30 & S31). The modes for the two statements associated with PEOU were also split between "Disagree" and "Agree." The coefficient of correlation between PEOU and the indication of the intended use of OSS in the next six (6) month was 0.3580.

Just over 60% of respondents showed a lesser degree of PIIT. The modes for the two statements associated with PIIT were both "Disagree" (S32 & S33). The coefficient of correlation between PIIT and the indication of the intended use of OSS in the next six (6) month was 0.3167. Given a sample N > 50, this was seen to be significant. Thus the relationship between PIIT and the intention to adopt OSS was not as strong as was suggested by Gwebu and Wang (2011). The majority, 67.11%, of the group of respondents, did not identify strongly at a social level with the Open Source community (S34 & S35). The modes for the two statements associated with Social Identification (SI) were both "Disagree." The coefficient of correlation between SI and the indication of the intended use of OSS in the next six (6) month was 0.6137, resulting in strong connection between SI and the intention to adopt OSS. The overall intention of respondents to use OSS software in the next six (6) months was only 37% (S36); behavioral intention to adopt is a key variable in determining future behavior around OSS adoption (Gwebu & Wang, 2011).
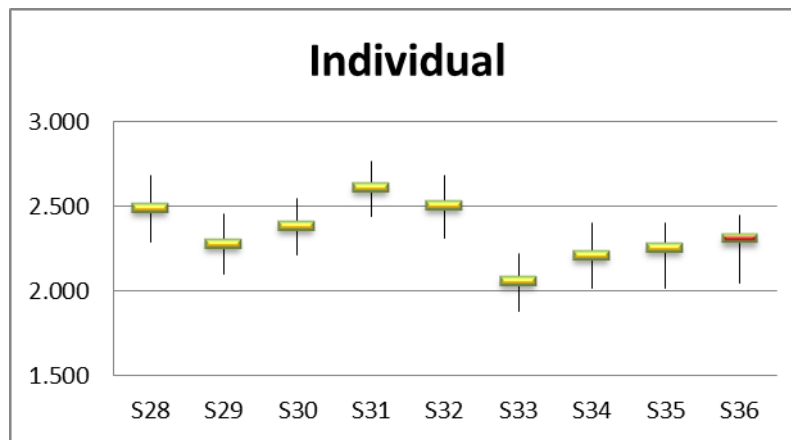

Figure 7: Average ratings for individual adoption barriers

There was only one adoption barrier found while analyzing the general responses as to why South African organizations will not adopt an OSS ERP system that was not found in the literature. The respondent indicated that the relatively low cost of OSS ERP syystems could lead to organizations questioning the overall quality of the product. It was only mentioned by one respondent, but it was felt that it was worth investigating further in the focus group.

Ranking of the Adoption Barriers

The various potential adoption barriers were initially grouped under eight topics and sent to the focus group. The eight topics were Knowledge Barriers, Sunk Costs, The Individuals' Perceptions of OSS ERP Systems, Lack of Support, Low Costs, Lack of Sizable Providers, Lack of Brand Equity, and The Fact that it is OSS as seen in Figure 8. These adoption barriers were ranked according to their impact or significance as adoption barriers as presented in Figure 8.

A consensus was reached by the focus group after two rounds, and the rankings can be seen in Figure 8. The only difference between the second and third rounds was that the Lack of Brand Equity tied with Knowledge Barriers for first place.
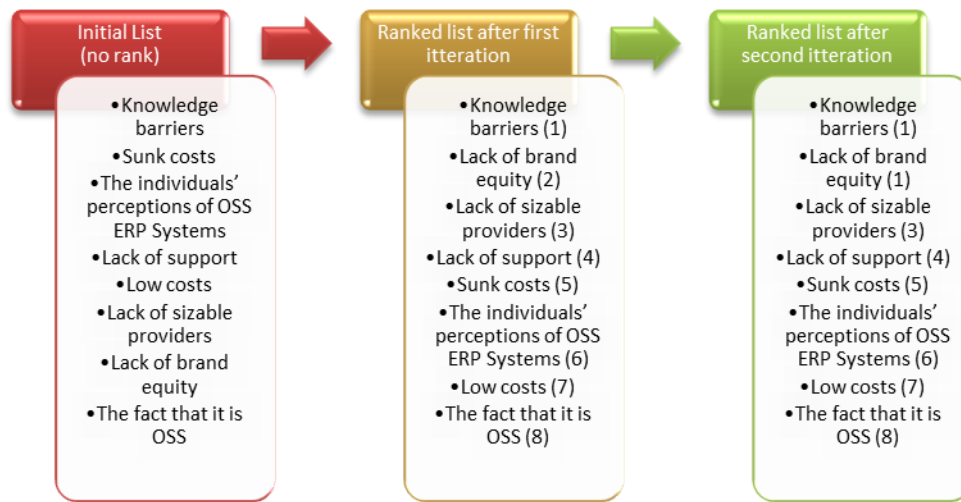
Figure 8: Adoption Barrier Ranking process of Focus Group using Delphi method

DISCUSSION AND CONCLUSION

The study investigated the adoption barriers of OSS ERP Systems for economically developing countries by focusing on the barriers for South African organizations. Using the adapted TOE framework with an individual dimension added to it, the study identified the following constructs as OSS ERP adoption barriers for SA organizations: The Innovativeness of the Organization, Boundary Spanners, Support Infrastructure, Availability of External Support Services, and Product Awareness. These constructs and their underlying factors were reformulated into two main barriers: Knowledge Barriers and Lack of Sizable Providers. Low Costs emerged as a third unexplored potential adoption barrier. The constructs relating to cost, i.e., TCO were not regarded as an adoption barrier for OSS. Generally, the OSS adoption barriers identified for SA are similar to those of economically developing countries in literature. The differences observed were that reliability was not regarded as an adoption barrier in South Africa, and no reference to sunk costs was found relating to OSS adoption in SA. However, a few respondents did make mention of sunk costs as an adoption barrier in the survey.

None of the technical adoption barriers specific to OSS were found to be applicable to OSS ERP. This was attributed to customization and the associated challenges being standard practice with most ERP implementations. Compatibility was also discounted due to the fact that ERP systems are mostly internally focused in an organization. Complexity was also seen as a quality of any ERP implementation rather than specific to OSS ERP systems. An insightful conclusion drawn from the research emanated around the concept of Sunk Costs. It was found that while Sunk Cost was a definite adoption barrier, it related to all ERP systems and not just OSS ERP systems. This principle was found to apply to a number of other constructs, such as the Human Resource factors, which are not regarded as an adoption barrier specific to OSS ERP systems in SA, but to OSS in general.

The environmental factors findings showed that legitimacy was not an adoption barrier for OSS ERP systems in contrast with legitimacy being an adoption barrier to OSS in SA in general. The individual dimension revealed very little correlation between the respective constructs and a propensity to adopt

OSS. The only construct that was found to have significant correlation was Social Identification. Based on this limited information, it was found that the adoption barriers for ERP systems are not materially different between proprietary and OSS systems.

This research highlighted that the generally accepted adoption factors associated with OSS might not apply to OSS ERP systems due to the unique nature of the application type. Many South African companies do not have ERP systems due to cost barriers. OSS ERP systems offer an alternative to eliminate this barrier. Furthermore, the findings of this study have significant implications on the development of effective strategies by OSS ERP vendors to understanding and meeting the needs and dynamics of the market.

The main limitation for this study was time. Furthermore, the survey method limited the ability to potentially clarify any uncertainty of a respondent around a particular question, and the opportunity to further explore potentially insightful feedback in the open ended questions. However, the electronic focus group was used to explore these potential insights to some extent. The findings suggested that the adoption barriers are very different from those found for OSS in general and that the requirements for success are not that far removed from those required of proprietary ERP systems. Most of the research undertaken has been for OSS in general. In light of this research, there is a possibility that the adoption barriers might be more inherent to the industry related to a specific application type rather than the development and licensing methodology. Future studies could determine if this is the case.

The impact of social identification and the current characteristics of the OSS community would be another opportunity for future research to explore whether there is any correlation between the potentially more liberal nature of the OSS community and the conservative nature found typical of business in developing economies. Finally, a potential adoption barrier that emerged from this current study, but not found in literature was relatively low cost of OSS ERP systems. Given the conservative nature of business in developing economies and cost being a potential measurement of quality, could this attribute of OSS, which has typically been seen as an enabler, not actually be an adoption barrier to OSS applications that have traditionally expensive proprietary alternatives? Indirect benefits of higher prices would include more funds for building infrastructure and for marketing to develop awareness. This is another opportunity for future research.

REFERENCES

Bhagwat, R. & Sharma, M.K. 2007. Information system architecture: a framework for a cluster of small- and medium-sized enterprises (SMEs). *Production planning & control.* 18(4):283-296.

Câmara, G. & Fonseca, F. 2007. Information policies and open source software in developing countries. *Journal of the American society for information science and technology.* 58(1):121-132.

Chwelos, P., Benbasat, I. & Dexter, A.S. 2001. Research Report: Empirical Test of an EDI AdoptionModel. *Information systems research.* 12(3):304-321.

das Neves, D., Fenn, D. & Sulcas, P. 2004. Selection of enterprise resource planning (ERP) systems. *South African journal of business management.* 35(1):45-52.

Debreceny, R., Putterill, M., Tung, L. & Gilbert, A.L. 2003. New tools for the determination of e-commerce inhibitors. *Decision support systems.* 34(2):177-195.

Dedrick, J. & West, J. 2003. Why Firms Adopt Open Source Platforms: A Grounded Theory of Innovation and Standards Adoption. *Proceedings of a Workshop on Standard Making: A Critical Research Frontier for Information Systems.* MISQ Special Issue Workshop. 236 - 257.

Depietro, R., Wiarda, E. & Fleischer. M. 1990. The Context for Change: Organization, Technology and Environment. In *The processes of technological innovation.* L.G. Tornatzky & M. Fleischer, Eds. Lexington, Mass: Lexington Books. 151-175.

Ellis, J. & Van Belle, J.P. 2009. Open Source Software Adoption by South African MSEs: Barriers and Enablers. *Proceedings of the 2009 Annual Conference of the Southern African Computer Lecturers' Association.* 49, Ed. New York. USA: ACM. 41 - 49.

Goode, S. 2005. Something for nothing: management rejection of open source software in Australia's top firms. *Information & management.* 42(5):669-681.

Gwebu, K.L. & Wang, J. 2010. Seeing eye to eye? An exploratory study of free open source software users' perceptions. *Journal of systems and software.* 83(11):2287-2296.

Gwebu, K.L. & Wang, J. 2011. Adoption of Open Source Software: The role of social identification. *Decision support systems.* 51(1):220-229.

Iacovou, C.L., Benbasat, I. & Dexter, A.S. 1995. Electronic Data Interchange and Small Organizations: Adoption and Impact of Technology. *MIS quarterly.* 19(4):465-485.

Johansson, B. & Sudzina, F. 2008. ERP systems and open source: an initial review and some implications for SMEs. *Journal of enterprise information management.* 21(6):649-658.

Johnston, K.A. & Seymour, L. 2005. Why South Africans don't FLOSS? *Proceedings IBIMA, 2005 International Conference on Information Management in Modern Enterprise.* Issues & Solutions. 438 - 446.

Koh, S.C.L., Gunasekaran, A. & Cooper, J.R. 2009. The demand for training and consultancy investment in SME-specific ERP systems implementation and operation. *International journal of production economics.* 122(1):241-254.

Luftman, J. & Zadeh, H.S. 2011. Key information technology and management issues 2010–11: An international study. *Journal of information technology.* 26(3):193-204.

Madapusi, A. & D'Souza, D. 2005. Aligning ERP Systems with International Strategies. *Information systems management.* 22(1):7-17.

Madapusi, A. & D'Souza, D. 2012. The influence of ERP system implementation on the operational performance of an organization. *International journal of information management.* 32(1):24-34.

Miscione, G. & Johnston, K. 2010. Free and Open Source Software in developing contexts: From open in principle to open in the consequences. *Journal of information, communication and ethics in society.* 8(1):42-56.

Mutula, S. & Kalaote, T. 2010. Open source software deployment in the public sector: a review of Botswana and South Africa. *Library hi tech.* 28(1):63-80.

Nagy, D., Yassin, A.M. & Bhattacherjee, A. 2010. Organizational Adoption of Open Source Software: Barriers and Remedies. *Communications of the ACM.* 53(3):148-151.

Ogunyemi, A.A. & Johnston, K.A. 2012. Exploring the roles of people, governance and technology in organizational readiness for emerging technologies. *The African journal of information systems.* 4(3):100-119.

Qu, W.G., Yang, Z. & Wang, Z. 2011. Multi-level framework of open source software adoption. *Journal of business research.* 64(9):997-1003.

Rose, M., Johnston, K. & Van Belle, J.P. 2006. Barriers and Enablers of OSS-on-the-Desktop Adoption. *Proceedings of Conference on Information Science, Technology and Management.* Chandigarh: CISTM. 1 -14.

Saunders, M., Lewis, P. & Thornhill, A. 2009. *Research methods for business students.* 5th ed. Essex: Pearson Education Limited.

Serrano, N. & Sarriei, J.M. 2006. Open source software ERPs: a new alternative for an old need. *Software, IEEE.* 23(3):94-97.

Spinellis, D. & Giannikas, V. 2012. Organizational adoption of open source software. *Journal of systems and software.* 85(3):666-682.

Subramanyam, R. & Xia, M. 2008. Free/Libre Open Source Software development in developing and developed countries: A conceptual framework with an exploratory study. *Decision support systems.* 46(1):173-186.

Venkatesh, V., Morris, M.G., Gordon B. D. & Davis, F.D. 2003. User Acceptance of Information Technology: Toward a Unified View. *MIS quarterly.* 27(3):425-478.

Watson, R.T., Boudreau, M., York, P.T., Greiner, M.E. & Wynn Jr., D. 2008. The Business of Open Source. *Communications of the ACM.* 51(4):41-46.

Zaffar, M.A., Kumar, R.L. & Zhao, K. 2011. Diffusion dynamics of open source software: An agent-based computational economics (ACE) approach. *Decision support systems.* 51(3):597-608.

APPENDIX A: SUMMARY OF OSS ADOPTION FACTORS

Factor	Barrier	Findings	Source
Technology	Total Cost of Ownership (TCO)	Hardware and software cost, training and technical support, interoperability costs and maintenance, and upgrades.	Ellis & Van Belle, 2009; Johnston & Seymour, 2005; and Dedrick & West, 2003
Technology	Reliability	OSS perceived as an immature technology for commercial purposes. OSS was perceived to be more reliable and superior in quality due to the availability of the source code and resultant transparency that allows for peer review, which has resulted in enhanced security capabilities.	Ellis & Van Belle, 2009; Gwebu & Wang, 2011
Technology	Compatibility	A large portion of OSS was noted to be compatible with other operating system platforms such as MAC OSX and Microsoft Windows. IT departments are staffed by Microsoft certified technicians, resulting in a reluctance to adopt OSS systems and as such a technical bias was noted as an adoption barrier.	Ellis & Van Belle, 2009; and Johnston & Seymour, 2005
Technology	Complexity	A perception that OSS is complex and problematic to deploy, and a shortage of OSS technically skilled staff to deploy and maintain OSS.	Ellis & Van Belle, 2009; and Johnston & Seymour, 2005
Technology	Performance Expectancy	Expectations with regards to improved job performance through the use of the technology.	Miscione and Johnston, 2010; Ellis & Van Belle, 2009
Organization	Human and financial resources	Organizations with more time available to evaluate new technologies and a limited budget available for ICT expenses were more easily persuaded to adopt OSS.	Ellis & Van Belle, 2009; Dedrick& West, 2003; Miscione & Johnston, 2010
Organization	Innovativeness	The level of organizational innovativeness can be an influencing factor relating to the adoption consideration and timing of adoption of new technologies.	Ellis & Van Belle, 2009; Dedrick & West, 2003; Qu, Yang, & Wang, 2011; Spinellis & Giannikas, 2012
Organization	Boundary Spanners	OSS advocates and boundary spanners in an organization remedy lack of awareness in OSS adoption.	
Environment	Availability of Product Skills & Support Services	Lack of skills and support services - related to greater level of risk to potential adopters compared to proprietary software products.	Ellis & Van Belle, 2009
Environment	Legitimacy	Legacy integration could be a factor for organizations not adopting OSS.	Nagy et al., 2010; Miscione & Johnston, 2010
Environment	Availability of External Support Services	Technical support, i.e. after sales support and services.	

Factor	Barrier	Findings	Source
Environment	Platform Long-term Viability	Technology standard - Organizations seem to prefer platforms which are perceived to be the benchmark through brand equity.	Miscione & Johnston (2010) (Ellis & Van Belle, 2009)
Environment	Product Awareness	The lack of awareness by key ICT decision makers is a major obstacle to the widespread use of OSS.	(Ellis & Van Belle, 2009; Johnston & Seymour, 2005; and Nagy et al., 2010).
Individual	Personal Innovativeness in Information Technology (PIIT)	Willingness of an individual to try out any new Information Technology. Potential users with a high PIIT are more likely to view OSS applications as useful.	(Gwebu & Wang, 2011).
Individual	Social identification (SI)	Sense of solidarity with the OSS community can positively impact member behavior including product evaluation, adoption, purchasing, word-of-mouth marketing, and member participation and engagement	(Gwebu & Wang, 2010).
Individual	Perceived ease of use (PEOU)	The extent to which a person believes that using an OSS application will be free of effort. PEOU was found to be positively influenced by the user perceptions of the technological characteristics, namely flexibility, quality, and capability.	(Gallego, Luna, & Buena, 2008) Davis (1989)
Individual	Perceived usefulness (PU)	The extent to which one believes that using an OSS application will enhance his or her job performance. PU, in turn, was shown to directly and positively impact the intention to adopt OSS applications.	Ellis & Van Belle (2009). Gwebu and Wang (2011)

APPENDIX B: SURVEY QUESTIONNAIRE

(A Likert Scale with Agree/Disagree measures was used)

Construct	Code	Category	Question
Support cost	S1	Technology	The support cost for the OSS ERP systems are more expensive than that of proprietary systems
Switching cost	S2	Technology	The costs involved in switching to an OSS ERP package is too high
	S3	Technology	We have to pay a contract termination penalty to get out of our current ERP contract
Maintenance cost	S4	Technology	It is much more cost effective in the long run to maintain an OSS ERP package
Sunk costs	S5	Technology	We will not implement an OSS ERP because of the cost already incurred for our current system
Reliability and Quality	S6	Technology	We will not be implementing OSS products because we question the reliability and security capabilities
	S7	Technology	We will not be implementing an OSS ERP because we perceive its performance to be weak relative to proprietary alternatives
Compatibility	S8	Technology	OSS ERP systems are not compatible with the other software being used in our organization
	S9	Technology	Our employees do not have the necessary skill levels required by an OSS ERP
	S10	Technology	OSS ERP systems lack the ability to integrate with our legacy system
Bias	S11	Technology	The applications provided by Microsoft, Oracle, SAP and Apple are much better than any of the OSS packages
Complexity	S12	Technology	OSS ERP systems are much more complex to implement than the proprietary systems
Lack of skill	S13	Technology	We do not have the technical knowledge in our organization to implement an OSS ERP system
IT Capital Budget	S14	Organization	Our organization only implements well-known brand names
IT staff time	S15	Organization	The skill levels and required time available in our organization are too little for an OSS ERP implementation
Innovativeness of IT in the organization	S16	Organization	We will not implement any OSS ERP because there are no well-known brands in the market
	S17	Organization	Our organization prefers to stick to the tried and tested when implementing new IT solutions
Boundary spanners	S18	Organization	We do not have any staff that have experience in an OSS implementation

Construct	Code	Category	Question
	S19	Organization	If we have staff with experience in a particular ERP package we will strongly consider it irrespective of whether it is OSS or proprietary
	S20	Organization	The skill levels and required time available in our organization are too little for an OSS ERP implementation
	S21	Organization	We do not perceive the after sales support sufficient to implement an OSS ERP
Support Infrastructure	S22	Environment	After sales support is very important when deciding to implement any new technology
	S23	Environment	We are not aware of any OSS ERP providers in our area
Availability of skilled IT workers	S24	Environment	The online OSS ERP community is a great alternative to the traditional support model of proprietary systems
Availability of external support services	S25	Environment	If there are large enough vendors for OSS ERP that can support the system we will consider the system on par with any other solution
	S26	Environment	We are not that concerned with the level of customization, the package must just be good enough to start out with
Platform and long-term viability	S27	Environment	We do not perceive an OSS ERP solution to be viable in the long term
Perceived usefulness	S28	Individual	Using OSS would give me greater control over my tasks than using proprietary software
	S29	Individual	I am more productive if I use OSS compared to if I use proprietary software
Perceived ease of use	S30	Individual	Generally, I find it easy to get OSS to do what I want it to do
	S31	Individual	It is easy for me to become skilful at using OSS
Personal innovativeness in technology	S32	Individual	Among my peers, I am usually the first to try out new information technologies
	S33	Individual	I am proud to think of myself as a member of the OSS community
Social identification with OSS	S34	Individual	I am proud to think of myself as a member of the OSS community
	S35	Individual	I think about being an open source user often
Behavioural intention to adopt	S36	Individual	During the next 6 months, I plan to use OSS