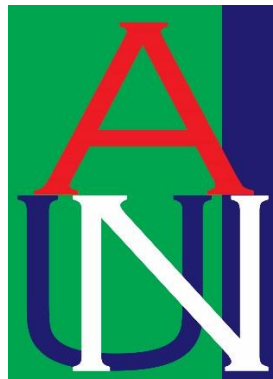


**EMPIRICAL INVESTIGATION OF THE IMPACT OF OPEN SOURCE INFORMATION
TECHNOLOGY SOFTWARE QUALITY CHARACTERISTICS ON BUSINESS VALUE OF
AN ADOPTING ORGANIZATION. A CASE STUDY OF OpenERP IN AUN.**



BY

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A thesis presented to the Post-Graduate School, American university of Nigeria, Yola.

**In Partial fulfillment of the requirement for the award of a degree of Master of Science (MSc)
in Business Administration.**

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DECLARATION.

I, Emmanuel Obinwa Agha, hereby declare that the substance of this thesis is based on my original work (all sources and assistant received were duly acknowledged and referenced) and that neither the whole or part of this work has been, is being, or is to be submitted for another degree in this university or any other university.

Signature:

Date:

DEDICATION.

To Aunty Tonia, I solely dedicate this work to you.

CERTIFICATION

This Thesis report entitled “Empirical Investigation of the Impact of Open Source Information Technology Software Quality Characteristics on Business Value of an Adopting Organization. A Case Study of OpenERP in AUN.” meets the regulations governing the award of Master of Science (MSc) degree of the American University of Nigeria and is approved for its contribution to knowledge and scholarly presentation.

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I gladly appreciate God for making this work a success, for ensuring all needs were met in bringing this work to fruition.

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ABSTRACT.

The purpose of this research is to investigate the impact of information technology software quality characteristics on the business value of an adopting organization. This phenomenon was explored empirically by examining three research questions; 1.) What is the impact of system quality of open source ERP on business value of an adopting organization? 2.) What is the impact of information quality of open source ERP on business value of an adopting organization? 3.) What is the impact of service quality of open source ERP on business value of an adopting organization? Adoption of open source ERP has been on the increase. The research problem thus arises as scanty empirical works exist to explain how its software quality characteristics impact on business value. To answer these research questions, the quantitative research method, employing the survey strategy, supported by positivists was adopted. The research explored the OpenERP system used by American University of Nigeria, been the case study. The research was targeted at identifying the significant relationship between system quality, information quality and service quality on business value (directly) and when moderated by extended use. Single source of quantitative data (questionnaire survey) was used to collect data. The research model used for the data analysis was developed from a conceptual framework synthesized from relevant literatures, by Delone & Mclean. The findings debunked hypothesis one, while that of two and three were validated, thereby giving rise to empirical (academic) contributions, and practical contributions. The practical relevance is based on helping management prioritize on the three quality characteristics, vis-à-vis business value. This work therefore provides empirical evaluation of the impact of software quality characteristics of open source information technology on business value.

TABLE OF CONTENTS.

Chapter 1	1
1.1. Background of the study.....	1
1.2. Statement of Problem.....	2
1.3. Objective of the Study.....	3
1.4. Research Questions.....	3
1.5. Research Hypothesis.....	4
1.6. Scope of the Study.....	4
1.7. Research Contributions.....	5
1.8. List of abbreviations and acronyms.....	5
Chapter 2	6
2.1. Review of Related Literature.....	6
2.2. Theme One: Business Value of IT.....	7
2.3. Theme Two: ERP Business Value	9
2.4. Theoretical Framework and Hypothesis Development.....	14
2.4.1. IS Success Measurement Model.....	14
2.4.2. System Quality.....	16
2.4.3. Information Quality	17
2.4.4. Service Quality.....	18
2.4.5. Extended Use.....	19
2.4.6. Business Value.....	19
Chapter 3	20
3.1. Research Design... ..	20
3.2. Population of the Study.....	21
3.3. Sample Size Determination.....	21
3.4. Sampling Procedure.....	22
3.5. Instruments for Data Collection.....	22
3.6. Administration of Instruments.....	23
3.7. Validity and Reliability of Instruments.....	24

3.8. Ethical Considerations.....	24
Chapter 4.....	26
4.1. Data Presentation, Analysis and Interpretation.....	25
4.1.1. SmartPLS Results.....	26
4.2. Explanation of Results.....	33
4.2.1. Explanation of Target Endogenous Variable Variance.....	33
4.2.2. Inner Model Path Coefficient Sizes and Significance.....	33
4.2.3. Outer Model Loadings.....	33
4.2.4. Indicator Reliability.....	33
4.3. Bootstrapping.....	34
Chapter 5	35
5.1. Summary of Findings.....	35
5.2. Discussion and Recommendations.....	35
5.3. Conclusion.....	37
5.4. Limitations and Future Research.....	37
Appendix: Operationalization of variables.....	38
Questionnaire	40
Reference	45

LIST OF TABLES.

Table 1.1: Discriminant Validity	29
Table 1.2: Variable Reliability and Validity	30
Table 1.3: Outer Loading	31
Table 1.4: Bootstrapping (Path Coefficient)	32

LIST OF FIGURES.

Figure 1.1: Delone & Mclean (2003) IS success model	14
Figure 1.2: Hsieh et al., (2011) Post-Adoptive Extended Use	15
Figure 1.3: Hypothesis Development	19
Figure 2.1: PLS Algorithm	27
Figure 2.2: Bootstrapping	28

Chapter 1

1.1. BACKGROUND OF THE STUDY.

As organizations face unrelenting competition, tight budget, economic downturns, coupled with intensified emphasis on operational efficiency and exceptional service delivery, information technology (IT) has become a veritable tool adopted to remain competitive in the face of these challenges. Organizations' investment on IT infrastructure have been demonstrated to be huge, running in their billions. It therefore becomes paramount and legitimate for management to evaluate the contribution of IT investment in terms of business value to overall organization's performance. Business value depict the justifications for investing on a given project. It includes all the values of which in the long run determine the health and well-being of a firm. By been context specific, business value is measured by different organizations either in monetary or non-monetary terms (Jain, 2016). The monetary are evaluated in profitability and cost saving, and non-monetary on quality and excellent service experience (Fotini et al., 2008; Rai et al., 1996). Therefore, understanding and assessing the business values generated by IT infrastructure continue to elicit growing interest from both practitioners and researchers.

IT business value depicts performance impact of information technology at all levels, which includes both competitive and efficiency impacts. Levels at which IT value are recognized are categorized into Macro and Micro levels (Umzeyemungu & Raymond, 2012; Jain, 2016)

Studies linking investment in IT to business value has been done in the past (Banker & Kauffman 1991; Hitt et al., 1994; Soh & Markus, 1995; Melville et al, 2004). Others has also been done with specific IT infrastructure, such as e-commerce (Delone and Mclean, 2004), the Enterprise Resource Planning system (Fotini et al., 2008; Shang & Seddon, 2000; Seo, 2013; Sarrab & Rehman, 2014; Constantinos et al., 2014; Jain, 2016). Furthermore, interest on business value of these specific IT artefact has intensified, leading to much work on the proprietary category. The emergence of open source software has translated into a shift of attention from proprietary software. Despite this shift, researchers have shied away from investigating the impact of open source software qualities on business value of an organization.

Unlike proprietary technologies, where software is developed by a vendor and released to the public with the aim of gaining market and making profit, open source technologies make their source codes

publicly available, giving users' freedom to modify and adapt to user need, freedom to improve and redistribute improvement to the public (under the general public licensing) (Coll et al, 2008; Wu & Lin, 2001). Linux Operating System, Apache web browser, Mozilla web browser, MySQL database, PHP and Perl programming languages, OpenOffice office suite, OpenERP are the commonly used open source technologies.

Open source enterprise resource planning (OpenERP) will be considered for the purpose of this work. An Enterprise Resource planning (ERP) system is a software package that integrate information flow from all functional areas of a business. The major challenge it was developed to handle was the fragmentation of information in large organizations, caused by disparate IT artefacts

Despite the increasing adoption of Open Source ERP, research works detailing its software quality impact on business value remains scarcely available. Chengular-smith et al (2010) and Sarraf & Rehman (2014) came close to investigating this area. While the former treated other factors, aside software qualities for deriving value from open source, the latter analyzed open source software qualities as a basis for selection and adoption, and not as an antecedent to value creation in an adopting organization

1.2. STATEMENT OF PROBLEM.

Extant literatures have been able to relate adoption of Enterprise Resource Planning (ERP) IT artefacts to business value in an organization. These business values could either be direct or indirect, and it usually cut across multiple dimension of an organization. They are measured in financial, internal, learning and growth and in customer perspective (Jain 2016). Five perspective were identified by (Shang & Seddon, 2000) on which ERP brings value. These include; operational, managerial, strategic, infrastructural and organizational benefits. A mixed report has also been relayed by (Velcu, 2005; Yusuf et al., 2004), thus creating a keener desire for investigation in this area.

Majority of researchers have also observed that organizations that invest on IT infrastructure are better positioned for higher performance outcomes, such as; increased customer satisfaction, employee satisfaction, better product/service design and decreased lead time in service delivery (Soh & Markus, 1995; Melville, 2004). Hence, IT resource can be seen as a critical organizational asset of which business value should be closely evaluated. Though, with avalanche of studies on ERP value

in organizations, there exist paucity of research on open source ERP, and how it impacts on business value of an adopting organization.

Adoption of open source ERP in organizations is already something prevalent, but what is worth knowing is, how does its software qualities characteristics impact on business value? This question continues to persist in business research (Abugabah & Sanzogni 2010; Serrab & Rehman 2014), as well as forms the research problem of this thesis.

To address this problem, a positivist approach is undertaken to empirically evaluate the impact of open source ERP software quality characteristics on business value. Positivist approach is adopted because the research investigation aims to uncover and present truths via empirical means (Antwi & Hamza 2015). Also, the research theoretical framework integrates (Delone and Mclean, 2003) Information System (IS) success model together with (Hsieh et al., 2011) post-adoptive extended use, of which were slightly re-conceptualized to fit the research need.

1.3. OBJECTIVE OF THE STUDY.

The purpose of this research is to empirically investigate the impacts of open source ERP software quality characteristics on business values of an adopting organizations. This study answered three research questions as detailed next.

1.4. RESEARCH QUESTIONS.

Furthermore, this work was also motivated by a call to test IS success models empirically (Delone & Mclean 2003). One aspect adapted in evaluating IS success is the system quality characteristics, which adopt measures such as reliability, ease of use, functionality, convenience etc., in evaluating performance of an Information system (Petter & Mclean 2009). This work looks at how system quality impacts on business value of an organization either directly or indirectly (when moderated by extended use). Extended use was co-opted as usage in the site of investigation is mandatory. Second, another criterion used in accessing IS success is the information quality characteristics. This measure captures information system accuracy, completeness, relevance, timeliness, precision and currency (Delone & Mclean 1992). Another question to be answered will be how this attribute directly, or when moderated by extended use impacts on the business value of an organization. Lastly, another aspect that requires genuine attention is the service quality characteristics. Models embedded in this

criterion are captured as support service by the IT department, measured in terms of responsiveness, empathy, skill sets etc., thus, from these forgoing, below are the three research questions of this thesis:

Research Question 1 (RQ1): *What is the impact of system quality of open source ERP system on business value of an adopting organization?*

Research Question 2 (RQ2): *What is the impact of information quality of open source ERP system on business value of an adopting organization*

Research Question 3 (RQ3): *What is the impact of service quality of open source ERP system on business value of an adopting organization?*

To answer the research questions above, below were the hypothesis generated and tested.

1.5. RESEARCH HYPOTHESIS.

1. There is a significant direct relationship between system quality of open source ERP and organization's business value.

1b. There is a significant relationship between system quality of open source ERP to extended use, and then to organization's business value.

2. There is a significant direct relationship between information quality of open source ERP and organization's business value.

2b. There is a significant relationship between information quality of open source ERP and extended use, and then to organization's business value.

3. There is a significant relationship between service quality of open source ERP and extended use, and then to organization's business value.

4. There is a significant relationship between extended use and organization's business value.

1.6. SCOPE OF THE STUDY.

The investigative context of this work is institution of high learning. Faculty and staff of American University of Nigeria were surveyed to ascertain how the software quality characteristics of OpenERP used in the school impacts on business value in such areas as; automation of processes, self-service supports, enhanced reliability and integrity of data, real time access to data etc.

1.7. RESEARCH CONTRIBUTIONS.

Two types of contributions, namely; Academic and practice, resulted upon addressing the research problem.

In academic terms, this research helped to empirically evaluate IS success measurement models as synthesized from extant literatures by Delone & Mclean. The work is an answer to the call by Delone & Mclean for the empirical investigation of their IS success models, and also a gifting to the paucity of work on the research topic. Furthermore, in the area of practice, this research will help management prioritize their resources on IS artefacts, in terms of software quality characteristics. It can now concern itself more with information quality, as it has been identified to impact on greater scale on business value than service quality and system quality.

1.8. LIST OF ABBREVIATIONS AND ACRONYMS.

AMOS	Analysis of a moment structure
ERP	Enterprise Resource Planning
OPenERP	Open Source Enterprise Resource Planning
CB-SEM	Covariance based Structural Equation Modelling
LISREL	Linear Structural Relations
PLS	Partial Least Square
IS	Information Systems
IT	Information Technology
BSC	Balance Score Card

Chapter 2

2.1 REVIEW OF RELATED LITERATURE.

Business value reflects those myriad justifications that usually precede the approval of a project. It includes all forms of value of which in the long run determine the health and well-being of a firm. Business value measures the true success of a projects. It encompasses both monetary and non-monetary benefits (Philipy, 2014). The monetary are evaluated in profitability and cost saving, and non-monetary on quality and excellent service experience. Three categorical framework exists wherein business value is measured; Running the business, Growing the business and Transforming the business (Hunter et al., 2008). Running the business are captured in such values as cost reduction and risk reduction. Growing the business value entails enhanced products and service experience. Then Transforming the business value covers getting new markets, new products and new business models.

What is business value to one organization may not be business value to another organization, hence, business value can be said to be context specific (Jain, 2016). One of such projects usually accompanied by huge investment, of which management anticipate to derive value from is information technology (IT) infrastructure. Thus, in the IT context, one of the persisting questions that researchers have continually sort answers for is the degree to which investment in IT has delivered value or enhanced business performance.

This work uses the traditional/narrative literature review approach to identify, evaluate and synthesize existing body of work produced by researchers. Narrative approach, unlike other approaches (Meta-analysis and systematic) was adopted as it's a valuable technique for theory development and hypothesis generation. It is also valuable in linking many works on varying topics for reconceptualization (Baumeister & Leary, 1997).

Due to the many literatures studied, this review was guided by such criteria as; search strategy, inclusion and exclusion criteria. To locate studies on business value of IT and ERP business value, a search of research journals was done using google scholar, pdf at google and Researchgate. The keywords used in the searches are: Business Value of IT, Business Value of ERP, Business Value of Open source ERP, Business Value of OpenERP. The selected journals consisted of scholarly journals on business value of IT infrastructure. These journals which had been highly cited include;

Management Science, Information and Management, International Journal Business Information System, Computer Information Systems Faculty Publications, Information Systems Research, Journal of the Association for Information Systems, Information Technology Management.

Then, papers on business value of IT, ERP business value and Open source ERP were identified and reviewed. As part of the selection process, emphasis was laid on titles, abstract and research findings. This helped to identify and select the appropriate papers on business value of IT. Studies published between January 1, 1991 and December 31, 2016 formed the inclusion criteria. The year 1991 was chosen as the 1980s witnessed a period when researchers could not significantly link IT investment to business value (Fotini et al., 2008). Also included are studies that focused on private sectors and not on government parastatals. Studies excluded includes those published before January 1, 1991.

To be able to understand impact of IT business value in the context of ERP systems on an adopting organization, this work classifies the literature into two themes. That includes; Business value of IT and ERP business value.

2.2. THEME ONE: BUSINESS VALUE OF IT.

IT Business value has been measured in improved products and services, enhanced business processes, increased customer and employee satisfaction and decreased lead time in service delivery (Soh & Markus, 1995). These values appear in form of residual incomes, superior firm performance and competitive parity or advantage (Dehning et al., 2005). Banker & Kauffman (1991) captures IT business value in terms of reduction in operational cost, increase in business revenue and higher competitive advantage. Furthermore, it has been conceptualized in terms of productivity, consumer value and business performance (Hitt et al., 1994). It has also been demonstrated in productivity enhancement, profitability improvement, cost reduction, competitive advantage and other measures of performance (Melville et al, 2004). Measures of performance are seen in the area of financial and non-financial indicators. IT business value measured in financial terms includes; assets turnover (ATO), return on investment (ROI), return on assets (ROA). Stock valuation is also included in the financial performance indicator (Fotini et al., 2008). Non-financial indicators are seen in edge cutting operational efficiency (Constantinos et al., 2014). These operational efficiencies are evidenced in superior customer service, improvement in quality, improved business processes, less cycle time and excellent service delivery (Rai et al., 1996). For many other organizations, IT is used as a cost-saving strategy and tool for competitive advantage (Dehning et al., 2005; Brynjolfsson & Hitt, 1996). Cost

saving in the areas of transportation, inventory and information handling costs and reduction in number of personnel (Jain, 2016). Of these conceptualizations, a convergence could easily be noticed; that IT value is widely agreed to be expressed in less cost, revenue gains and competitive advantage. A further dissect, links these values to different levels in the IT value chain. IT business value indeed deserve a special attention as it can only be managed if its capable of been measured (Aranyossy, 2007).

These various IT business values can be conceptualized into two broad categories; the Macro and the micro IT value levels. The Macro entails the economy and industry level, while the micro comprise of the organizational, process and individual levels (Jain, 2016; Uwizeyemungu & Raymond, 2012). At the macro level, the overall productivity performance is measured, as against the micro level where firm's return on investment (ROI), profitability and throughput are measured. This categorization is necessary as concentration on one level will not give a holistic view on the values an IT artefact is capable of yielding (Mooney et al., 2001). Three perspective of an organization on which performance can be evaluated are identified by (Soh & Markus, 1995). Organizations as a goal seeking entities, where performance is measured in goal accomplishment. Secondly, as a coalition of constituencies, where performance is measured by degree of satisfaction of constituents and lastly, as a bargaining relationship with its surrounding, where performance is measured in garnering resource from the surrounding and turning it into an output. This perspective is necessary to give clarity; a manufacturing firm will know from on-set that its expected value from IT will be different from that of a service organization.

In creating value, IT infrastructure interact with other resources (usually beyond the IT infrastructure) both internal and external to the organization (Soh & Markus, 1995; Uwizeyemungu & Raymond, 2012). To create and capture value, IS technologies must be designed to fit organizational task and must be appropriately used (Soh & Markus, 1995), a good relationship must be maintained with providers of complementary products (West, 2007).

The extent to which investment in IT creates value for an organization has been a common question which information system and business researchers have attempted to answer (Jain, 2016). Many extant literature has investigated the impact of IT investment on business value, and findings from these works ranges from significant statistical relationship between IT investment to business value (Soh & Markus, 1995; Rai et al., 1996; Brynjolfsson & Hitt, 1996; Melville et al, 2004), to

contradiction; that IT links significantly with productivity and consumer value, but with non-impact on firm performance (Hitt & Brynjolfsson, 1994), and to negative productivity gain (“productivity paradox”), that investment in IT has no link to business productivity (Yusuf et al, 2004; Barua et al., 1995 (citing Loveman, 1994)). IT investment in the real sense does not add value, just that the performance of non-adopters continues to deteriorate while that of adopters remain constant (Constantino et al., 2014). Proponents of positive IT value faults the outcome of the “productivity paradox” on hastiness to derive value. As organizations invest huge amount on IT, they immediately want to reap all the gains imbedded therein. However, due to delay in acceptance by employees, time needed to integrate IT into the business processes of an organization, values from IT are usually delayed (Dehning et al., 2005). It therefore can be said that early return is not an appropriate representative of true IT value (Brynjolfsson & Hitt, 1996). Comparing the return on investment (ROI), return on assets (ROA) and assets turnover (ATO) over a 3-year period of IT adopters and non-adopters shows increase in these financial indicators to be significant among adopters (Fotini et al., 2008). The negative relationship could have also been due to measurement issues, lags and mismanagement of IT infrastructures (Barua et al., 1995; Brynjolfsson & Hitt, 1996; Rai et al., 1996). Data from the federal government collected to measure IT value at the economy level are usually of questionable quality. Also, there is always lag in learning and adjustment by an organization when a new IT infrastructure is deployed (there could even be resistance). Then, to derive value from an IT installation, modules must be appropriately combined, system parameters well configured and business processes well reengineered.

Increasing interest on business value of a particular type of IT artefact such e-commerce (Delone and Mclean, 2004) and Enterprise resource planning systems (Shang and Seddon, 2000) has intensified. This work therefore contextualizes its evaluation on enterprise resource system.

2.3. THEME TWO: ERP BUSINESS VALUE.

An ERP system is a software package that integrate information flow from all functional areas of a business. The major challenge it was developed to handle was the fragmentation of information in large organizations, caused by disparate IT artefacts. It aimed to integrate all the functional areas of an organization, namely; Human Resource, Finance, Suppliers and Vendors, customers etc. It comes in modules, of which a particular module applies to a certain functional area. ERP then enhances business performance as its able to draw data from modules representing the various functional areas

(Mckena, 2011; Davenport, 1998). To reap the benefits of an ERP system requires careful plans for success. It requires total commitment from everyone in the organization, management must give their full support. Implementation team must be set up, accurate data must be imputed into the system, training must be provided, proper performance measurement must be established etc., (Umble &Umble, 2002).

Business values are created by an ERP systems in an organization in five varying perspectives (Shang & Seddon, 2000). These are; operational, managerial, strategic, infrastructural and organizational benefits. Operational benefits captures improvements leading to cost reduction, high productivity, less cycle time, high quality output and exceptional customer service. Managerial benefits entails improvement in decision making, enhance and better management of resources. Strategic benefits are seen in business innovation, business alliance, product differentiation, cost leadership. Infrastructural benefits include enhanced IT artefacts capability, reduction in IT cost, flexibility of business. Finally, organizational benefits of ERP systems leads to an atmosphere for business learning, organizational changes, common vision.

Impact of ERP systems is usually pervasive in an organization. Thus values could either be direct or indirect, and they usually cut across multiple dimension of an organization (Jain 2016). A balance score card approach was adopted by (Jain, 2016) on which were identified four perspectives wherein ERP values to a business are measured. These includes; financial, internal, learning and growth, and customer perspective. Making up the financial perspective are return on investment, sales revenue and profit margin. The internal perspective comprises of process optimization, improvement in throughput rate. Learning and growth rate leads to an enhanced employees' skill and improvement in organizational learning. Lastly, customer perspective entails improvement in response and delivery time. A critical look at these value measures by these authors, there seem to be a convergence, in terms of time cycle, cost, learning environment, productivity etc.

Investment in ERP system has been linked to superior financial performance, in terms of profitability, higher returns on assets, return on investment and assets turnover (Fotini et al., 2008). Reduction in cost of goods, Product and services customization, standardized information and process and transparency are some of the values ERP bring into an adopting organization (Fotini, 2008).

A mixed result regarding impact of ERP systems to business value has been established (Fotini et al., 2008). For instance, adoption of an ERP system has been seen to provide competitive advantage (Constantinos et al., 2014), but competitive advantage is quickly lost or non-existent as ERP software is accessible to all firms, thus is easily replicable (Uwizeyemungu & Raymond, 2012). Findings by Velcu (2005) further supports this; that there exists no significant difference in terms of return on assets and return on investment between a well successful ERP adopter and a less successful ERP adopter. However, a further analysis reveals a better efficiency benefits on the part of the successful ERP adopters in terms of assets turnover and capital turnover in the early stage (usually two years) of implementation.

Despite these many research, similar research on value creation of open source ERP system is scarce (Morgan & Finnegan 2008). Though Chengalur-smith et al (2010) and Sarraf & Rehman (2014) came close to investigating this area, the two works differ in terms of purpose and context of investigation with this work. Thus, this work having been contextualized in the boundary of higher institution of learning, reveals how the adoption of OpenERP impacts, in terms of value as modelled by (Seo, 2013) on faculty and staff. These values are expressed in improved information access, reduced wastages due to improved operational efficiency, campus wide integration, improved internal communication, improved self-service environment, enhanced reliability and integrity, real time access to data, elimination of manual processes etc.

The adoption of open source ERP by organizations is on the increase, and the reasons are not far-fetched. Some of these reasons has been highlighted by extant literatures. The cost implication of proprietary software, and its widely reported failure in meeting outcomes (Abugabah & Sanzogni, 2010) has led organizations to seek for a better surrogate software. Proprietary software has been associated with high cost of acquisition, maintenance cost due to upgrade and vendor lock-in due to high exit cost (Chengalur-Smith et al, 2010). In contrast, open source software is less expensive even when purchased from a third party, far more flexible and scalable at no cost, reliable and stable than their proprietary counterparts (Wu & Lin, 2001). However, most Open source cannot be said to be totally free as they are either available through online subscription or with on-site support, of which fees are charged (Al-Saleem, 2013). In recognition of open source benefits, organizations have begun to adopt them due to reduced cost of installation, maintenance and support services in enhancing their value creation (Chengalur-Smith et al, 2010). Many of these organizations, both government and

private further makes it clear that it's just as competitive as any of the proprietary software (Sarraf & Rehman, 2014).

Furthermore, open source offers organizations self-reliance through source code modification, projects are also implemented in line with organizational goal as against proprietary software vendor's, and organizations have options of selecting from varieties of hardware and software vendors (Koenig, 2004). With open source, organizations can start with one application and scale up as the needs arises (Vartak et al, 2014; McKenna, 2011). Additionally, contributions of open source communities help to enhance components and knowledge sharing (Morgan & Finnegan 2008). Communities also help reduce the risk associated with long term software maintenance (Chengalur-Smith et al, 2010). Therefore, open sources technologies present immense opportunities for gaining business value in an organization.

Information of the studies included in the Review.

<i>Themes</i>	<i>Author (year)</i>	<i>Study design</i>	<i>Focus</i>
<i>Business Value</i>	<i>Hunter et al., 2008</i>	<i>N/A</i>	<i>Investment areas to expect value from a business.</i>
	<i>Philipy, 2014</i>	<i>N/A</i>	<i>Identifying and delivering business value.</i>
<i>Business Value of IT</i>	<i>Banker & Kauffman 1991;</i>	<i>Quantitative</i>	<i>Unveiled how IT investments are transformed into Biz value.</i>
	<i>Hitt et al., 1994;</i>	<i>Quantitative</i>	<i>Identified three aspects of IT value.</i>
		<i>N/A</i>	<i>Process model of conversion of IT investment to organizational performance</i>
	<i>Soh & Markus, 1995;</i>	<i>Quantitative</i>	<i>Methodology to measure IT impacts on performance.</i>
	<i>Barua et al., 1995;</i>	<i>Quantitative</i>	<i>Effects of IT investment on firm's performance.</i>
	<i>Rai et al., 1996;</i>	<i>Quantitative</i>	<i>Disappearance of the "productive paradox".</i>
		<i>N/A</i>	<i>Conceptualize biz value of IT investment beyond firm level.</i>
	<i>Brynjolfsson & Hitt, 1996;</i>		
	<i>Mooney et al., 2001;</i>	<i>Qualitative</i>	<i>Integrative model of IT value</i>
	<i>Melville et al, 2004;</i>	<i>N/A</i>	<i>Issues to confront for successful ERP system</i>
		<i>Quantitative</i>	<i>Firm level multiple effects of IT investment on firm value.</i>
	<i>Yusuf et al, 2004;</i>		
	<i>Dehning et al., 2005;</i>	<i>N/A</i>	<i>Roles of complementary assets in capturing IT business values.</i>
	<i>Aranyossy, 2007;</i>		
	<i>West, 2007;</i>		
	<i>Constantinos et al., 2014;</i>	<i>N/A</i>	<i>Relationship of ERP to business performance</i>
	<i>Jain, 2016.</i>	<i>Quantitative</i>	<i>Used BSC to validate four dimensions of ERP value</i>

ERP Value.	business	Shang & Seddon, 2000;	Quantitative	Framework to assess benefits of ERP systems.
		Velcu, 2005;	Quantitative	Compares financial performance of successful and non-successful ERP implementers.
		Fotini et al., 2008;	N/A	Critical review of extant literature on business value of ERP systems.
		Morgan & Finnegan 2008;	N/A	Characteristics of IT that enables value creation.
		Chengular-smith et al 2010;	Quantitative	Antecedents of business value of open source IT infrastructure.
		Uwizeyemungu & Raymond, 2012;	Quantitative	Links ERP capabilities to organizational performance.
		Seo, 2013;	Quantitative	Business value in the context of higher institution of learning.
		Constantinos et al., 2014;	N/A	Relationship of ERP to business performance
		Sarrab & Rehman, 2014;	Quantitative	Selection of Open source software based on software quality characteristics.
		Jain, 2016.	Quantitative	Used BSC to validate four dimensions of ERP value.

2.4. THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT.

2.4.1. IS Success Measurement Model.

To answer the research questions, the IS success model proposed by (Delone & Mclean, 2003) together with (Hsieh et al., 2011) post-adoptive extended use were adapted. Though re-conceptualized, they help form the framework used in this work to evaluate impact of software quality characteristics on business value. Notwithstanding the numerous works done on models of IS success evaluation (Rabaa'i, 2009; Mukti & Rawani, 2016), Delone & Mclean was adapted due to its general acceptance in the 'IS-Business' research community (Petter & Mclean, 2009; Mukti & Rawani, 2016). The Delone & Mclean 2003 model consist of six interrelated dimensions of IS systems' success; System quality, Information quality, Service quality, Use, User satisfaction and Net benefits.

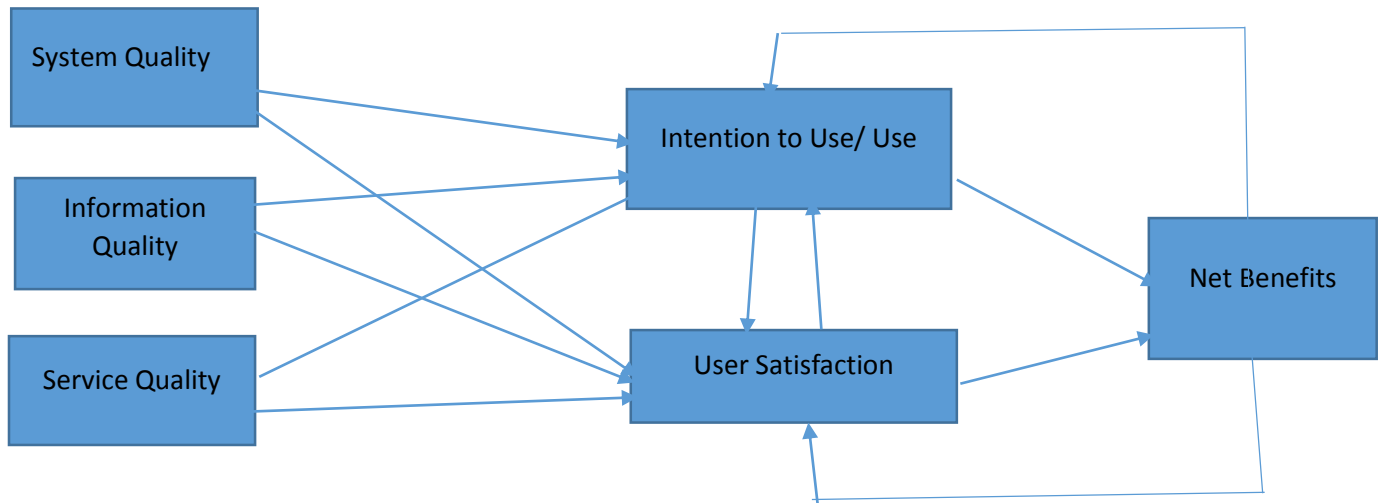


Figure 1.1 Source. Adapted from Delone and Mclean (2003).

As illustrated in Figure 1.1, six variables of IS success models is synthesized by DeLone & McLean (2003). This they did from myriad of reviewed literatures. This taxonomy establishes a process and causal interdependence between these variables (Delone & Mclean, 1992; Delone & Mclean, 2003; Rabaa'I, 2009). The D&M model proposes that information Quality, System Quality and Service Quality jointly and individually affect both Intention to Use/Use and User Satisfaction. Also, that Intention to Use/Use affects the degree of User Satisfaction either

positively or negatively, and that extent of User Satisfaction also, affects Intention to Use/Use. Furthermore, Intention to Use/Use and User Satisfaction impacts directly on Net benefits. Net benefits was adapted as impacts could either be negative or positive.

The above updated model of (Delone & Mclean, 2003) was not wholly adapted in this work. It was developed basically for more traditional IS infrastructure where usage is at the volition of the User. Gable et al, (2003) suggested that “Usage”, either perceived or actual is pertinent when such use is not mandatory. “Use” was also not seem as having the tendency to cause impact (Seddon, 1997), in reaction to D&M original model. In agreement with the process flow, Seddon argued that “Use” always precede impacts, but does not cause them. However, (Delone & Mclean, 2003) in a counter argument suggests that variability in the quality and intensity of “Use” is likely to have a significant impact on realizations of benefits. On this ground, the concept “Use” was re-conceptualized in this work to reflect its unique place in assessing open source ERP systems. A call for a re-conceptualization were supported by extant literature that held their reservation about a likely bias that will ensue in evaluating Open source ERP like any other IT systems (Ononiwu, 2013). “Post-Adoptive Use” and “Extended Use” are terms that have been proposed, which could equally be employed to evaluate Open source ERP systems (Hiesh et al, 2011; Hsieh & Wang, 2007; Hsieh & Zmud, 2006). Therefore, been that usage is mandatory in the principal research site of this work; that data will be collected from faculty and staff who are mandated to use Open source ERP (OpenERP) in their everyday operation, this work adopted the concept “Extended Use” (as moderating variable) in place of “Use” or “Intention to Use”.

The Information quality, System quality and Service quality models recognized in this work as software quality characteristics will be evaluated to test their impact on “Extended Use”, and consequently on business value assuming the context of a higher institution of learning.

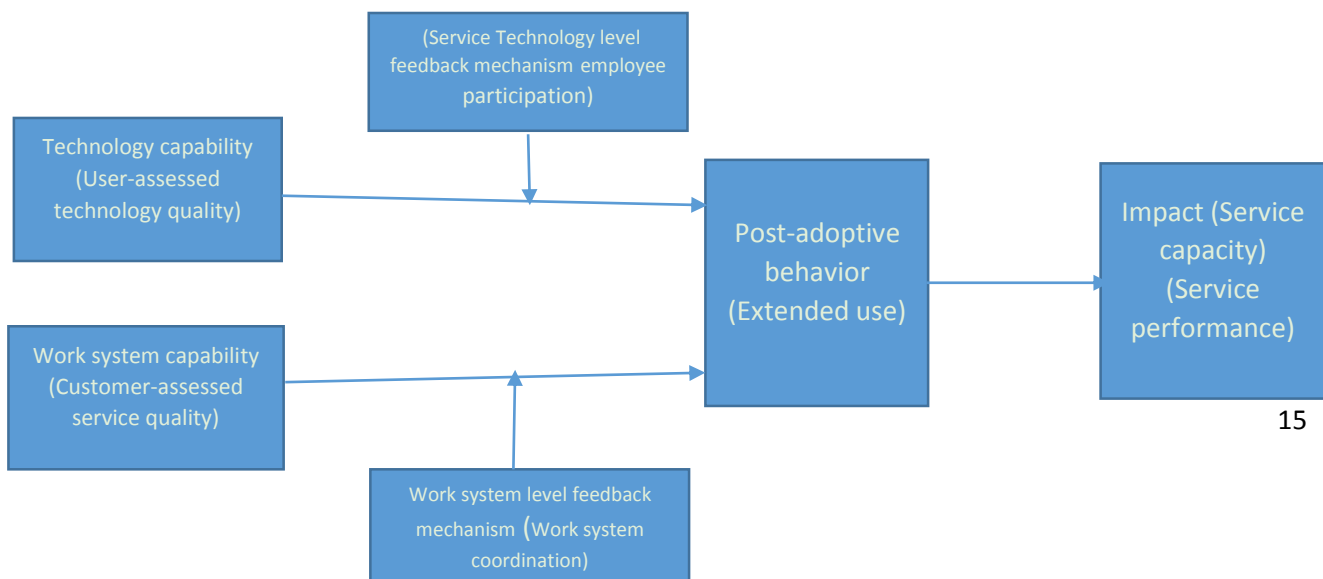


Figure 1.2 Source. Adapted from Hsieh et al., (2011).

From the above framework, after making use of an IT infrastructure, a user assesses the technology and its outcome. The result of this assessment is then taken to signal the capabilities of the technology. Such a user usually relies on the technology capability and work system capability (which is referred in this work as software quality characteristics, comprising; system quality, information quality and service quality) for such an assessment. Therefore, the user may perceive higher quality as representing greater capability of the technology. This perception usually affects the user's extended use of the technology. Extended use is triggered off by (self) motivation and not compulsion. Thus, when a user perceives the technology (based on earlier usage), to be of higher quality, and also appreciate its support of his work, he develops a strong belief in the value of the technology, and good attitude towards it. Thus, by positively believing in, accepting the technology, and engaging it beyond the 'ordinary' use, extended use is promoted. Such an extended use (as seen in figure 2) then enhances performance impact.

Meanwhile, when users encounter low technology and work system capability, they will most likely form a negative cognition about the IT resource and its potential to support their work, which in turn impedes on extended use. To overcome this negative influence, a feedback mechanized is developed to elicit users' feedback, relating to their experience, thus helping to garner information on the strengths and weakness of the IT infrastructure. Users may relax their negative cognition about the IT capability if feedback on how to improve the technology is offered by them. This can then lead to more extensive use of the technology (extended use).

2.4.2. System Quality.

The implications emanating from use of IT infrastructure are usually of great concern to users, as their work performance are linked to it. Hence, users will evaluate the technology and outcomes of their application of it. The result of this evaluation is then interpreted to be the capability of the

technology. In the course of their assessment, users will usually rely on the system quality to form their cognition of the technology capability.

System quality entails the performance of the processing system itself (Delone & Mclean 1992), evaluated in terms of convenience, ease of use, integration, availability and functionality (Delone & Mclean, 1992; Delone & Mclean, 2003; Delone & Mclean, 2004; Wixom and Todd, 2005; Petter & Mclean, 2009; Rehman & Sarrah, 2014). Users usually desire high system quality that can support their work performance, of which a higher system quality is signaled to mean greater capability of the IT infrastructure. And greater capability is then translated into business value, as user will accept and use it the more in the performance of the task (Hsieh et al., 2011).

This variable (system quality) was assessed to evaluate how American university of Nigeria is able to create and capture value (with OpenERP) through self-service environment and feedback mechanism for staff (functionality); help features, processing time and intuitiveness (ease of use); integration of data from various sources; elimination of the need for backup systems (Availability). This work therefore looks at system quality impact on business value from two dimensions; its direct impact to business value, and its impact on extended use, and then to business value. Thus, the first hypothesis is;

1: *There is a significant direct relationship between system quality of open source ERP and organization's business value.*

1b: *There is a significant relationship between system quality of open source ERP to extended use, and then to organization's business value.*

2.4.3. Information Quality.

Users also rely on information quality of an IT artefact in the course of their assessment. This variable measures basically the information output from the software system (Delone & Mclean, 2003); usually evaluated in the completeness, relevance, accuracy and security of data (Delone & Mclean, 2003; Delone & Mclean, 2004). Instruments here were assessed to evaluate how value is created and captured through system wide security and protection of confidential information (Security) and capacity to act with information from the system (relevance); Accuracy, which entails the perception of the user on the correctness of information produced. Also, extent to which

all necessary information are provided by the system (Completeness) (Delone & Mclean, 2004; Wixom and Tood, 2005).

Users are inclined to use the system the more when there is a greater information quality. And the more the IT infrastructure is used, at-least beyond ordinary usage, the greater impact is felt on business value. Likewise, this work looks at information quality impact on business value from two dimensions. Therefore, the second hypothesis is derived thus:

2. *There is a significant direct relationship between information quality of open source ERP and organization's business value.*

2b. *There is a significant relationship between information quality of open source ERP and extended use, and then to organization's business value.*

2.4.4. Service Quality.

This variable entails the overall support services delivered (Delone & Mclean, 2003; Delone & Mclean, 2004), and how they aid in creating and capturing value in an organization. IT personnel with strong skill sets will possess the ability to provide effective and efficient IT operations in an organization. Service quality can be evaluated by service behavior, service products and service provider (Jiang et al, 2009). For each of these objects, Jiang et al (2009) identified other five dimensions of quality indicators; Time and efficiency, price and cost, quality of service content, resources and conditions, reputation and risk. Unlike Jiang et al (2009) that conducted their research for a community-based software outsourcing process; this work treats a situation with internal service support department.

As the IT department possesses the requisite skill, and is able to resolve encountered challenges, also empathic to users, users will be more inclined to use the system more. This usage beyond the ordinary then leads to business value. In the case of American University of Nigeria, the IS department performs this function. This variable is assessed to evaluate how responsiveness, skill set and empathy of IS personnel impacts on business value of American University of Nigeria. IT personnel are not the users. Their contribution only motivates the users to use the technology the more. Thus, our third hypothesis will only triangulate indirectly to business value. Therefore, the third hypothesis is:

#3. There is a significant relationship between service quality of open source ERP and extended use, and then to organization's business value.

2.4.5. Extended Use.

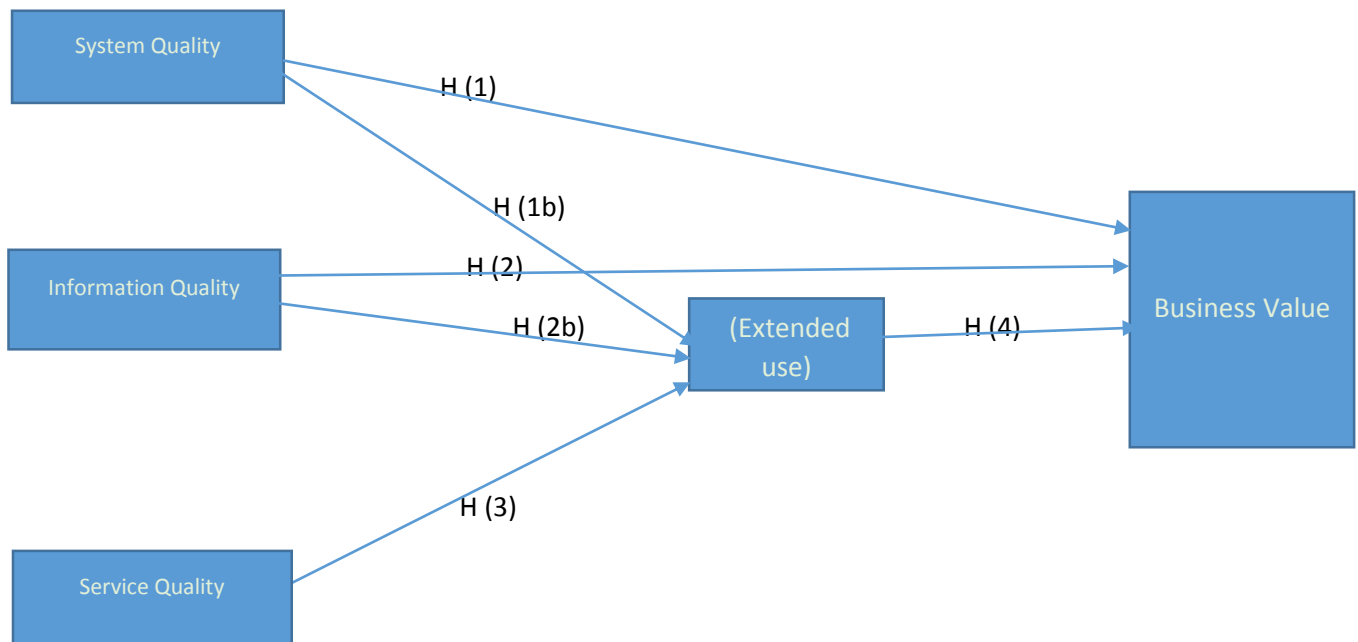
Software quality facilitates the use of a given IT infrastructure. But it is the extent of use of such technology that will most ultimately impact on business value. Extended Use entails motivating users to enhance their use of an already implemented IT system (Hsieh et al, 2011). Though management may mandate employees to use IT artifacts, Extended Use behavior is usually out of volition, as extent of usage is determined by an individual employee (Hsieh & Zmud, 2006). Hsieh and Wang (2007) terms it as usage behavior that exceeds simple, shallow and routine use, hence should be measured against certain time frame. Usage here usually cover most features of the technology, it also exceeds usage by average users, and facilitates learning of new functions. Therefore, it was adapted in this work to moderate Open source software quality characteristics (System quality, Information quality and service quality) and business value (Hsieh & Wang, 2007; Hsieh et al, 2011). That leads to the Fourth hypothesis:

#4. There is a significant relationship between extended use and organization's business value.

2.4.6. Business Value.

Business value in this work was adapted from (Seo, 2013). IT business value in the context of higher institution of learning was expressed in terms of improved information access, reduced wastages due to improved operational efficiency, campus wide integration, improved internal communication, improved self-service environment, enhanced reliability and integrity, real time access to data, elimination of manual processes etc.

Below is the re-conceptualized framework (based on Delone & Mclean, 2003 and Hsieh et al., 2011), capturing the hypothesis of this work.



From Figure 3., the software quality characteristics, including system quality, information quality and service quality individually impact on extended use, and then to business value. Meanwhile, both system quality and information quality are proposed to directly impact on business value.

Information of the studies on Theoretical Framework.

<i>Themes</i>	<i>Author (year)</i>	<i>Study design</i>	<i>Focus</i>
<i>Success Measurement Model and Extended Use.</i>	<i>Delone & Mclean, 1992;</i>	<i>N/A</i>	<i>IT infrastructure measurement models.</i>
	<i>Seddon, 1997;</i>	<i>N/A</i>	<i>A re-specified version of Delone & Mclean IS success model</i>
	<i>Rabaa'i, 2009;</i>	<i>Quantitative</i>	<i>Comparison of two varying IS success models.</i>
	<i>Delone & Mclean 2003;</i>	<i>N/A</i>	<i>Updated version of IT infrastructure measurement models.</i>
	<i>Gable et al, 2003;</i>	<i>Quantitative</i>	<i>Measurement models for assessing success of ERP systems</i>
	<i>Delone & Mclean, 2004;</i>	<i>Qualitative</i>	<i>Adaptation of IT success model</i>
	<i>Wixom & Tood, 2005;</i>		
	<i>Hsieh & Zmud, 2006;</i>	<i>N/A</i>	<i>IS implementation model and post-adoptive behavior</i>
	<i>Hsieh & Wang, 2007;</i>	<i>Quantitative</i>	<i>Issues of system under-utilization and extended use.</i>
	<i>Jiang et al., 2009;</i>		
	<i>Petter S & McLean E R, 2009;</i>	<i>Quantitative</i>	<i>Evaluation of the updated D & M IT success model.</i>
	<i>Hsieh et al, 2011;</i>	<i>Quantitative</i>	<i>Understands the antecedents, contingencies and consequences of extended use of IT artefacts</i>
	<i>Ononiwu, 2013;</i>	<i>Quantitative</i>	<i>Post-Adoptive Use</i>
	<i>Hsieh et al., 2014;</i>		<i>Model to understand employee use post-adoptive extended use of IT infrastructure.</i>
	<i>Mukti & Rawani, 2016.</i>	<i>N/A</i>	<i>Unveil the challenges of ERP implementation.</i>

Chapter 3

RESEARCH METHODOLOGY.

3.1. Research Design.

Every researcher brings certain worldview assumption into his/her work, which should be critically looked at, as it influences both research design and specific methods (Creswell, 2012). Worldviews encapsulates the general philosophical orientation about the world and the nature of research that a researcher brings into his work. They are usually a function of discipline orientation, advisor's/mentor inclination and past research experiences (Creswell, 2012). Worldviews defers on the standpoint of ontological, epistemological and methodological stance (Antwi & Hamza, 2015). Different worldviews include; Positivism, Realism (Critical Realism), Interpretivism, Pragmatism (Saunders et al, 2006). This research expresses the views of positivists.

Saunders et al (2006) highlighted the basic ideas of positivism. Positivist believes that a credible data should emanate from a phenomenon that can be observed; and that to generate a research strategy to collect these data, you will most likely use existing theory to develop hypothesis. This has been clearly done in the preceding section. Furthermore, these hypotheses will be tested and confirmed, in whole or part, or refuted, leading to further development of theory, that further research may test (which is done in subsequent section).

Positivism entails also that research be undertaken in a value-free way. That is, researcher is independent of and neither affects nor is affected by the subjects of the research. This worldview by virtue of these features usually adopt the quantitative research methods.

To maximize the benefits of quantitative research methods, this work deployed as research design the survey research strategy. This is particularly essential as data will be collected from sample of elements drawn from a well-defined population, through the use of a questionnaire (Visser et al, 1996). Using the survey design declines investigation of the whole population (which usually is time consuming and requires huge resources), but rather, will settle for samples drawn as a representative of the whole population; which is quite easy and achievable.

3.2. Population of the Study

A cross-sectional field study and multisource collection of data was conducted to test the Theoretical framework and hypothesis. Cross-sectional surveys are used to collect data from a sample at one-time period, aimed at documenting the prevalence of particular characteristics in a population (Visser et al, 1996). The unit of analysis were faculty and staff drawn from sample of Openerp users.

3.3. Sample size determination

Samples size of a given population can be obtained by either of these ways; using published tables, imitating sample size of similar studies and applying formulas etc. (Israel 1992). This research used the formula option. To do so, formula developed by Cochran (1965:75) as adapted by (Israel, 1992) is used. Furthermore, to do this, one has to select the appropriate level of precision, confidence level and degree of variability (Israel, 1992). The level of precision, also known as margin of error depicts the range in which the true value of the population is estimated to be. The confidence level tells how sure one is on the result accuracy. Then the degree of variability entails the homogenous or heterogeneous nature of the study population. A more heterogeneous population will require a greater sample than a homogenous population. The survey standard for these three criteria is usually 5%, 95% and 50% respectively (FluidSurveys, 2014), and these are adopted in this work.

The formula used to derive the sample size is;

$$n = Z^2pq/d^2$$

n is the sample size, Z2 is the abscissa (1.96), p is the degree of variability (50% or 0.5), q is (1-p), d is degree of precision (5% or 0.05).

$$n = (1.96)^2 \times 0.5 \times (1-0.5)/(0.05)^2$$

$$n = 384 \text{ (approx.)}$$

When we factor in the population size, the true sample size is derived by this formula.

$$n_a = n/(1 + (n - 1)/N)$$

n_a is adjusted sample size, n is the sample size, N is the total population size.

$$n_a = 384/(1 + (384 - 1)/430)$$

$$n_a = 203 \text{ (Approx.)}$$

Therefore, questionnaire was administered to over four hundred (400) participants, comprising of faculty and staff who currently use OpenERP to perform their task, and who have been using it for up to two years.

To encourage responses and to protect the confidentiality of subjects' feedback, subjects' identities were coded in such a way that only the researcher will be able to match data from different sources, and that no one in the institution could identify the subjects

3.4. Sampling procedure

When everyone in a population is measured, the true value of the population is usually known, except where measurement errors exist. But measuring the population can be demanding in areas of time and finances, hence, the need for sample. Likewise, to obtain a good sample for any study, appropriate sampling techniques must be used. Basically, there are two major sampling techniques; Probability sampling and Purposeful sampling (Barreiro & Albando, 2001). While the former entails a technique that ensures that each sample has the probability of been selected, the later tries to produce a representative sample depending on researcher's opinion or purpose, thereof making the representation subjective. Probability sampling is divided into random sampling, stratified sampling, systematic sampling and clustered sampling. For the purpose of this work, random sampling was adapted to obtain the sample size. This technique was chosen due to the homogenous nature of our research site, and also its ability to minimize biases. To ensure wider representation of participants, a random sampling selection process was performed to identify a sample size of over four hundred (400+) faculty and staff.

3.5. Instruments for data collection.

All variables in this study were operationalized with multi-item scales, and measures adapted from already existing scales, tailored towards the investigative context. These measures were collected from multiple data source; faculty and staff of American University of Nigeria. A five point Likert scale was used for each item, with anchors ranging from strongly agree (5) to strongly disagree

(1). This data sources were asked questions about software quality characteristics, extended use and business values.

Software quality is measured as a variable with three reflective dimensions: System quality, Information quality and Service quality. Items of measurement for these three variables were adapted from (Delone & Mclean, 1992; Delone & Mclean, 2003; Delone & Mclean, 2004; Petter & Mclean, 2009; Rehman & Sarraf, 2014; Jiang et al, 2009). Items for extended use was adapted from Hsieh and Wang (2007). As extended use does not occur on daily basis, Hsieh and Wang (2007) suggests that extended use be operationalized against certain time frame. Based on extant literature, the items of extended use will be controlled within two months' time frame (Hsieh et al, 2011). Measures for business value was adapted from the works of Seo (2013).

3.6. Administration of instruments.

This study was conducted in American University of Nigeria. The institution began the use of OpenERP on 5th January 2014, to replace the then legacy system (Banner). Thus the institution was chosen as it has successfully been running OpenERP over a two-year period. It was deployed to take care of the inadequacies posed by Banner, some of which includes; Unavailability of HR model. The institution needed a better solution that will integrate all functional areas of the institution. Also, Banner was not flexible; there were no rooms to develop new or additional functionalities. Then, the issue of multi-currency. American University of Nigeria is an institution comprising of both national and expatriate staff, who are paid in naira and dollar respectively. Banner had no provision to accommodate more than a currency at a time. Lastly, though not the least, Banner was quite expensive.

Users of OpenERP in the institution comprises of All staff, faculty and students, but this work restrains its survey to all faculty and some staff (in HR, Finance, Registrar, few in security, student Affairs etc.), to capture those that make greater use of it in the performance of their jobs. Estimated number of intense users ranges to 430 faculty and staff who were sent questionnaire surveys via email, of which phone calls and face to face follow up ensued.

3.7. Validity and Reliability of instruments.

Variable validity was assessed by examining both convergent and discriminant validity. When measures of a variable that are expected to be related to each other, in fact, are observed to be related to each other, convergent validity is established (Wixom & Todd, 2005). Items that reflect the same latent variables are indicated by high convergent validity. A satisfactory convergent validity must have average variance extracted equal to or above 0.5. On the other hand, when measures of a variable expected not to be related to each other are, in fact, observed to not be related to each other, requirement for discriminant validity has been met. Satisfactory discriminant validity entails that square root of average variance extracted of each latent variable should be greater than the correlations among the latent variable (Wizom & Todd, 2005; Straub et al, 2004)). The researcher was able to establish good Validity of all variables (See tables 1.1 and 1.2).

Also, the reliability of the measurement models was established. To do so, both indicator and internal consistency reliability were established. Indicator Reliability measures how well an indicator measures a given variable, while internal consistency measures how well the items on a test measure the same variables. To establish good indicator reliability and internal consistency, the square of each of the outer loading must equal or exceed 0.4, and composite reliability equal or above 0.6 respectively (Straub et al., 2004). All scales met both the 0.4 and 0.6 cut-off, indicating a consistency on the results based on the scales used in this work.

Based on the outcomes of these tests, the researcher concludes that the scales are both valid and reliable, hence, confident enough to proceed to test the hypothesis using structural equation modelling (Hox & Bechger, 2007; Gefen et al, 2000).

3.8. Ethical Consideration.

Ethical issues have increasingly become a matter of concern in research involving human subjects. Protection for human subjects in earlier times solely laid on the investigator, which brought a situation where research topic gained ascendancy over the welfare and dignity of human subjects (Kroll, 1993). Important legislations saw a complete reversal of this scenario.

Addressing ethical issues helps strengthen the quality of research work. And the onus lies on the researcher to observe standards of ethics in all aspect, with respect to the research process.

Ethical issues that was addressed in this research relates to maintaining the anonymity/ confidentiality of research participants. Anonymity was assured as research participant's identity cannot be linked with personal responses. Confidentiality was also addressed as the researcher was able to meet up with the promise of anonymity. Confidentiality is the management of private information by the researcher in order to protect the subject's identity (Fouka & Mantzourou, 2011). Either way, research participant dignity and privacy will be protected. Specifically, the ethics in research code of American University of Nigeria was strictly adhered to, as contained in the Consent Form for Adults, of which research participants were required to read, understand and accept, before proceeding to participate in the research process. The Consent Form ensures the protection of participant's right to autonomy. Autonomy entails ability for self-determination in action according to a personal plan (Fouka & Mantzourou, 2011).

The Consent Form also informs the research participant of his/her right and risk, associated with the research process, duration of the process and liberty of participant to cease participation in the event of foreseeable risk.

Chapter 4

4.1. DATA PRESENTATION, ANALYSIS AND INTERPRETATION.

The data analysis was done using SmartPLS 3. Of the diverse approaches to Structural Equation Modelling (SEM), Partial Least Square (PLS) was chosen over others, such as Covariance-based structural equation modelling (CB-SEM), Analysis of Moment Structure (AMOS), Linear Structure Relations (LISREL) etc., because of its ability to generate significant analysis with small sample size, it's paramount predictive accuracy, its ability in instances where correct specification of models is not guaranteed (Wong, 2013). All variables were modelled as Reflective. Measures are specified as reflective if they are being caused by their variable as against causing the variable (Bagozzi, 2011), are interchangeable and can co-vary (Wang et al, 2015). The three measures of software qualities (System quality, Information quality and Service quality) all satisfy these requirements of a reflective measurement (Petter et al, 2007; Wixom and Todd, 2005), and individually, they impact on IT business value.

Structural equation modelling combines both factor analysis and path analysis, aimed at obtaining parameter estimates of a model (loadings and cross-loadings), and to assess the fit of the model. The path diagram is made up of boxes and circles connected by arrows. The boxes usually capture the observed variables, while the circles represent the latent variables. Single arrows describe causal relationship in the model, with variables at the point of the arrow been caused by variables at the tail. Correlations are described by double headed arrows, though without a causal interpretation (Kox & Bechger, 2007). The structural model of SmartPLS Algorithm was used to test parameter fit of indicators to the latent variables. A bootstrapping procedure was further done to assess significance of the path coefficients, and extent of variance in the endogenous variable attributed to the exogenous variables. See below results of the analysis.

4.1.1 SmartPls Results.

For the analysis of this work to be done, survey questionnaire was sent to over four hundred (400) OpenERP users (comprising of faculty and staff) in American university of Nigeria. Exactly two hundred and five (205) participants responded, and out of this figure, two (2) were completely blank (which were deleted), and forty-three (43) missing values were identified. To proceed with the analysis, Mean Replacement was used in the SmartPLS, of which -9999 was used to replace

the 43 missing values. For significant analysis, the research sample size transcended the minimum sample required to give a significant analysis using SmartPLS. Hair et al., (2014) and Gefen et al., (2000) both agreed that the minimum sample should be ten (10) times the number of items in the most complex variables. Business value is the variable with the largest number of items, numbering a total of six. Six (6) multiply by (10) gives sixty (60), a value of which the number of participants that responded far exceeded.

To ascertain indicators loading, a PLS Algorithm was done, followed by bootstrapping, which helped unveil the path coefficients. From these were the Discriminant validity, Convergent validity, variable reliability and T-Statistics calculated. See below the PLS results.

Figure 2.1 (PLS Algorithm)

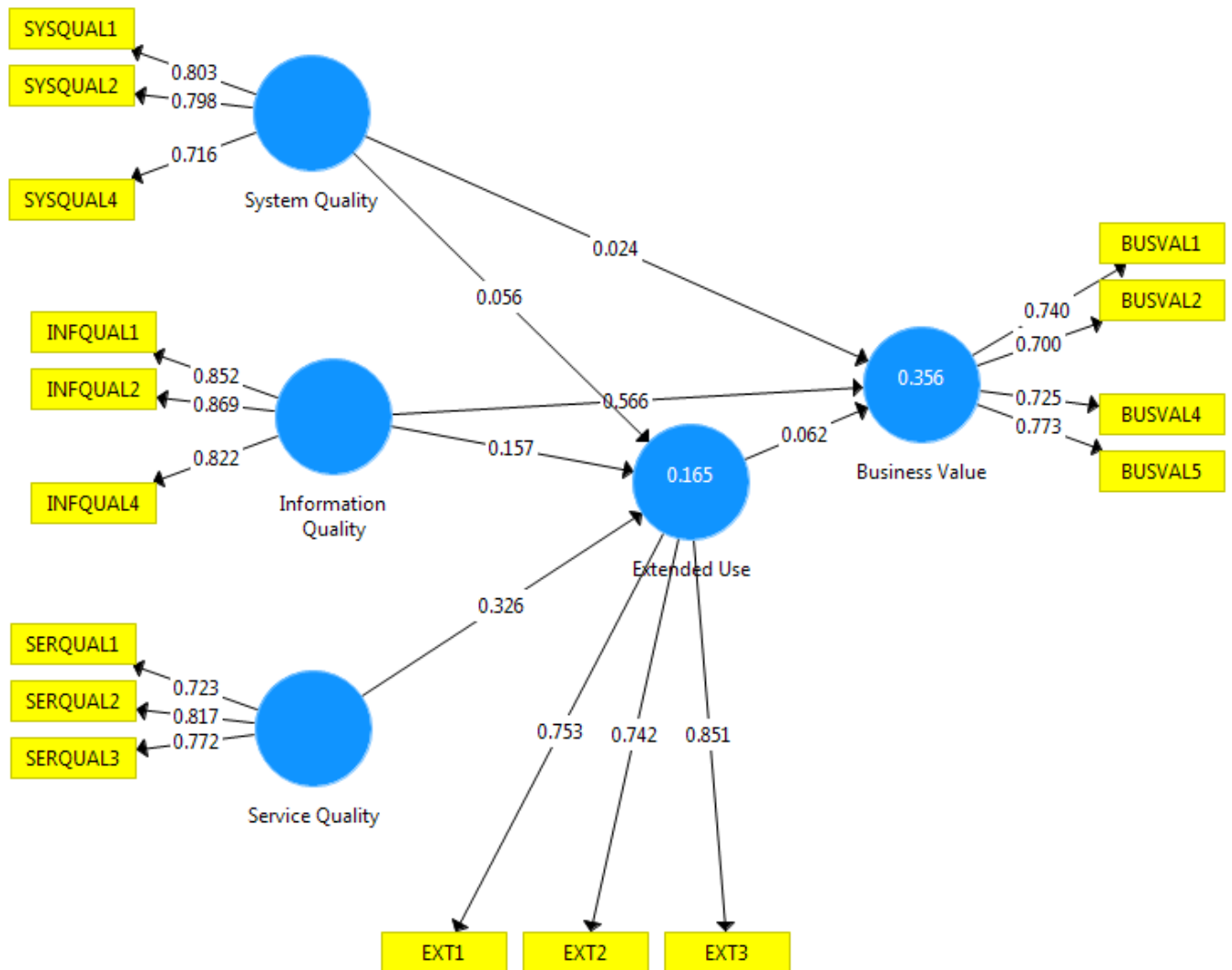
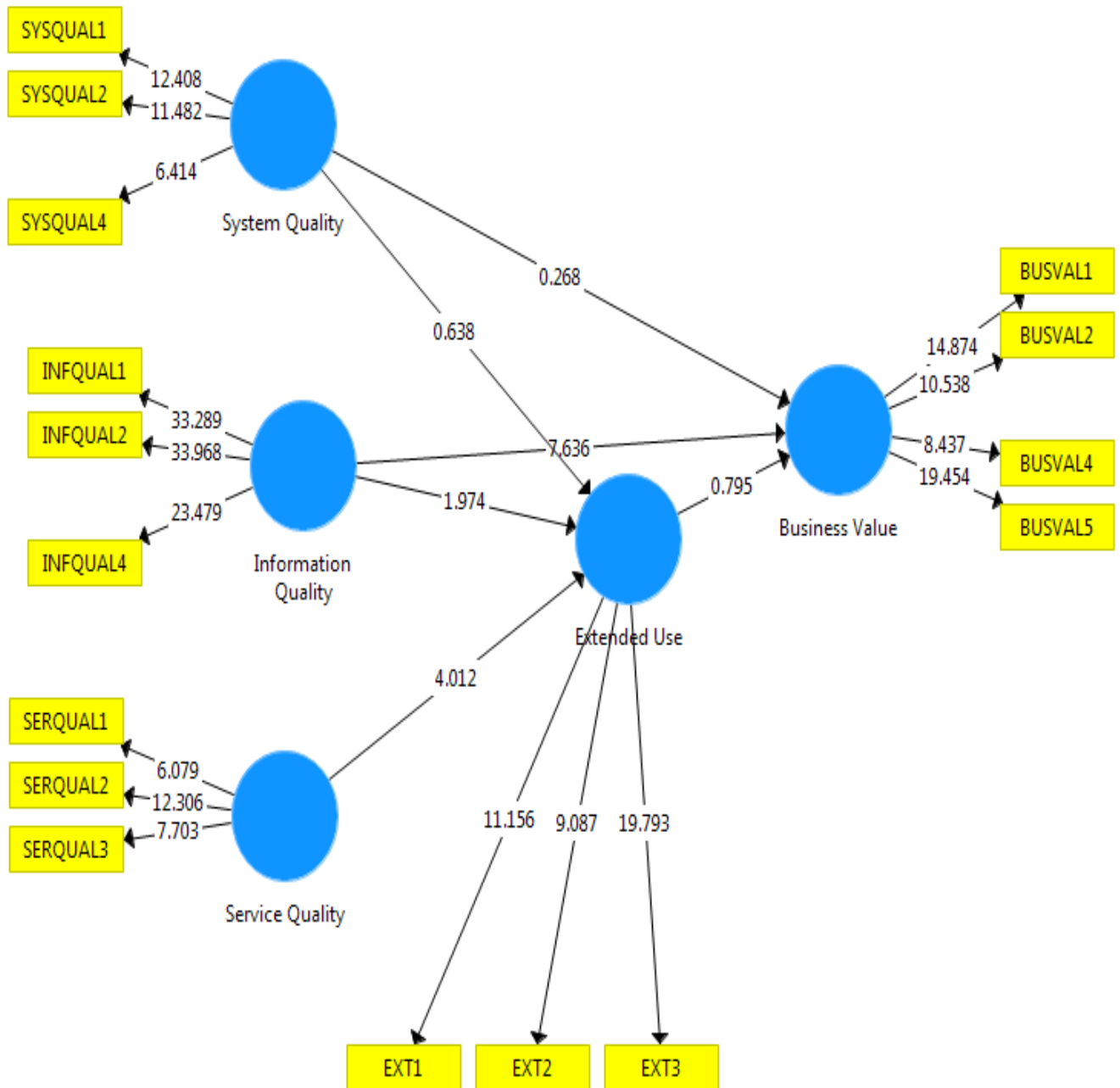


Figure 2.2 (Bootstrapping).



Discriminant Validity

Fornell-Larcker Criterion

Business Value	0.735				
Extended Use	0.199	0.784			
Information Quality	0.593	0.235	0.848		
Service Quality	0.024	0.360	0.150	0.772	
System Quality	0.330	0.195	0.520	0.176	0.774

Table 1.1

Variable Reliability and Validity.

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Business Value	0.718	0.726	0.824	0.540
Extended Use	0.704	0.774	0.826	0.614
Information Quality	0.804	0.806	0.885	0.719
Service Quality	0.695	0.752	0.815	0.595
System Quality	0.664	0.659	0.817	0.598

Table 1.2

Outer Loading

	Business Value	Extended Use	Information Quality	Service Quality	System Quality	<i>Square of Outer Loading</i>
BUSVAL1	0.740					0.55
BUSVAL2	0.700					0.49
BUSVAL4	0.725					0.53
BUSVAL5	0.773					0.60
EXT1		0.753				0.57
EXT2		0.742				0.55
EXT3		0.851				0.72
INFQUAL1			0.852			0.73
INFQUAL2			0.869			0.76
INFQUAL4			0.822			0.68
SERQUAL1				0.723		0.52
SERQUAL2				0.817		0.67
SERQUAL3				0.772		0.60
SYSQUAL1					0.803	0.64
SYSQUAL2					0.798	0.64
SYSQUAL4					0.716	0.51

Table 1.3

Bootstrapping (Path Coefficient).

Mean, STDEV, T-Values, P-Values

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Value s
Extended Use -> Business Value	0.062	0.075	0.077	0.795	0.427
Information Quality - > Business Value	0.566	0.563	0.074	7.636	0.000
Information Quality - > Extended Use	0.157	0.164	0.079	1.974	0.049
Service Quality -> Extended Use	0.326	0.332	0.081	4.012	0.000
System Quality -> Business Value	0.024	0.028	0.088	0.268	0.789
System Quality -> Extended Use	0.056	0.062	0.088	0.638	0.524

Table 1.4

4.2. Explanation of Results.

4.2.1. Explanation of target endogenous variable variance.

From figure 2.1., The coefficient of determination, R^2 , is 0.356 for the business value endogenous latent variable. This means that the four latent variables (System Quality, Information Quality, Service Quality and Extended Use) moderately explain 35.6% of variance in business value. System Quality, Information Quality and Service Quality explain 16.5% of the variance in Extended Use. With respect to the heuristics for correlation coefficient in Information System-Business research, .50 has been pegged as relationship that correlate significantly, while .30 and .10 are moderate and weak effects respectively (Straub et al., 2004).

4.2.2. Inner Model path coefficient sizes and significance.

The inner model suggests that Information Quality (0.566) has the strongest effect on Business Value, followed by Extended Use (0.062) and System Quality (0.024). Service Quality had no direct link to Business Value, hence was struck off. From this, the only hypothesized path relationship that is statistically significant is Information Quality and Business Value. The rest are not significant as their standardized path coefficient is lower than 0.1 (Wong, 2013). Therefore, the researcher concludes that Information Quality is a stronger predictor of Business Value, but that Service Quality predict Business Value indirectly.

4.2.3. Outer Model Loadings.

Indicator loadings become significant if equal or above 0.7, Hair et al (2011). In this work, indicators with loadings below this threshold were deleted, after which the PLS algorithm was ran, until indicators in figure 2.1. were retained, been able to meet the desired benchmark. Its worth of note that fourth indicators for both Service quality (SerQual4) and Extended Use (Ext4) both met the 0.7 threshold, however their inclusion brought about a reduced value (below 0.7) for two of the other indicators in each variables, if when deleted leaves these said variables with just two indicators each, thus not meeting up with three minimum required indicators for a variable.

4.2.4. Indicator Reliability.

To complete the examination of the structural model, it's vital to establish that the latent variables are reliable and valid. This entails deriving the indicator reliability, internal consistency reliability,

convergent validity and discriminant validity. Internal consistency measures a variable through varying items within the same instrumentation. To demonstrate acceptable reliability, scores from each of these items must correspond highly with each other (Straub et al., 2004). When items that reflect a variable show correlation that is significant with each other, especially when compared to the convergence of items relevant to other variables, we have a convergent validity. Discriminant validity test that measurement items that make up a variable differ from those that not believed to make up the variable (Straub et al., 2004). For the first two, square of each of the outer loading, with figure equal or above 0.4 and composite reliability equal or above 0.6 respectively suggests preferable reliability. For the last two, the average variance extracted should be equal or above 0.5 for a good convergent validity and the square root of average variance extracted of each latent variable should be greater than the correlations among the latent variable for a good discriminant validity.

From table.3, square of each indicator's outer loading exceeded 0.4, which is acceptable Wong (2013). All latent variables demonstrated high Internal consistency reliability as their composite reliability exceeded the 0.6 threshold, as can be seen in table.2.

On validity ground, average variance extracted of variables exceeded 0.5, signifying a good convergent validity. That's to say that more than half of the indicators' variance were explained by the latent variable. On the other hand, good discriminant validity was maintained as the square root of average variance extracted of each latent variable were greater than the correlations among the latent variables. See tables.1&2.

4.3. Bootstrapping.

Bootstrapping was also done to give credence to the path coefficient result given by the PLS Algorithm. For a path coefficient to be significant when bootstrapped, it's T-Statistics must have a value equal or above 1.96 (Wong, 2013). As can be seen in table.4, Information quality both directly and indirect has a significant path coefficient with Business Value, while Service Quality only had indirect significant path coefficient with Business Values. The rest were below the 1.96 threshold, therefore cannot be said to have significant path coefficient. All these tend to confirm and agree with the result of the PLS Algorithm.

Chapter 5

5.1. SUMMARY OF FINDINGS.

The structural equation result generated by SmartPls supports some of the research key arguments for the impact of information technology software quality characteristics on business value. This work could not find empirical support for the hypothesized relationship between system quality to business value, either directly or indirectly when moderated by extended use (Hypothesis 1 and 1b). But, support for the hypothesized relationship between information system quality and business value, both directly and indirectly, when moderated by extended use was found. Lastly, the researcher found a support for the hypothesized relationship between Service quality and business value, though indirectly when moderated by extended use. In a nutshell, System quality, information quality and service quality explain about 35% variance in business value, signifying existence of other factors (aside IT infrastructure) that contributes to business value. This supports Soh & Markus (1995) claim of existence of other infrastructure beyond IT that contributes to business value in an organization.

5.2. DISCUSSION AND RECOMMENDATION.

The purpose of this work is to evaluate the impact of software quality characteristics of open source information technology on business value of an adopting organization, by understanding the relationships among system quality, information quality, service quality, extended use _moderating variable, and business value. Through a survey of OpenERP users in American University of Nigeria, followed by subsequent structural equation modelling in SmartPLS, the important factors that impacts on business value were identified.

In this research, system quality is found to be measured in convenience, ease of use and integration of information. With loadings of 0.803, 0.798 and 0.716 respectively, they are good indicators of system quality. However, data loss was below the threshold of 0.70 (Hair et al, 2011), and hence was dropped as system quality indicator. The results of the SmartPLS bootstrapping for system quality was 0.268 and 0.638, which were far below the minimum of 1.96 (See figure 2, and table 1.4). Thus, a significant path coefficient between system quality and business value, was not

established. Therefore, our first hypothesis establishing a significant relationship between system quality of open source software and organization's business value when moderated by extended use has been debunked. This denotes that the investigated software is not convenient in helping faculties and staff in doing their job, and also, it's not intuitive enough in terms of ease of use. Respondents only continue to use it as its mandatory in the work environment. Management should therefore work closely with software team to enhance these capabilities, else, respondents will begin to find ways of bypassing the software.

It is also revealed that complete, relevant and accurate information are important indicators of information quality, with loadings of 0.852, 0.869 and 0.822 respectively. Meanwhile, security of information as an indicator was struck off as it did not meet up the 0.7 threshold. The bootstrapped results for information quality was 7.636 and 1.974, higher than the required figure of 1.96. Thus, establishing a significant path coefficient between information quality and business value. This then depicts that the second hypothesis establishing a significant relationship between information system quality and organization's business value has been validated. Therefore, because the investigated software produces complete, relevant, and accurate information, management can proceed to using the output of the software in managerial and strategic decision making. This should suffice to still retain the software, while something is done to enhance the system quality.

The indicators for service quality that were significant are responds, requisite skill and eagerness, with loadings of 0.723, 0.817 and 0.772 respectively. Problem solving though met the threshold, was dropped as its inclusion would have brought about deletion of two other indicators, leaving service quality with less than minimum indicators of three. The bootstrapped result for service quality was 4.012, higher than the required figure of 1.96, thus, evidencing a significant indirect impact of service quality on business value. The third hypothesis, therefore, establishing an indirect significant relationship between service quality and business value can be said to have been validated. Being that the support team are seem by respondents to possess the requisite skills, are eager to resolves challenges, management should find a way to channel these 'resources' to improving the system quality of the software. Possible community ties could be intensified to help in improving the system quality.

The indicators for extended use that were significant are usage beyond average user, usage beyond ordinary, learning from more usage, which all loaded 0.753, 0.742 and 0.851 respectively. The

bootstrapped result for extended use was 0.795, below the required figure of 1.96. That is an insignificant path coefficient between extended use and business value. Therefore, the fourth hypothesis establishing a significant relationship between extended use and business value has been refuted. What this connotes is that respondents are not using the software beyond as it is required to perform their task, and that due to lack of deep usage, learning of other functionalities has been grossed impaired. Non interest in deep usage could be linked to the poor system quality of the software. That still leads to the call on management to enhance the system quality of the software.

Lastly, the analysis of the inner model shows that system quality, information quality and service quality together, directly and indirectly (through extended use) explain 35.6% of variance in business value (which is moderate, Hair et al, 2011). This finding is vital as it suggests existence of others factors to be considered when exploring impact of open source software on business value in future research.

5.3. CONCLUSION.

Evaluation of open source information technology, though now widely adopted, is yet to receive tangible investigation that relates its software qualities to business value, compared to proprietary infrastructures. This study therefore fills a gap in the business value of information technology by investigating how software quality characteristics of open source information technology impacts on business value of an adopting organization. Software qualities were reflected in three dimensions; system, information and service quality. The study shows significant link between information and service qualities to business value, but could not significantly establish a link between system quality to business value. The research further found that information technology contributes only a certain percentage to business value, while the rest comes from other infrastructures beyond the IT infrastructures.

5.4. LIMITATION AND FUTURE RESEARCH.

The apparent key limitation to this research is time and resources. This challenge thwarted the thought of wider investigative context, that could have proven for a better generalization. Future research should be open to more than one higher institution, or a mix of both private and public higher institution to enable an encompassing generalization.

Appendix.

OPERATIONALIZATION OF VARIABLES.

VARIABLES	MEASURES	SOURCES
<p>System Quality</p> <p>1- Strongly disagree</p> <p>5- Strongly agree</p>	<p>SystQual 1: Using OpenERP is convenient in doing my work.</p> <p>SystQual 2: Using OpenERP is ease and it processes information fast</p> <p>SystQual 3: Using OpenERP does not need data back-up, as OpenERP does not lose my data.</p> <p>SystQual 4: Using OpenERP allow information that used to come from various places to be pulled together.</p>	<p>(Delone & Mclean, 2004; Petter & Mclean, 2009; Rehman & Sarrah, 2004; Wixom & Todd, 2005)</p>
<p>Information Quality</p> <p>1- Strongly disagree</p> <p>5- Strongly agree</p>	<p>InfoQual 1: Using OpenERP enable me produce complete information.</p> <p>InfoQual 2: Using OpenERP enable me produce desired relevant information.</p> <p>InfoQual 3: Using OpenERP enable me protect my work from unauthorized access.</p> <p>InfoQual 4: Using OpenERP enable me produce information that is reliable and accurate.</p>	<p>(Delone & Mclean, 2004; Petter & Mclean, 2009; Rehman & Sarrah, 2004)</p>
<p>Service Quality</p> <p>1- Strongly disagree</p> <p>5- Strongly agree</p>	<p>ServQual 1: OpenERP support team responds immediately when called upon.</p> <p>ServQual 2: OpenERP support team have the requisite skills that solves my problem.</p> <p>ServQual 3: OpenERP support team are always eager to resolve my issues.</p> <p>ServQual 4: OpenERP support team usually address my problem and need.</p>	<p>Jiang et al, (2009)</p>

<p>Extended Use</p> <p>1- Strongly disagree</p> <p>5- Strongly agree</p>	<p>ExU 1: In an Interval of two months, I use most of the OpenERP features I am give access right for.</p> <p>ExU 2: In an Interval of two months, I use OpenERP more than an average user in performing my work.</p> <p>ExU 3: In an Interval of two months, I have learnt new OpenERP function that is helping me do my work.</p> <p>ExU 4. In an Interval of two months, I invent new ways of doing my job with Openerp.</p>	<p>Hsieh & Wang (2007)</p>
<p>Business Value</p> <p>1- Strongly disagree</p> <p>5- Strongly agree</p>	<p>BusVal 1: With OpenERP, wastages of resources like stationeries, time etc has drastically reduced.</p> <p>BusVal 2: With OpenERP, I can make most of my request myself.</p> <p>BusVal 3: With OpenERP, I don't manually do my work anymore.</p> <p>BusVal 4: With OpenERP, internal communication has been enhanced.</p> <p>BusVal 5: With OpenERP, the reliability and integrity of my work has been enhanced.</p> <p>BusVal 6. With OpenERP, I can now make request to and work with various departments and units of the university without physical presence.</p>	<p>Seo (2013)</p>

QUESTIONNAIRE.

SYSTEM QUALITY CHARACTERISTICS -

Measuring processing performance of OpenERP

a) Using OpenERP is convenient in doing my work.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

b) Using OpenERP is easy and it processes information fast

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

c) Using OpenERP does not need data back-up, as OpenERP does not lose my data.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

d) Using OpenERP allow information that used to come from various places to be pulled together.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

INFORMATION QUALITY CHARACTERISTICS

Measuring information output of OpenERP software

a) Using OpenERP enable me produce complete information.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

b) Using OpenERP enable me produce desired relevant information.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

c) Using OpenERP enable me protect my work from unauthorized access

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

d) Using OpenERP enable me produce information that is reliable and accurate.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

SERVICE QUALITY CHARACTERISTICS

Measuring overall support services delivered

a) OpenERP support team responds immediately when called upon.

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

b) OpenERP support team have the requisite skills that solves my problem.

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

c) OpenERP support team are always eager to resolve my issues.

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

d) OpenERP support team usually address my problem and need.

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

EXTENDED USE

Measuring further usage of OpenERP software

a) In an Interval of two months, I use most of the OpenERP features I am given access right to.

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

b) In an Interval of two months, I use OpenERP more than an average user in performing my work.

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

c) In an Interval of two months, I have learnt new OpenERP function that is helping me do my work.

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

d) In an Interval of two months, I invent new ways of doing my job with OpenERP.

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

BUSINESS VALUE

Measuring the business value

a) With OpenERP, wastages of resources like stationeries, time etc has drastically reduced.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

b) With OpenERP, I can make most of my request myself.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

c) With OpenERP, I don't manually do my work anymore.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

d) With OpenERP, internal communication has been enhanced.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

e) With OpenERP, the reliability and integrity of my work has been enhanced.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

f) With OpenERP, I can now make request to and work with various departments and units of the university without physical presence.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

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