Understanding the Impact of Cloud Computing Service Adoption on Supply Chain Performance: An Empirical Study

Mac-Kingsley Ikegwuru
Supply Chain and Logistics Studies
And
Harcourt Horsfall
Department of Marketing
Rivers State University, Port Harcourt, Nigeria
[1]bestvaluecrest@gmail.com
[2]harcourthorsfall@gmail.com

Abstract

The field of technology takes a dynamic path and for organizations to survive in the highly dynamic, tempestuous and competitive business landscape, they must grasp technological innovations and flow with the pace of technological advancement. 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. A convenience sample of 55 companies taken from the fuel retail firms in Nigeria is used to test the study's hypotheses. The data were gathered by questionnaire survey, obtaining a 95.3 percent response rate. The multiple regression statistics was used to test the hypotheses. The results suggest that cloud computing service adoption has a very strong, significant and positive influence on supply chain performance. The study concludes that the results of the quantitative analysis demonstrate that cloud computing service adoption programs adopted by fuel retail firms in Nigeria affect supply chain performance through software as a service, platform as a service and infrastructure as a service. The implication for managers is that they should focus on higher levels of cloud computing service adoption to endear superior supply chain performance. The study recommends amongst others that in order to enhance supply chain performance, management should adopt cloud computing services that are capable of stimulating positive supply chain performance that are favorable for the focal company Further research should be carried out to investigate this topical area by using samples from both firms and respondents of fuel retail firms to confirm the relationship found in this study. This is one of the first attempts to untwist the effects wield by cloud computing service adoption on supply chain performance of fuel retail firms under the lens of technology, organization and environment (TOE) model.

Keywords: Cloud computing service adoption, Fuel retail firms, Nigeria, Supply chain performance.

1. Introduction

This background espouses the supply chain of the fuel retail firms, the importance of supply chain in the fuel retail firms, impact of cloud computing on supply chain performance, and knowledge gap. To remain competitive in the world wide business terrain, companies need to apportion their resources to information technology (IT) to advance both information sharing among supply chain partners and a setting possible for enriched supply chain performance. This is because the field of technology takes a dynamic path and for organizations to survive in the highly dynamic, tempestuous and competitive business landscape, they must grasp technological innovations and flow with the pace of technological advancement. Cloud computing stands as the most recent extension in the IT infrastructure (Lai & Bharadwaj, 2016). Cloud computing technology emerged in the 2000s as the final stage of IT architectural growth which alludes to "a computing model that enables organizations or individuals acquire computing power and software solutions through the

internet or parallel networks" (Laudon & Laudon, 2014: 200). The evolution of cloud computing in the past few years is one of the major breakthroughs in the history of computing, transforming the way information technology services are contrived for the first time, developed, deployed, sustained and purchased (Marston, etal., 2010).

Cloud computing technology sprang up and evolved out of distributed, grid and utility computing (Shau & Chau, 2016), and it is a complicated reckoning up of different service models such as: software as a service (SaaS), platform as a service (PaaS) and infrastructure as a service (IaaS) (Lal & Bharadwaj, 2016; Hoberg etal., 2012; Wu etal., 2011; Mell & Grance, 2011) and a firm can choose various combinations of distinct service models in order to adopt cloud computing. In recent times, cloud computing has allured a lot of focus in both business and academic domain. The importance of cloud computing to supply chain management appreciates as it receives an encouraging attention in academics and industry. The cloud improves agility, scalability, collaborations, availability, cleverness to modify to fluctuations in harmony with demand increase development work, and furnish potential for cost minimization through optimized and confidence computing (Centre for the Protection of National Infrastructure, 2010; Khalid, 2010). It is therefore, important to study cloud computing because, an entrance into the cloud ushers in numerous right of entry to applications and analytics that facilitate enterprise collaboration and supply transparency and visibility into demand planning and supply chains management processes, whose outcome is increased agility (Xu, 2012).

Cloud computing is recognized as a new business model and a direction that portrays the next-generation application framework, but most existing cloud based studies are exploratory, descriptive or cloud-based research (e.g., Lin & Chen, 2012; Wu etal., 2011; Sultan, 2011, Marston etal., 2011; Iyer & Henderson, 2010; Dillion etal., 2010). Given that the acknowledgement of the significance of cloud computing service is well supported in literature, many of the articles available on cloud computing service adoption are from the practitioners' perspective and very little from the academic research, with none bordering on cloud computing service adoption in the fuel retail sector in Nigeria. Previous studies (e.g., Benlien et al., 2010; Ge & Huang, 2011; Cheng et al., 2014; Lin & Liu, 2014; Fu & Cheng, 2015) and recent ones (e.g., Loukis et al., 2017; Attaran, 2017; Liu et al., 2016; Schnederjans, 2016; Hsu & Lin, 2014; Lal & Bharadwaj, 2016 Chen, Chaung & Nakatani, 2016) report on the impact of cloud-based services adoption in order to improve or maintain supply chain performance, conceptual development and risks opportunities, thereby making their works almost in-exhaustive.

Despite this background literature, there exists a dearth of scholarly inquiries on the influence of cloud computing service adoption on supply chain performance in the fuel retail firms in Nigeria. Against this background, the present study investigates the impact of cloud computing service adoption of Nigerian fuel retail firms on supply chain performance, and bridge the gap in knowledge by providing a cloud computing service adoption model through the lens of the Technological Organization Environment (TOE) Model.

2. Statement of the Problem

Previous scholarly inquiries (e.g., Benlien et al., 2010; Hui et al., 2010; Ge & Huang, 2011; Cheng et al., 2014; Lin & Liu, 2014; Fu & Cheng, 2015) and recent ones (e.g., Loukis et al., 2017; Attaran, 2017; Liu et al., 2016; Schnederjans, 2016; Hsu & Lin, 2014; Lal & Bharadwaj, 2016; Chen etal.2016) report on the impact of cloud-based services adoption in order to improve or maintain supply chain performance, conceptual development and risks opportunities, thereby making their works almost in-exhaustive. Aside, these studies being alien to the fuel retail industry and to Nigeria's setting, constitutes a geographical gap whereby scanty or no research has been done in the current site where the researchers intend to conduct their research, culture and other environmental variables may play down on the validity of their findings. Most existing cloud based studies are exploratory, descriptive or cloud-based research (e.g., Lin & Chen, 2012; Wu etal., 2011; Sultan, 2011, Marston etal., 2011; Iyer & Henderson, 2010; Dillion etal., 2010). These studies are founded on the general conceptualization and definitions of cloud computing, qualitative articulation of the clouds benefits and affairs, or supposition benefit reckonings based on cloud vendors' pricing lists. It lacks empirical studies. This is a methodological gap, since there is a trend to the use of qualitative approaches at the expense of quantitative method with the possibility that certain data that could be obtained only through the use of quantitative method may have been missed. This study will hence break with tradition and will employ quantitative approach.

The magnitude of these problems, bring about a research project to develop a standardized way of doing transaction safely and efficiently and connect fuel retail firms with the role of cloud computing as a change agent for quality supply chain performance. Thus, with a view to complementing the body of knowledge on cloud computing service adoption and supply chain performance, the current study seeks to investigate the link between the variables; using cloud computing service adoption on supply chain performance (logistics process flexibility, order fulfillment and information sharing).

3. Literature review and hypotheses

A sweeping review of literature was done to understand two major concepts of the study, i.e, cloud computing service adoption and supply chain performance.

3.1. Cloud computing service adoption

The name "Cloud" emanate from a network design that was used by network engineers to portray the position of several separate network artifices and there inter-connection. The shape of this network design was like a cloud (Guru 99, 2019). Cloud is extracted from the notion of business and users ability to obtain applications from anywhere globally on demand (Imran, 2013). Information system existing currently in the cloud are: (1) Email (2) ERP (3) Human Resources System (4) Information Security System (5) Video Conferencing (6) CRM (7) e-Business (8) Project Management (9) SCM. Cloud is used to describe platforms for distributed computing- a group cluster of servers, network, software, interface, etc, which enable a user to implement a specific amount of work. Thus, cloud computing is conceptualized as an assemblage to divest of a body, of corporeal existence of services obtainable from anywhere through the aid of a mobile device with an internet based connection (Misra & Mondal, 2010; Sultan, 2010). Armbrust, Fox,

Giffith, Joseph, Katz & Konwinski (2010) define cloud computing as an application delivered as a service through the internet and computing resources (hardware and software) in the data centers and furnish on-demand access to these resources and services. Goscinski and Brook (2010) defined cloud computing in terms of a computing technologies offered by a third party which, vigorously equips, configures, and reconfigures servers to handle a vast array of e-business needs. Holding the same view of Groscinski and Brook (2010, Amachandran and Chang (2016:619) define cloud computing as "transferring, manipulating, computing and storage of data via a network to an offsite computing infrastructure managed and maintained by a third party. The computing resources are configured to run application simultaneously to multiple users or multiple tenants". Based on technical perspective, IBM (2011) describes cloud computing as a shared IT infrastructure where computing inventiveness are dispersed but joined together via the internet into a massive pool of computing reserves and that cloud immediately regulate the distribution of computing resources as the need for computing service changes. This supports the views of Voas and Zhang (2009) that the "cloud" on the internet disguises accessible resources and furnishes a criterion interconnection, through which users would be enabled to use the whole World Wide Web as a potent personal computer. Miller (2009) sees cloud computing as the spread of management of applications and files to the 'cloud.' Zhao, Raicu and Lu (2008) observes that cloud computing is a large-scale apportioned computing model where virtualized and vigorously comprehensive computing power, storage, platforms and services are merged to provide on-demand services.

The above definitions and explanations clarify what cloud computing is. One common agreement among the authors is that cloud computing is an application delivered as a service through the internet. These definitions and explanations visualize cloud computing as the fusion of two components: applications delivered as internet based services and hardware and system software in data centers which tender the services. However, some important aspects of cloud computing, these authors seem to ignore are the terms such as infrastructure, hardware or platform as a service. The above definitions tended to focus on infrastructure or data centre based perspective like Amazon Web Services. Cloud computing itself is an involved reckoning up of distinct service models and a firm can choose different combinations of definite service models in order to adopt cloud computing. Cloud computing consists of three service models: 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, 2011).

This study examines cloud computing application from the perspective of the fuel retail firms, not a hardware vendor. The study will leverage the NIST categorization for cloud service types SaaS, Paas, and IaaS as they are more conspicuously used in practice. As a working definition, the study adopts Marston (2011: P, 10) encapsulation of cloud technical characteristics and business benefits defining cloud computing as:

> An information technology service model where computing services (both hardware and software, are delivered on-demand to customer over a network in a self-service fashion, independent of device and location. The resources required to provide the required quality-of-service levels are shared, dynamically scalable, rapidly provisioned, virtualized and released with minimal service provider interaction, users pay for the service as an operating expense without incurring any significant initial

capital expenditure, with the cloud services employing a metering system that divides the computing resource in appropriate blocks.

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). The three major Cloud Computing Offerings are:

- Software as a Service (SaaS)
- Platform as a Service (PaaS)
- Infrastructure as a Service (IaaS)

(Chen etal., 2016; Lal & Bharadwaj, 2016; Hoberg etal., 2012; Wu etal., 2011; Mell & Grance, 2011). The three major Cloud Computing Offerings is illustrated in Figure 1.

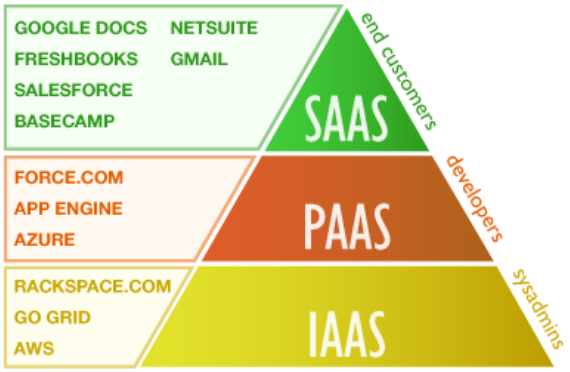

Figure 1. Cloud Computing Service Offerings
Source: Hutt, M. (2019) IaaS vs PaaS : The Difference. ezTalks Video Meeting

These three models or layers accomplished by the end-user layer and covered the end-user perspectives of cloud computing services.

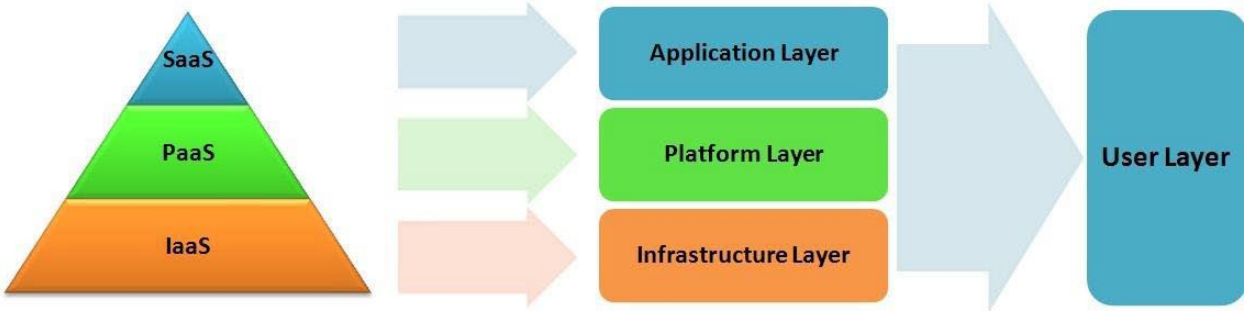

Figure 2: Cloud Computing Stack

Source: Hutt, M. (2019) IaaS vs PaaS : The Difference. ezTalks Video Meeting

As depicted in 2, cloud computing stack supply services for infrastructure, platform and application layers which encapsulated to ultimately support the user layer. Software as a Service (SaaS) encapsulates the vertical stack of service propositions from the basic infrastructure layer (IaaS) to platform layer (PaaS) to application layer (SaaS). Each layer in cloud computing stack can be integrated to or disintegrated from peer layers. The U.S. National Institute of Standards and Technology (NIST) define the service models of cloud computing as follows.

"Software as a Service (SaaS). The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

Platform as a Service (PaaS). The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has SaaS in Business: Exploring Strategic Benefits and Considerations of Software as a Service (SaaS) Model in Business Organizations

Infrastructure as a Service (IaaS). The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control of select networking components (e.g., host firewalls)." (Mell and Grance 2011).

Software as a service runs on a cloud infrastructure supplied by the cloud service provider. Customers can obtain applications from numerous client devices via a web browser or a program interface. Underlying ICT infrastructure of the cloud does not control by customer but cloud provider. With platform as a service, consumers are able to deploy and administer self-created or acquired applications on a platform supplied by the cloud provider. Underlying IT infrastructure of the cloud are not control by the customer but they have control over the deployed applications and are able to configure the settings for the application-hosting environment as well. Infrastructure as a service are owned, administered and operated by the organization itself, third party cloud service providers or can be a combination of them, and can be exist. These three models or layers accomplished by the end-user layer and covered the end-user perspectives of cloud computing services.

4. Supply Chain Performance

Supply chain is a series of continuous actions and changes of integration of supply chain activities and information flows linked with it, by ameliorating and harmonizing supply chain activities in manufacturing and product supply (Biniazi et al., 2011). Supply chain performance is defined as a measure of the ability of a supply chain to meet the customer requirements through product or service accessibility at the right time, at the right place, at the right price and at the right quantities (Cuthbertson & Piotrowiz, 2011). Supply chain performance transcends both functional line and company thresholds (Mugo, 2011). Supply chain performance improvement is an unceasing process that needs an analytical performance measurement system. It also needs a machinery to originate steps in order to meet key performance indicators (Cai etal., 2008). For any organization to stay competitive, it needs to acknowledge the central function of measuring performance. Forslund (2007) noted that high performance logistics needs supremacy in the discipline of measurement. This study in line with Mihi-Ramirez etal. (2012), Misra and Sharan (2014), and Barratt and Oke (2007), adopts logistics process flexibility, order processing, and information sharing as the measures of supply chain performance. Logistics process flexibility is defined keeping hard work network, software and people in mind information technology application consume resources and process may not be complete in the absence or opacity of any of the resources process flexibility in terms scaling up and down of resources function as a significant factor is cloud computing adoption.

Logistics processes flexibility: borders on receiving and delivering products as the source of supply and customers change, while operation flexibility permit firms to react to threats from competitors and fulfills customers' requirement in time and place (Fisch & Zschoche, 2012; Lim, 2011). Lambert (2004) defines order fulfillment as the supply chain process that involves more than just filling orders. According to Misra and Sharan (2014), order fulfillment lead-time involves: number of order delivered in full delivery on customer commit date and accurate documentation & perfect condition of the number of order delivered in full is considered perfect if the products ordered are the products provided and the quantities ordered matched the quantities provided (% in full). Delivery on customer commitment date entails that a delivery is measured perfect if the location, specified customer entity and delivery time ordered is met upon receipt. Accurate documentation supporting the order line is considered perfect. Information sharing refers to the coordination of information flow across the supply chain. A greater part of literature has examined integration in terms of information flow (Williams etal., 2013; Zhao etal., 2002). Information sharing between supply chain members should optimally lead to more effective supply chain.

5. Review of previous empirical studies on cloud computing service adoption and supply chain performance

In some prior studies, diverse authors established relationship that exist between cloud computing service adoption and supply chain performance. Chen etal. (2016) studied the benefits of cloud computing perceived by adopter and examine the impact of moderating factors on the relationship between the type of cloud computing and the perceived benefit. The moderating variables encompass firm size and value chain activities. A 5-point likert scale questionnaire was administered on businesses of different sizes in Taiwan. Such cloud computing benefits measured in the study include cost reduction, improved capability and enhanced scalability. A sample of

7000 companies was randomly chosen from four directories (Directory of Hi-Tech Promotion centre; Department of Economic Development; Taipei City and Government) The statistic for Taipei City firms and Corporations Registration (Taipei City Office of Commerce), Directory of Nanking Software Park Website and Business Registration Directory of Department of Commerce (MOEA), and invited to participate in the survey through postal mails. After expunging invalid responses, the study obtained 65 effective questionnaires. The one way analysis of variance (ANOVA) was used to analyze data. The findings demonstrate that after adopting cloud computing, business gain more capability in support activities than in primary activities. Nevertheless, there is no significant difference in composite benefit among software as a service (SaaS), Platform as a service (PaaS), and Infrastructure as a service (IaaS). Furthermore, there exist marginally significant interaction effect between the types of cloud computing and the business size.

Lal and Bharadwaj (2016) probed into the factors that power the adoption of cloud-based service and advanced the understanding of cloud-based adoption services on organizational flexibility. The study adopted an in-depth interview approach and semi-structured questionnaire. The theoretical sampling was employed and positive response was received from 21 organizations in India. The respondents are professional groups representing the managerial groups made up of CIOs, CTOs, IT-heads and system managers. The finding reveal that cloud based services provide relative advantage in terms of scalability, accessibility, and on demand deployment of services. In the cloud adoption decision, easy to use interface, experience, and expertise of the cloud service provider and support from top management plays significant role. Further, the study found that any model of cloud-based services (Software as a service (SaaS), platform as a service (PaaS), or Infrastructure as a service (IaaS) adopted impacts organizational flexibility (economic flexibility, process flexibility, performance flexibility and market flexibility). Fu and Cheng (2015) analyzed the factors affecting the adoption of cloud consumer relationship management in th (TOE)e framework as a theoretical framework. A pair wise comparison questionswas administered to top managers of firms in the machinery industry in Taiwan that have adopted cloud CRM. A fuzzy hierarchical process (FAAP) was used to sum up the weight of the factors. The result demonstrates that enterprises in the machinery industry gave precedence to the factor, support of senior managers, followed by the factors

5.1 Organizational policies and system information security.

Bortamuly and Goswami (2015) distinguished and anatomized the regulation of technological adoption in the handloom industry in Assam. The study employed a binary logistic regression model for primary data analysis, with the dependent factor (technology) dividing into two parts. It was revealed that the education level and annual income of the owners contribute immensely in the adoption of modern technology. Cao, Schniederjans and Schniederjans (2017), studied the establishment of the use of cloud computing in Supply Chain Management and seeks to address how cloud computing impacts information sharing among supply chain partners, the impact of cloud computing on supply chain performance. Using a multimethod research design, the authors present a combined semi structured interview of four different companies in the United States and a survey to analyze the empirically assessed results. Structural equation modeling was used to

analyze the results of the study. The findings provide empirical, information sharing and supply chain performance. The data provide evidence on the impact of Cloud computing in enhancing information sharing. This information sharing through cloud computing appears to positively impact supply chain performance.

Battleson, West, Kim, Ramesh and Robinson (2016) empirically investigate how dynamic capabilities with cloud computing can be achieved. A field study was carried out using multiple case study design on 14 organizations that use cloud computing. The purposive theoretical sampling technique was employed to select senior executives. The snowball sampling technique was also employed to distinguish key contact person as the Chief Information Officer. The result reveals that, organizations respond to market dynamism growing dynamic capabilities.Yang, Qu and Liu (2016), focused on the value creation potential of cloud computing in inter-firm partnerships. It investigates how cloud-based IT infrastructure capabilities in flexibility and integration contribute to partnering agility and, consequently firm performance. A questionnaire was adopted to gather data from 184 client firms of Alibaba cloud (the largest cloud computing services providers in China). The PLS analysis was used and the study revealed that cloud infrastructure (CI) flexibility has a positive effect on partnering agility, while the effect of CI integration on partnering agility is moderated by business influence on life cycle and market turbulence. Schniederjans, Ozpolat and Chen (2016), investigated the Impact of cloud computing use on collaboration and its consummate influence on the agility of humanitarian supply chain. The paper also analyzed the moderating role of inter-organizational trust in the relationship between cloud computing use and collaboration. The study employed an interview analysis on 19 participants from its relief organizations and their supporters. Collaboration was revealed to have a significantly positive relationship with agility in humanitarian setting.

Camara, Fuentes and Mmarin (2015) Analyzed the effects of two technologies, cloud computing and Web 2.0, on a firm's operational performance, examining the relationship between these two technologies and operational performance, and the mediating role played by supply chain integration. The study employed a random sample of 394 companies taken from Duns 50,000 database in Spain. The data were gathered by telephone survey using the CATL computerized system to manage interviewees' answers, obtaining a 19.36 percent response rate: factorial analyses and structural equation modeling were used to test the hypotheses. The findings suggest that cloud computing requires the mediating support of supply chain integration. However, these is no concluding evidence that web has a positive effect on either supply chain integration or operational performance. A positive, significant relationship was found between supply chain integrating and operational performance in all the models used. Kyriakoy and Pazalos (2016) investigate empirically the effects of firms inter-organizational collaboration or the design and implementation of innovations, and also use of ICT for supporting that collaboration, on firms propensity to adopt cloud computing and in this way examines objectively what extent firms regard cloud computing as a cost-effective means of supporting inter-organization collaboration for the design and implementation of innovation. It was revealed that firms of these sectors regard cloud computing as a cost effective means of supporting, collaboration with other firms for the design of innovations in their products, services and processes, and also of reducing the cost and increasing the capabilities and flexibility of current electronic support of inter-organizational

innovation design collaboration. Furthermore, the results show that firms find cloud computing useful for the reduction of the costs and the increase of the capabilities and flexibility of their current electronic support of the complex operations needed for the inter-organizational implementation of innovations.

6. Theoretical perspective and conceptual model development

In this study the technology, organization and environment (TOE) model was used as grounding for understanding the impact of cloud computing service adoption on supply chain performance.

6.1. TOE architecture

This study illuminates the Technology-Organization-Environment (TOE) Model in order to ascertain the influence of cloud computing service adoption on supply chain performance and adopted them thereafter. This present study is anchored on this model because its relevance to cloud based services adoption and supply chain performance. The TOE model was developed by Tarnatzky and Fleibher (1990) and it is a framework that proposes that technological innovation adoption is a function of three facets: Organizational context (allied to resources and their internal attributes); Environmental context (inside which it regulates its business procedures); and Technological context (constitutes organization allied internal and external technologies accessible in the market employed, or not, by the organization) (Baker 2012). The TOE provides a technological perspective and also emphasizes the important influence of organizational attributes and environmental factors. Thus, it is a framework for investigating adoption of a collection of information systems, products and ICT services on the organizational level. Zhu, Kraemer, Xu and Dedric (2004) assert that TOE is one of the most far-reaching theoretical frameworks on ICT adoption, providing an extensive background of technology adoption and application and presages the impression on value chain agility and the ensuring diffusion of factors that impact business decision. (Wang, Wang & Yang, 2010; Salwani, Marthandan, Narzaidi & Cheng, 2009; Lin & Lin, 2008). This study conceptualizes cloud computing adoption through the TOE framework perspective as a theoretically informed consortium of established constructs adopted for cloud computing spanning technological, organizational and environmental perspectives of the firm to identify projecting factors that impact cloud computing and how it can lead to supply chain performance of the fuel retail firms in Nigeria.

Figure 3 shoes the conceptual model developed based on the literature review for this study. Based on the foregoing, this study argues that a firm's supply chain performance resulting from cloud computing service adoption depends largely on the available cloud-based service at the disposal of the firm which fundamentally leads to supply chain performance in terms of increase in logistics process flexibility, order fulfillment, and information sharing.

The cloud computing service adoption framework developed in this study proposes that CCSA have a direct impact on supply chain performance through logistics process flexibility, order fulfillment and information sharing. Based on the foregoing, this study contends that a firm's supply chain performance resulting from the use of cloud computing services hinges predominantly on the architecture of accessible resources at the disposal of the firm. Such precious architecture is imaged in software as a service, platform as a service, and infrastructure as a service which eventually leads to success in supply chain performance in terms of increase in logistics process flexibility, order fulfillment, and information sharing. Based on this argument, the conceptual framework adopted in this study is designed as follows.

i Cloud Computing Service Adoption (CCSA) – the independent or predictor variable (IV or PV);

ii Supply Chain Performance (SCP) – the dependent or criterion variable (DV or CV).

The study therefore argues that success in supply chain performance is a function of cloud computing service adoption.

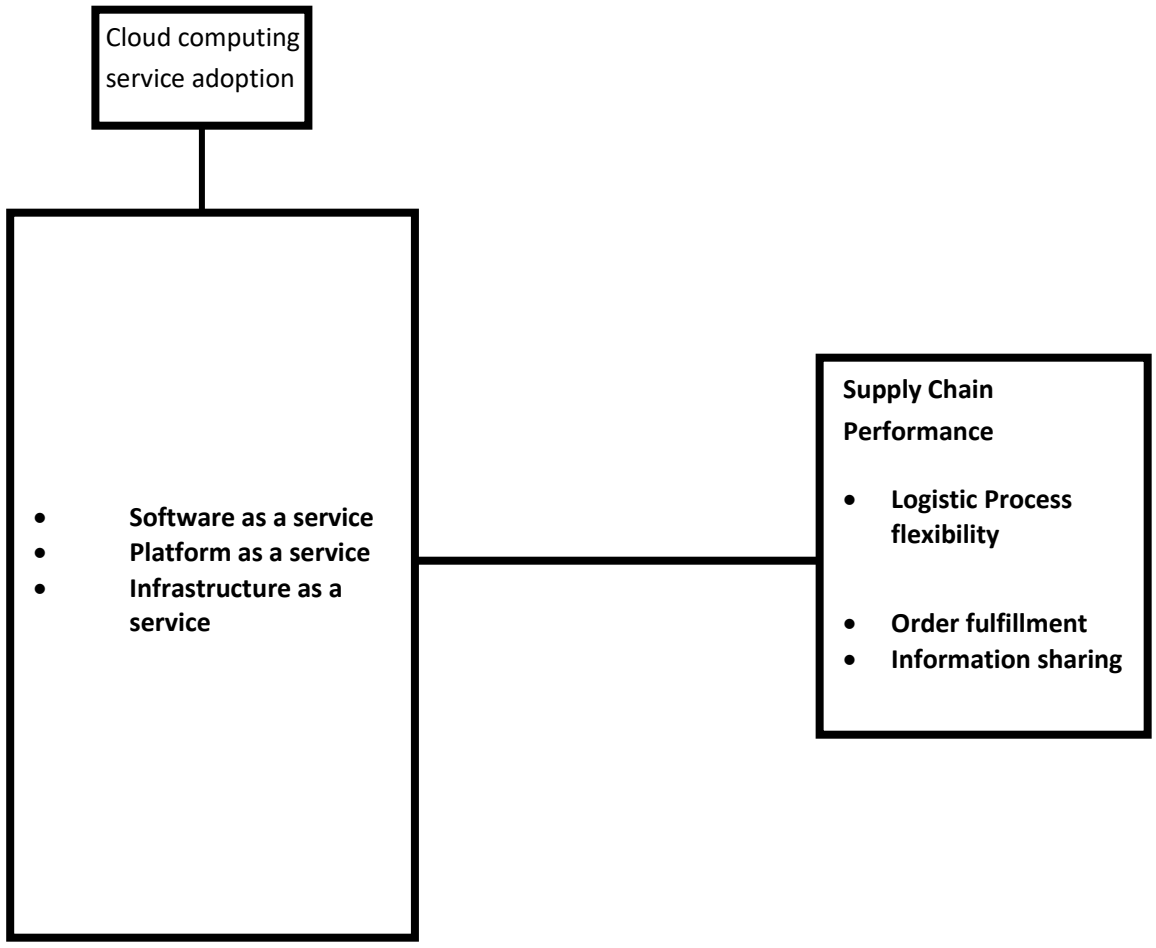

Figure 3.. Conceptual framework of cloud computing

Service adoption and supply chain performance

As noted earlier, CCSA have an impact on various aspects of supply chain performance. This leads to the following hypotheses.

Ho_1: Cloud computing service adoption does not significantly influence logistics process flexibility.

Ho_2: Cloud computing service adoption does not significantly influence order fulfillment.

Ho_9: Cloud computing service adoption does not significantly influence information sharing

3. Research Methodology

3.1. Sample and data collection

A survey instrument was developed to investigate the impact of CCSA on supply chain performance. The questionnaire was pre-tested several times to guarantee that the wordings, format, and sequel of questions were suitable.

Data for the study was collected through a self-administered questionnaire that was distributed to 220 fuel retail firms' managers within the city of Port Harcourt in Nigeria. The sample was selected through the convenience sampling technique from the database of the Business Registration Directorate of the Commercial Department of the Rivers State Ministry of Commerce and Industry, Port Harcourt. The sampling frame consists of 55 fuel retail firms operating in Nigeria. Of the 220 questionnaires administered, a total of 202 questionnaires were returned after three follow-up. A total of 10 questionnaires were discarded due to incorrect filling, missing and fragmental information in the demographic profile. The overall response rate was thus 95.3 percent which was considered satisfactory for subsequent analysis.

7. Measurement of Variables

7.1 Cloud Computing Service Adoption

A total of 15 items were chosen to test cloud computing service adoption using the cloud computing service types from the original study of Chen etal. (2016) as the basis for selection. The questions were grouped in constructs from the previous studies, but missing of questions took place. Five of the questions bordered on software as a service, five on platform as a service and five on infrastructure as a service. Chen etal (2016) present evidence of convergent validity, discriminate validity and concurrent validity for these measures of cloud computing service adoption. The wording for these questions was adopted primarily from the study of Hoberg (2012) instrument which validated Chen etal (2016) construct in the Taiwan context. Hence we become more confident that the activities comprising cloud computing service adoption in the fuel retail firms operating in Nigeria are similar to those found by Chen etal (2016),.Consequently, the cloud

computing service adoption construct in this study was measured by Chen etal (2016), scale. A five-point scoring format (1= strongly disagree, 5 = strongly agree) was employed for all 15 items.

7.2 Supply Chain Performance

This section examines various measures of the indicator of the dependent variable, supply chain performance are compiled from extant literature: logistics process flexibility and order fulfillment, as well as relational measure such as information sharing. These measures encompass both operational and relational components, which are well supported in previous studies (Krocks & Ghosh, 2010; Chen & Paulraj, 2004). The sources of these indicators are listed in Table 1. Hence, each respondents in the study was asked to rate on a five-point Likert scale his/her company's existing supply chain performance relative to competitors as it affects cloud computing service adoption variables with respect to logistics process flexibility, order fulfillment and information sharing. A total of 16 items were used to measure the relationship between cloud computing service adoption variables and supply chain performance indices.

Table 1: Sources of Supply Chain Performance

Supply Chain Performance	Sources
Logistics Process Flexibility	Mihi-Ramirez etal. (2012)
Order Fulfillment	Misra and Sharan (2014)
Information Sharing	Barratt and Oke (2007)

Source: Review of Literature, 2019

8. Results and discussion

Data analysis for the study was conducted in three steps. The first step were analyzed to understand the cloud based service models frequently used by fuel retail firms in Nigeria, the second step examined the categories of value chain activities fuel retail firms use cloud computing for, and the third step aided in investigating the impact of cloud computing service adoption on supply chain performance. The study covered only those firms that have applied either one or a combination of cloud based services models (SaaS, PaaS, or IaaS) for IT applications. There is a considerable usage of the cloud based service models in the fuel retail firms studied

8.1. Types of cloud based service models used by firms

The study examined the extent of the use of the three cloud based service models (Saas, PaaS, or IaaS) in fuel retail firms in Nigeria. The result is presented in Table 1

Table 2: Types of Cloud based Service Models Employed

S/n	Dimension	Frequency	Percentage
1.	Software as a Service	99	49.0
2.	Platform as a Service	63	31.2
3.	Infrastructure as a Service	40	19.8
	Total	202	100.0

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

Table 2 demonstrates that 99 or 49.0% of the respondents use the SaaS service model, 63 or 31.2% use the PaaS service model while 40 or 19.8% use the IaaS service model. This implies that there is a considerable usage of the cloud based service models in the fuel retail firms studied. This is further illustrated in Figure 4.

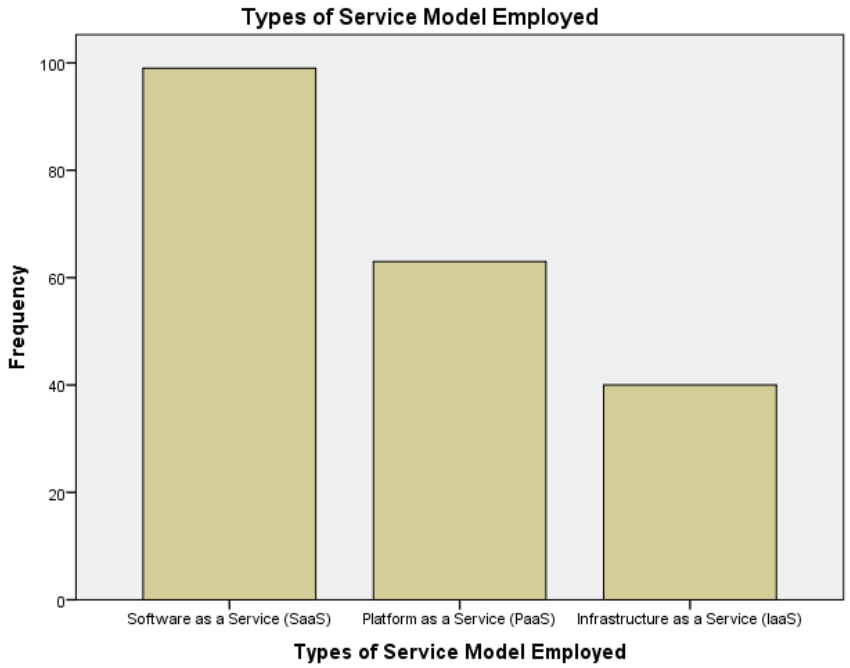

Figure 4: Types of Cloud based Service Models (n=202).

8.2. Categories of value chain activities cloud computing is used for

Table 3: Categories of Value Chain Activities (n=202)

SN	Value Chain Activities	Frequency	Percentage
1	Inbound Logistics	47	23.3
2	Outbound Logistics	35	17.3
3	Marketing & Sales	53	26.2
4	Technological Development	57	28.2
5	Company Infrastructure	10	5.0
	Total	202	100.00

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

The participants in this study identified five categories of value chain activities that are powered by cloud computing. Table 3 reveals that the five categories of value chain and the respondents there includes 47 for Inbound Logistics (23.3%), 35 for Outbound Logistics (17.3%), 53 for Marketing and Sales (26.2%), 57 for Technological Development (28.2%) and 10 for company infrastructure (5.0%). This is further illustrated in figure 4.9.

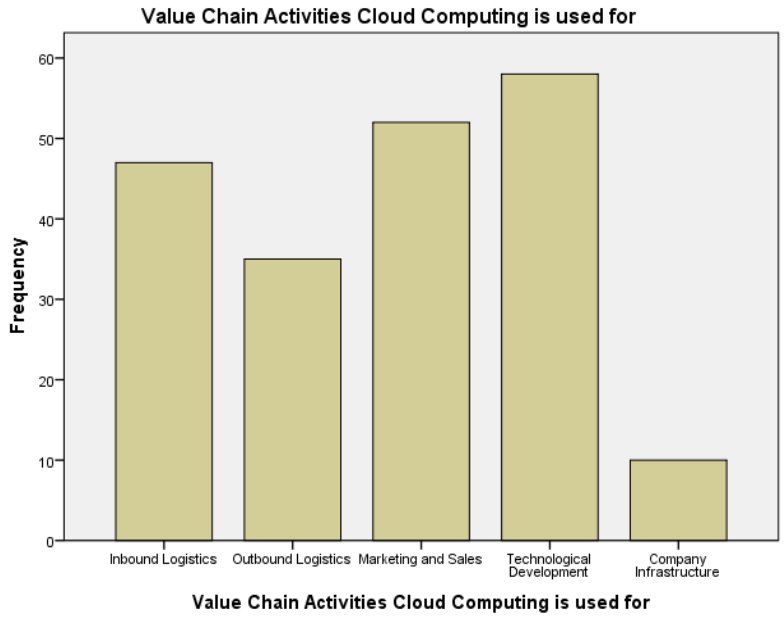

Figure 5: Value Chain Activities (n=202).

As can be seen from figure 5, the option on the use of cloud computing for Technological Development had more respondents, followed by Marketing and Sales. The use of cloud computing for Inbound Logistics produced the third highest response on the instrument, responses on Outbound Logistics recorded fourth position while, the least response rate came from the use

of cloud computing for company's infrastructure activities. Thus, the responses were composed of cloud computing usage for disparate value chain activities.

8.3. Regression analysis

The Multiple Regression was used to measure the impact of cloud computing service adoption on supply chain performance, while controlling for the effect of other variables (s). Under this, a stepwise selection was employed to test the collinearity among independent variables in a regression coefficient.

Table 4: Model Summary

Model	Variables Entered	R	R2	Adjusted R2	Standard Error of the Estimate
2	a)CCSA b) Logistics Process Flexibility	0.967	0.934	0.933	0.843
3	a)CCSA b) Order Fulfillment	0.969	0.939	0.938	1.039
4	a)CCSA b) Information Sharing	0.926	0.858	0.856	1.511

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

In Table 4, model 1 (R2 = 0.934, P<0.01) shows that the predictor variables explained about 93.4% behaviour variations of logistics process flexibility; model 2 (R2 = 0.939, P<001) shows that the predictor variables explained about 93.4% variations of order fulfillment; and model 3 (R2 = 0.858, P<0.01) indicates that the predictor variables explained about 95.8% of variations in information sharing. The correlation matrix denotes that the independent variables have varying degrees of relations on supply chain performance, logistics process flexibility, order processing and information sharing at P<0.01.

8 .4 Test of Model Utility

The serviceability of the overall regression statistics was tested prior to the testing of the individual hypotheses for their levels of significance. The fitness of the model can be explained by F-ratio in Table 4.45. The F-ratio in the model is 1145.195, which is very significant at $p < 0.05$. This implies that there is significant evidence to extrapolate that cloud computing service adoption is linearly related to supply chain performance. The study concludes that, the regression model is useful to the extent that the predictor variable significantly predict the behaviour of the metrics of dependent variables investigated. The implication is that the independent variable has none zero coefficient.

This proposes that the model is measured to be fit and that cloud computing service adoption has substantial influence on supply chain performance.

Table 5: F-ratio Test

	Model	Sum of squares	Df	Mean square	F	Sig. 000[b]
1	Regression	2527.278	3	842.426	I145.195	
	Residual	145.652	198	736		
	Total	2672.931	201			

a. Dependent Variable: Supply Chain Performance

b. Predictors: (Constant), CCSA.

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

According to results of this study all hypotheses were supported and it was found that cloud computing service adoption has impact on supply chain performance thus supporting earlier works (Chen etal., 2016; Lal & Bharadwaj, 2016; Hoberg etal., 2012; Wu. 2011; Mell & Grance, 2011). The findings analyzed in this study show that fuel retail firms' " cloud computing service adoption is a driver for firms' " supply chain performance". A scale for measuring CCSA and its impact on supply chain performance was proposed through multiple regression analysis. Gaining knowledge on these areas is critical for all successful managers in order to improve supply chain performance in today's highly challenging and competitive business landscape. This study confirms that CCSA affect supply chain performance of retail fuel firms in Nigeria. The findings of this study show that the development of stable supply chain performance is affected by cloud computing service adoption that has significant influence on logistics process flexibility, order fulfillment and information sharing.

The regression analysis of (of cloud computing service adoption and supply chain performance) revealed that the model was statistically significant in explaining fuel retail firms' supply chain performance across the three metrics (logistics process flexibility, order fulfillment and information sharing). It was therefore, established that the study made statistically significant contributions in predicting the behaviour of supply chain performance. These findings were fairly robust across the three metrics as no insignificant influence was recorded.

9. Conclusion and implications

This work focused on investigating the influence of cloud computing service adoption on supply chain performance in the fuel retail firms in Nigeria. The study attempted to assess the extent to which responses from the respondents on cloud computing service adoption explain supply chain performance. The research used the TOE model for interpreting the findings. This paper has provided empirical justification for a framework that identified cloud computing service adoption and supply chain performance within the context of fuel retail firms. Data for the study were collected from a sample of 55 retail fuel firms in Nigeria and the research framework was tested using the multiple regression analysis. The result indicate that cloud computing service adoption have a significant and direct impact on supply chain performance.

The study offers some managerial implication s. First, by developing and validating the construct of cloud computing service adoption and by exhibiting its value in improving the supply chain performance, it provides fuel retail firms managers with a useful tool for evaluating their existing supply chain management processes. Second, the analysis of the relationship between CCSA and supply chain performance indicates that the adoption of cloud computing might directly influence the supply chain performance of fuel retail firms. Third, the findings of this study tend to support the view that implementation of CCSA programmes has a significant impact on the supply chain performance of fuel retail firms in emerging country

10. Contributions to Knowledge

This research provided the validity to the concept of cloud computing service adoption through empirical studies. Although the concept of cloud computing service adoption has been believed to have important implications in the field of supply chain management, only a limited number of studies have attempted to test this premise empirically. The results of this research confirmed the premise that cloud computing service adoption influences supply chain performance. This study integrated the TAM views in the cloud computing service adoption and supply management literature. Given the lack of quantitative studies in this area, scales were adapted from previous research. Cloud computing service adoption and metrics of supply chain performance were identified using existing literature. The variables are discussed in relation to theoretical lens (TAM). This study provided the validity to the concept of cloud computing service adoption through empirical studies. Although the concept of cloud computing service adoption has been believed to have important implications in the field of supply chain management, only a limited number of studies have attempted to test this premise empirically. The results of this research confirmed the premise that cloud computing service adoption influences supply chain performance.

11. Recommendations

Based on the findings of the study, we proffer the following recommendations:

Management of fuel retail firms in Nigeria should adopt the cloud computing service adoption and supply chain performance conceptual framework which has been developed and translated into practical guidance for mangers. This conceptual framework provides specific boosters for creating favourable supply chain performance in fuel retail firms and would allow managers to focus and priotize resources. Further, in order to enhance logistics process flexibility, order fulfillment and information sharing, management should adopt cloud computing services that are capable of stimulating positive supply chain performance that are favorable for the focal company.

12: Limitation and Suggestions for further studies

The most serious limitation to this study is that it suffers from methodology limitations. Data were collected over a six months period June – December 2018 in two specific places (fuel terminal depot and fuel retail stations) and the sample was not wholly representative of the 55fuel retail firms under study.

This study also has a narrow focus on Nigerian fuel retail firms, thus precluding the generalization of the findings to other emerging countries as well as other sectors such as service and government sectors that may benefit from CCSA programmes.

As indicated in the research design, the research contextual population was restricted to 55 Fuel retail firms in Rivers State from which the findings and conclusions were drawn.

It is entirely possible that there may be significant differences in the findings, if this study is replicated using fuel retail firms in two or more states in the South-South geo-political zone of Nigeria.

Further study may also investigate this topical area by using samples from both firms and respondents of fuel retail firms to confirm the relationship found in this study.

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