Effects of Interorganizational Trust on the Influence of Cloud Computing on Supply Chain Performance

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Abstract

This paper analyzes the effects of interorganizational trust on the influence of cloud computing on supply chain performance of fuel retail firms in Rivers State of Nigeria. Using the arguments of the social capital theory (SCT), a theoretical framework has been constructed that illuminates the role of interorganizational trust in cloud computing and how this can procreate imperious supply chain performance. A survey questionnaire was administered on 202 management staff of 55 retail petroleum marketing firms in Rivers State of Nigeria, and stepwise regression was used to test the hypothesis. The results suggests that cloud computing requires the moderating support of inter-organization trust to have a strong and significant influence on supply chain performance. The results therefore reinforce the across-the-board explanation presaged by germane theoretical framework as social capital theory (SCT), and recommends that managers should be prepared to develop sound interorganizational trust practices capable of reinforcing cloud computing that will dramatically improve the firms' supply chain performance. Nonetheless, further study and longitudinal anatomy should be conducted in a distributed industrial and geographical contexture to authenticate these findings.

Keywords: Cloud computing, Interorganizational trust, Petroleum marketing firms, Supply chain performance.

1. Introduction

The development of the internet and thereafter the World Wide Web (WWW) has situated an inner striving on companies to reappraise their business operations. The adoption of new technology by companies is a well investigated area (Wu, 2011).With the rapid development of information communication technologies (ICT), such as cloud computing (CC) and the internet of things (IOT) (Atzori, Iera & Morabito, 2010), new opportunities emerged to build applications which adequately integrate the real time conditions of physical resources and fill the gap between the virtual and real world (Distefano, Merlino & Puliafito, 2012). Howbeit, there are areas of concern in the decision to adopt cloud based services. There is the issue concerning information security and protection against non-authorization access (Duncan, Crest & Goldsmith, 2015; Ai, Khan & Vasilakos, 2015); the dearth of knowledge of the privacy capabilities of service providers (Del Alamo, Trupero, Martin, Yelmo & Suri, 2015); a deficiency of comprehension between the company and the cloud providers as to service scope and implementation (Autry, Grawe, Daughety & Riesay, 2010); technical obstacles (Wang etal., 2010), financial barriers that companies in distinct sectors might have to contend with the provisioned investment in technology and competent IT Personnel (Olivera etal., 2014; Abdollahzadehgar etal., 2013) and trust issues (Rahi, Bisui & Misra, 2016)

Trust in cloud computing is a delicate matter (Tang et al., 2016) and it is one of the most disputable issues in the materializing cloud epoch (Sidhu & Singh, 2016). Besides, it is a recent topic of research that has been looked into in many research and academic publications (Selvara & Sundararajan, 2017). Renowned trust theorists, have referred to trust as an instrument for managing with risk that is probable to increase in the request as technological progress generally increase (Lynn etal., 2016; Mohammad, and Navimipour, 2016). Several challenges exits in cloud based service adoption, because several trust issues are linked with the adoption of this technology (Rahi etal., 2016). This study, therefore investigates the moderating effect of Interorganizational trust on the influence of cloud computing service adoption on supply chain performance in the fuel retail firms in Rivers state of Nigeria.

1.2. Purpose of the Study

The major purpose of this study is to empirically investigate the effects of interorganizational trust on the influence of cloud computing on supply chain performance in retail petroleum marketing firms in Rivers State of Nigeria. Specifically, this study was aimed

i. to examine the extent to which interorganizational trust moderate the influence of cloud computing on supply chain performance of retail petroleum marketing firms in Rivers State of Nigeria.

1.3. Research Question

i. To what extent does interorganizational trust impact on the influence of cloud computing on supply chain performance?

2. Literature review and Hypothesis

2.1. Theoretical foundation

This study is anchored on the Social capital theory (SCT). The social capital theory proclaims the advantages that relationships between individuals or organizations can engender. The capital is explained as an asset to companies founded on means of approach to resources made obtainable via relationships (Lawson, Tyler & Cousins, 2008). The social capital theory is made up of three dimensions: cognitive, structural and relational (Nahapiet & Ghoshal, 1998). Cognitive capital alludes to the really existing resources that can equip supply chain partners with shared visions and collective goals (Krause, Handfield & Tyler, 2007); Structural capital alludes to the really existing structure of the relationship (Lawson etal., 2008); and relational capital alludes to the really existing relationships between parties grounded on a sequence of interactions that produce trust and mutual exchange (Lawson et al., 2008). Social capital theory supports that the extent of the relationship among firms in a supply chain has a momentous influence on supply chain performance embracing operational and relational measures (Benton & Maloni, 2005). The social capital theory is relevant in this study as we are trying to understand the perspective of fuel retail terminal managers, logistics/transport managers, fuel retail station managers and fuel retail station

supervisors regarding the effect of interorganizational trust on the influence of cloud computing on the supply chain performance of the fuel retail firms in Rivers State of Nigeria.

2.2. Cloud computing

Cloud computing services offer a user remote access to a copious information system from a mobile artifice or desktop, and proffers considerable assurance for future expansion (LeRoux & Evans, 2011). Cloud computing becomes visible as a computational paradigm as well as a distribution framework that aims at providing stable, rapid, suitable data storage and net computing services, with all computing means of support pictured as services and delivered via the internet (Zhong, Zhang, Chen & Huo, 2010). Cloud computing is a service-and–application based technology managed in a distributed network that employs virtual resources and is easy to reach through networking and internet approved models (Rezai etal., 2014). Cloud computing is an application delivered as a service through the internet and computing resources (hardware and software) in the data centers and furnishes on-demand access to these resources and services, supplied by service vendors to the ultimate user through pay-per-use services. The three major cloud computing service models a are: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) (Chen etal., 2016; Lal & Bharadwaj, 2016; Hoberg etal., 2012; Wu. 2011; Mell & Grance).

2.3. Supply chain performance

Supply chain management aims at integrating business processes that span the organizational threshold of supply network partners to create value for each stakeholder such as consumers, buyers, suppliers, and shareholders (Silvestro & Lustrato, 2014). A prevalent sentiment in the supply chain literature is that supply chain information flows facilitate superior responsiveness and harmonization of business processes that the whole supply chain attain through greater access to important supply chain information (Kembro, Selviaridis & Naslund, 2014; Williams, Roh, Tokar & Swink, 2013). Studies have investigated supply chain performance in distinct dimensions and perspectives. It is visible that as supply chain is a network of distinct organizations, therefore functioning in collaboration is inherent for optimal performance (Santanu, 2012). All facets of performance measurement need to see with exact performance metrics, measurement procedure, analysis, ample evaluation and lastly the important process (Tian etal, 2003). A number of characteristics of valuable performance measurement systems that can be employed in the evaluation of these performance measurement systems have been presented by Gunasekaran etal. (2004). These characteristics encompass: inclusiveness (measurement of all relevant aspects) universally (allow for comparison under various operating conditions) measurability. The measures of supply chain performance are: Logistics process flexibility (Misra & Sharan, 2014), order fulfillment (Mihi-Ramirez, etal., 2012) and information sharing (Barrat & Oke, 2004).

2.4. Inter-organizational trust

Pattan and Mohammed (2015) describe trust as a subjective correlative measurable association between interacting services eager to act steadily, securely and dependably in a particular state in

a precise context of a stated time. Rotter, Rahi, Bisui and Misra (2017).posit that trust relies on partners engaged in any transaction. Since cloud based service is an internet-based application and Fuel retail firms have a lot of confidential information, transmission of data through internet primary and rely on "trust" between products user and provider. As noted by Goel (2015:44,), trust in the context of cloud computing is a" complex process which requires all participants to disclose volumes of information about themselves". For a trust setting to be feasible, the actors are "universally required to accept the underlying premise of trust" (Kramar 2010: p.2). The trust evaluation mechanism as an impressive way to warrant service equality on the cloud computing (Xie et al., 2016). Different properties of trust exist in cloud computing such as types (different classifications), characteristics and applications (Chiregi & Navimipour, 2017). Also, Chiregi and Navimipour (2017) identified different classification of trust in cloud computing as; contained statistic-dynamic, direct-indirect, centralized-distributed and proactive-periodic; trust characteristics as; security dependability, integrity, reliability, dynamicity, safety, scalability, availability and confidentiality; and trust applications as monitoring and tracking. Kramar (2010) observes that there are three different aspects that determine the concept of trust in a system: Trust relations, Trust domains and Trust management: Goel (2017:47) concludes that "trust is very much based on the establishment of building a reputation amongst all participating entities" A trust model considers all the entities that constitute the cloud computing environment to maintain the chain of trust that subsequently "creates a web of trust" (Goel 2015:47).

2.5. Empirical Review

Trust as a relational capability is reflected on as a 'strong' success factor for cloud computing adoption, added to managerial and technical capabilities (Garrison et al., 2012). Some scholarly studies on trust have accumulated. For example, Chiregi and Navimipour (2017) embarked on a comprehensive study of the Trust Evaluation mechanisms in cloud computing, Rahl etal. (2016) identified the moderating effect on the adoption of cloud-based services, Jabber etal. (2016) proposed a trust model of service layer of the cloud computing for educational institutes, Chahal and Singh (2016) proposed a fuzzy rule based expert system for determining Trustworthiness of the cloud service provider, Pathan and Mohammed (2015) proposed a method for building customer trust in the cloud computing using an ICT-Enabled global regulatory body, Goel (2015) examined trusted supply chains: surveying competitive value of the clouds, Periz et al. (2014) proposed a taxonomy of trust relationships in authorization domains for the cloud computing, and finally, Liu, Rau and Wendler (2014) explored the relationship between trust and information sharing from a cross-cultural perspective and revealed that interdependent individuals were more relationship-oriented in building their trust than independent ones. It was the contention of Bapna and Gupta (2011) that trust positively motivates the sustainable growth of interactive information sharing among friends. Schniederjans, Ozpolat and Chen (2016) examined the impact of cloud computing use on collaboration and its ultimate impact on the agility of humanitarian supply

chains. Further, the study examined the role of inter-organizational trust in the relationship between cloud computing use and collaboration. Cloud computing use was empirically assessed through an interview analysis of a 19 individuals from humanitarian organizations. 107 participants from US relief organizations was later administered a survey questionnaire. Based on the conceptual model of the study, the partial least square test was used to examine the relationships between variables. The study revealed how cloud computing is used in a humanitarian context. Also, the results portray that cloud computing use has a positive and significant impact on collaboration between humanitarian organizations and their supplier. Collaboration was found to be significantly positively associated with agility in humanitarian organizations. The study provides a theoretically and empirically validated model showing the relationship between cloud computing use, collaboration agility and inter-organizational trust in humanitarian supply chains. Rahi etal. (2016) research was on identifying the moderating effect of trust on the adoption of cloud-based services. The study aimed at identifying the trust factors in the adoption of cloud services in semiconductor industry.

This study adopted interorganizational trust as a moderating influence on the relationship between cloud computing and supply chain performance. This was included in the model for the purpose of determining the interaction effects of cloud computing service adoption on supply chain performance. In this study therefore, the actualization of the foregoing conceptual framework implicitly and explicitly leads to the achievement of the objectives of the study; which is to investigate the extent to which interorganizational trust moderate the influence of cloud computing service adoption on the supply chain performance of retail petroleum marketing firms in Rivers State. Drawing on the above arguments, the following hypothesis can now be proposed:

Ho_1: Interorganizational trust does not moderate the influence of cloud computing on supply chain performance.

3. Methodology

3.1 Population, questionnaire and data gathering

A population of 55 firms was used in the study. The population framework was taken from the business directorate database of Rivers State Ministry of Commerce and Industry. The units of analysis were selected through the random sampling technique. Fieldwork kicked off on June 2,

2018 and terminated on December, 21, 2018. The sample admittedly constitute 55 firms and 95.3 percent response rate was used for the analysis.

3.2 Validity and Reliability of Research Instrument

The validity of the survey was ensured through the following actions: The survey instrument was subjected to both content and face constructs validities, by exposing the instrument to pear supervisor's approval, colleagues scrutiny and a pilot test rectification, in order to ensure that the statement raised adequately represent properly what it tends to measure. For the reliability of the instrument, the internal consistency was carried out on the instrument with the use of Cronbach,s Alpha to scientifically measure the reliability of the instruments that describe the factors/constructs, as recommended by Ahiauzu (2006) and Nunally (1978). The exact results of the scale reliability analysis are reported in table 1.

Table 1. Shows the reliability measure of the study variables (n=202).

Scale	Dimension	Items	Reliability
CCSA	Cloud Computing Service Adoption	5	0.924
SCP	Supply Chain Performance	4	0.897
IOT	Interorganizational Trust	4	0.947

Source: **SPSS 22.0 Output (based on 2018 field survey data).**

Table 1. summarizes the reliability result of the study variables, which also includes the individual item reliability. Significantly, all items are reliable and are used to study the effect of inter organizational trust on the influence of cloud computing on supply chain performance of fuel retail firms in Rivers State. The extent of the association between the variables can be operationalised thus: cloud computing service adoption (.924) with 5-items measure; supply chain performance (897) with a 4-item measure and interorganizational trust (.947) with 4-items measure.

4. Analysis and results

4.1. Analysis of Research Question

The descriptive relationships between the variables: interorganizational trust, cloud computing service adoption and supply chain performance are presented in this section. The descriptive statistics is presented in relation to the research questions earlier stated in the study. The descriptive

findings of the interaction of cloud computing, interorganizational trust and supply chain performance are reported in Table 2. The relationship between cloud computing, interorganizational trust and supply chain performance was investigated by testing the significance of their mean differences. Nwokah (2006) used similar method. The result in Table 3 show that the mean differences between cloud computing service adoption, interorganizational trust and supply chain performance are high and significant, thus providing a clue of a positive association between cloud computing service adoption, interorganizational trust and supply chain performance.

Table 2: CC, IOT and SCP (n=202)

	CC	IOT	SCP
Mean	21.72	15.50	11.34
Std. Error of Mean	. 270	.288	.257
Std. Deviation	3.834	4.021	3.647
Variance	14.701	16.172	13.298
Skewness	-1612	-1007	-680
Standard Error of Skewness	.171	.171	.171
Sum	**4387**	**3130**	**2392**

Source: SPSS Window Output, Version 22.0 (based on 2019 field survey data).

Note: CC = Cloud Computing

IOT = Interorganizational Trust

SCP = Supply Chain Performance

4.2. Test of Hypothesis

Ho_1: Interorganizational trust does not moderate the influence of cloud computing on supply chain performance.

As stated earlier, the three measures of supply chain performance defined in this study are logistics process flexibility, order fulfillment and information sharing. Each of these dependent variables is

regressed on cloud computing variables, interorganizational trust (IOT) and the interaction variable (CC*SCP), and the results are presented in tables 5, 6 and 7.

Decision Rule:

Reject **Ho_1** if the *p*-value for the interaction term is less than 0.05. Otherwise, do not reject **Ho_1**.

Table 3: Effect of Interorganizational Trust on the Influence of Cloud Compution Logistics Process Flexibility (n=202)

1	**2**	**3**
Variable	**Beta Coefficient**	***p*-value**
Constant	-673.376	0.000
SaaS	0.956	0.000
PaaS	0.766	0.000
IaaS	0.225	0.000
IOT	0.941	0.000
CC*SCP	0.935	0.000
R-square 0.4431	Adj. R-squared 4.429	Prob(F-statistic) 0.0000

Source: SPSS Window Output, Version 22.0 (based on 2019 field survey data).

Table 3 shows the multiple regression results for the moderating effect of interorganizational trust on the influence of cloud computing service adoption on supply chain performance based on regression model. As earlier stated earlier, the log of logistics process flexibility as a linear function of software as a service, platform as a service, infrastructure as a service, interorganizational trust and the interaction variable. The interaction variable (CC*SCP) is the product of the three cloud computing service adoption dimensions (SaaS, PaaS, and IaaS) and interorganizational trust. From table 3, the F-statistic is associated with almost zero probability, indicating that overall, the estimated logistics process flexibility model is highly significant. The Adjusted R-squared is 4.431, indicating that the estimated model has a moderate fit; the model explains approximately 44% of the total variation in logistics process flexibility. Thus, factors not considered in the model jointly account for the remaining 56%. As table 3 further shows, the estimated coefficients have mixed signs, with SaaS (= 0.956), PaaS (= 0.766), IaaS (= 0.325) and IOT (= 0.941) associated with positive signs. The interaction term (= 0.935) is associated with positive coefficient. All variables are associated with zero probabilities. This shows that the main effects of software as a service, platform as a service and infrastructure as a service are significant at 1% level. The effects of interorganizational trust and the interaction variable are also significant

at 1% level, suggesting that interorganizational trust moderates the relationships between cloud computing service adoption and logistics process flexibility.

Table 4: Effect of Interorganizational Trust on the Influence of Cloud Computing on Order Fulfillment (n=202)

1	**2**	**3**
Variable	**Beta Coefficient**	***p*-value**
Constant	5388.52	0.000
SaaS	0.962	0.000
PaaS	0.755	0.000
IaaS	0.338	0.000
IOT	0.965	0.000
CC*SCP	0.937	0.000
R-square 0.3448	Adj. R-squared 3.389	Prob(F-statistic) 0.000

Source: SPSS Window Output, Version 22.0 (based on 2019 field survey data).

Table 4 shows the multiple regression results of the moderating effect of interorganizational trust on the influence of cloud computing on order fulfillment based on regression model. As earlier , the log of order fulfillment as a linear function of software as a service, platform as a service, infrastructure as a service, interorganizational trust and the interaction variable. The interaction variable (CC*SCP) is the product of the three cloud computing dimensions (SaaS, PaaS, and IaaS) and interorganizational trust.

From table 4, the F-statistic is associated with almost zero probability, indicating that overall, the estimated order fulfillment model is highly significant. The Adjusted R-squared is 3.448, indicating that the estimated model has a moderate fit; the model only explains approximately 34% of the total variation in order fulfillment. Thus, factors not considered in the model jointly account for as much as 66%.

As table 4 further shows, the estimated coefficients also have mixed signs, with SaaS (= 0.962), PaaS(= 0.755), IaaS (= 0.338) and IOT (= 0.959) are associated with positive signs.

The interaction term (= 0.937) is associated with positive coefficient. All variables are associated with zero probabilities. This shows that the main effects of software as a service, platform as a service and infrastructure as a service are significant at 1% level. The effects of interorganizational trust and the interaction variable are also significant at 1% level, suggesting that

interorganizational trust moderates the relationships between cloud computing service adoption and order fulfillment.

Table 5: Effect of Interorganizational Trust on the Influence of Cloud Computing on Information Sharing (n=202)

1	**2**	**3**
Variable	**Beta Coefficient**	***p*-value**
Constant	30.406	0.000
Saas	0.911	0.00
PaaS	0.692	0.000
IaaS	0.442	0.000
IOT	0.959	0.000
CC*SCP	0.878	0.000
R-square 0.2184	Adj. R-square 2172	Prob(F-statistic) 0.0000

Source: SPSS Window Output, Version 22.0 (based on 2019 field survey data).

Table 5 shows the multiple regression results for the moderating effect of Interorganizational trust on the influence of cloud computing service adoption on information sharing based on regression model. As earlier stated in the study, the log of information sharing as a linear function of software as a service, platform as a service, infrastructure as a service, interorganizational trust and the interaction variable. The interaction variable (CC*SCP) is the product of the three cloud computing service adoption dimensions (SaaS, PaaS, and IaaS) and interorganizational trust. From table 5, the F-statistic is associated with almost zero probability, indicating that overall, the estimated profitability model is highly significant. The Adjusted R-squared is 0.3876, indicating that the estimated model has a moderate fit; the model explains almost 39% of the total variation in profitability. Thus, factors not considered in the model jointly account for the remaining 61%. As table 5 further shows, the estimated coefficients have mixed signs, with SaaS(= 0.911), Pass (= 0.692), IaaS(= 0.442), IOT (= 0.959) are associated with positive signs. The interaction term (= o.923) is associated with positive coefficient. All the cloud computing service adoption variables are associated with low probabilities, an indication that their individual effects on profitability are all significant. The coefficient on IOT is associated with high probability (*p*-value = 0.959), indicating that the main effect of interorganizational trust is statistically significant. The interaction term (CC*SCP) is associated with a zero probability, suggesting that interorganizational trust has positive and highly significant moderating effect on the relationship between cloud computing and information sharing. A close examination of these results shows that the logistics process

flexibility model generally out performs both order fulfillment and information sharing models. For example, as reported previously, the Adjusted R-squared for the logistics process model is 0.4431or 44%, while for order fulfillment and information sharing models, the Adjusted R-squared is 0.3448 and 0.2184 respectively. Therefore, the tenth hypothesis was tested based on the estimated logistics process flexibility model in table 4.43, focusing only on the *p*-values in column 3. From table 6, the associated *p*-value of the t-statistic corresponding to the interaction term (CC*SCP) is 0.0000 which is very much lower higher than 0.05. Therefore, we strongly reject the stated null hypothesis, implying that interorganizational trust moderates the influence of cloud computing service adoption on supply chain performance.

Table 5 shows that there is a strong and significant relationship existing between cloud computing service adoption and supply chain performance (r=0.970, pv0.000< 0.05).

5. Discussions and Conclusion

Our finding shows that interorganizational trust moderates the influence of cloud computing service adoption on supply chain performance. When interorganizational trust is held constant, the influence of cloud computing service adoption on supply chain performance strong and significant. It shows that interorganizational trust plays a significant role in moderating the influence of cloud computing service adoption on supply chain performance. This implies that as the interorganizational trust amongst supply chain partners is greatly adhered to, there is the perceived likelihood that it will affect positively, cloud computing that leads to a superior supply chain performance. Interorganizational trust is one of the major determinants of fruitful relationships amongst supply chain partners.

The paper concludes that interorganizational trust significantly moderates the influence of cloud computing service adoption on supply chain performance. A possible explanation to this is that virtually all the respondents used in this survey understand their firms' interorganizational trust level. This may have influenced the result. Goel (2015) asserts that members trust a system less when they notice that they have minimal control over their assets. This implies that when the members of a supply chain noticed that they possess reasonable ownership and control over data transferred to the cloud, they increase their trust in the system. Besides, trust between supply chain members as noted by Cao etal. (2017) will aid in raising the security issues existing within the party transferring the data concerning the utilization of cloud computing. To sum up, this paper analyzes the effects of interorganiztional trust on the influence of cloud computing on supply chain performance Using the arguments of the social capital theory (SCT), a theoretical framework has been constructed that highlights the role of interorganizational trust in cloud computingand how this can generate superior supply chain performance. A survey questionnaire was used to collect data from 205 executives of 55 fuel retail firms in Nigeria and stepwise regression was used to test the hypothesis. The findings of the analysis section of this study reports that the null hypothesis (Ho) was rejected, while the alternative hypothesis (H1) supports the theoretical rationale that associates the effect of interoganizational trust with the influence of cloud computing on supply chain performance. The relationship is statistically significant. Interorganizational trust can be a factor that facilitates the knowledge and capability building that may eventually lead to cloud computing that will transform supply chain performance positively. The results suggests that cloud computing requires the moderating support of interorganizationl trust to have a strong and

significant effect on supply chain performance. This implies that the role of trust along the supply chain can be a significant predictor of the positive impact of modern assimilative technologies (such as cloud computing) on firms' supply chain performance. The results therefore reinforce the across-the-board explanation presaged by germane theoretical framework as social capital (SCT).

6. Managerial implications, further research and limitations

From a more specific point-of-view, retail petroleum marketing firms' managers should acknowledge the benefits of cloud computing. These benefits will result in better supply chain performance (such as logistics process flexibility, order fulfillment and information sharing) when cloud computing service is adopted in conjunction with interorganizational trust that deepen and consolidate cooperation between supply chain partners. Again, managers should be prepared to develop sound interorganizational trust practices capable of reinforcing cloud computing services that will dramatically improve the firms' supply chain performance. This study has focused on retail industry that occupies major position in the supply chain of the final products in which they are involved. These firms also continually interact with upstream and downstream companies in the oil and gas supply chain. Thereupon, the implications of the findings incubated here should be far-flung and wholesome. Nonetheless, further study and longitudinal anatomy should be conducted in a distributed industrial and geographical contexture to authenticate these findings.

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