Exploring strategies for outsourcing oil and gas functions in the cloud, and analysing the implications for the Oil & Gas industry.

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Abstract

Technology has proven to be a pivotal factor that helps to drive organizational effectiveness, because it helps to automate processes, improve speed of data processing, enhance organizational performance and ensure ease of exchange of information across the organization. One of such emerging technologies that is fast shaping the organizational landscape is cloud computing; and this research focused on the relevance of this technology to the oil and gas sector, the benefits, risks and analysing how the implications of adopting this technology can be addressed. Also, it has been established that adopting cloud based solutions is related to outsourcing, and this implies that another firm (cloud provider) will manage the function or process that is migrated to the cloud. Therefore, this research is important within the Oil and gas sector because the success of adopting this technology in the sector is based on how these companies can manage the diverse inter-firm relationships with cloud providers. To draw new insights, relational view approach was applied to gain the understanding of how managing these relationships can ensure successful adoption of the technology because existing literatures lack in-depth discussion on how organizations can manage multiple cloud deployments (especially in the Oil sector). Furthermore, the research aimed at understanding the current state of cloud deployment in this sector, determine the most suitable deployment model(s), and strategies for effective adoption, taking cognizance of the complexity of the operations within the industry. This research focused on the Nigerian Oil industry as the research setting for gathering data for this research. This is important because this sector is the major source of revenue for Government in Nigeria and any approach that helps in achieving performance improvement will automatically translate into more benefits for the country and other stakeholders in the sector. In view of this, this research was conducted qualitatively by conducting interviews for participants within the Nigerian Oil and gas sector. These participants cut across Oil exploration and production companies, Cloud providers, and Government/Regulator agencies. The data gathering was focused on understanding the extent of adoption within the sector, current usage of this technology (if any), implications, how the transitioning is being coordinated and risk and strategies currently being deployed. The findings of this research show a low level of adoption of cloud solutions, despite the moderate level of awareness of this technology. This low level of adoption was premised on some factors ranging from the conservative culture in the industry, infrastructure challenges (peculiar with Nigeria), suitability of cloud solutions for specific core oil and gas operations, security and confidentiality concerns, lack of suitable corporate strategies, regulatory concerns, just to mention a few. This research analysed these findings critically and proposed the need for corporate strategy, effective stakeholder collaboration and management and how to adopt suitable governance framework. Furthermore, the need for National cloud policy and how to address infrastructure challenges which are inhibiting cloud adoption in the research area (Nigeria) were also addressed.
Chapter 1 Introduction

1.1 Purpose of this study

Information systems have formed the basis on which operational efficiency and competitiveness of organizations are built (Oliveira and Martins, 2011). This is based on the rapid advancement in information technology and the rapid globalization in the business sphere. The importance of entrenching information technology (IT) into all facet of the organization is based on the automation, efficiency, speed and accuracy it helps achieve in the conduct of organizational activities (Pennings, 1995). In addition, information systems are greatly helping in the management of workflow, projects, business analysis, analysing big-data (complex and voluminous data) and lot more. For organizations, to maximize the opportunities that information systems offer, companies over the years have invested (and still investing) on hardwares (storage devices, servers, PCs, Laptops, tablets, mobile devices etc.) and softwares that would help meet their IT demands. To effectively install, administer, manage, maintain and support these IT systems, IT units (department) are often established in most organizations, and the size and scope of these IT departments depends on the size and strategic goals of the organizations.

One of the main characteristics of technology is that it constantly evolves (Arthur, 2009), this is the reason why new technological innovations are developed to help in bringing more efficiency into business environments. One of such technologies is cloud computing, which help ensure that infrastructures, platforms and softwares are available as a service on the web (public or private). Cloud computing help ensure that task being processed on servers or on PCs within an office location, are being managed and processed on the internet (Perrons and Hems, 2013). The emergence of cloud computing is creating a paradigm shift from how organizations render technology services in order to achieve their organizational goals. Also, this technology is shaping the way traditional information technology departments are being managed. The importance of this technology has increased spontaneously based on the influence of globalization in organizations. With the emergence of the internet, exchange of data across geographical locations has been made possible (Freiberger and Swaine, 2000) and this has been of immense benefit to organizations, especially multinationals. The emergence of cloud computing has created another opportunity which organizations can harness for improved effectiveness, by outsourcing the management of IT services to providers of cloud based solutions. The use of cloud solution is related to outsourcing decision because the client transfers their processes, assets, services or infrastructure to the cloud provider, so that the provider can manage the outsourced service or process for them. As buttressed by Schlattman, P. (2014), cloud computing is related to outsourcing because infrastructure, applications and services being hosted in the ‘cloud’ are still domiciled in datacenters being managed by other companies. The decision to outsource business process is often aimed at helping the company to ensure they achieve cost reduction and optimization, and to make sure that the company can focus on her primary (core) responsibilities (Holweg and Pil, 2012).
The current practice being used in managing IT units or functions is the ‘traditional’ approach, which involves in-house management of systems and processes required in IT operations and projects. But with the emergence of cloud solutions, organizations are currently embracing the technology. The use of cloud based solutions is increasing based on the opportunities it affords for cost optimization and with the dwindling price of crude oil, this technology serves as an attraction for oil companies. This technology creates a major shift in how IT services are being managed and if this process is not properly managed, it becomes challenging for organizations that are already structured towards in-house delivery and management of IT service. This is because the process or function taking away to the cloud will have to be migrated from in-house administration to cloud provider (organizations providing cloud solutions). Therefore, this topic is important for consideration because the tendency to embrace cloud computing is becoming very attractive to decision makers due to the perceived benefits, but if not properly managed it can generate some negative impact. This is because technological systems always impact established workflow, processes and responsibilities (Maroofi et al., 2013) and this makes the transitioning process to the cloud to be complex, especially in the Oil and gas sector (Kukreja and Karnawat, 2012).

This necessitated the need for studying this issue with focus on the Oil and Gas industry in Nigeria and it was approached with focus on how this technology can be adopted within the sector with minimal or no constraints at all. In view of this, the topic of this research is “Exploring strategies for outsourcing oil and gas functions in the cloud, and analysing the implications for the Oil & Gas industry”. This topic was studied as an insider because it is a situation that affects the industry in which I am currently employed and it provides an ample opportunity for action research approach to be applied.

In order to address explore this research topic, the aim was to identify and develop suitable strategies and framework that are required for effective adoption of cloud solutions in the oil and gas industry. To achieve this aim, the following objectives will be addressed in this research.

1. Examine the status of ITO and cloud adoption in the oil and gas sector and how oil companies are embracing and harnessing these cloud technologies.
2. Examine IT Governance, Operational and other strategies required by managers and other key decision makers to manage the adoption of cloud based systems.

1.2 Contextualizing the research

After the discovery of crude in Nigeria in 1956, the oil industry in the country has been a major dominant force in the Nigerian economy. As at today the industry is the largest contributor to Nigeria’s GDP, and Nigeria is the 12th largest oil producer in the world, with a daily production of 2.4million bbl/day. The initial exploration of oil in 1956 by Shell Group, ushered the dominance of multinational oil companies in the industry, until early 1990s when indigenous companies began to invest in the industry (KPMG, 2014). The current dwindling
state of the fortunes of oil companies because of low price of crude has made the need for cost optimization initiatives to be attractive because these companies need to remain in business. This issue is of extreme importance to me as a scholar researcher because I currently work in this industry having contributed 9 years of my total working experience in the sector. Also, the need for more effectiveness in oil and gas activities is of immense importance to me, in order to ensure that Oil companies remain in business. One of the ways efficiency and cost optimization can be achieved is through adopting relevant technologies and this is why companies invest a lot in technology infrastructure. In view of this, one of the ways I can contribute to this issue is by exploring technological solutions that can make Oil companies to be more effective; hence the choice of how oil functions can be outsourced to the cloud. This research is important because maximum benefits can only be derived from technological adoption when there are clear strategies for its implementation; because adopting innovative technologies is associated with business and technological challenges (Kallioranta and Vlosky, 2008).

Also, to further understand the research terrain the structure within the oil sector needs to be emphasized, because this research was conducted with focus on participants (with basic cloud knowledge) working in different sectors of the Oil industry. Organizations within the Nigerian Oil sector are largely divided into upstream, downstream, midstream, and services sector. The upstream sector is focused on the exploration and production (E&P) of crude oil and gas. Downstream operation is focused on transmission, refining and distribution and marketing of petroleum products. Gas sector focuses on gas development and how it can be harnessed in meeting diverse energy demands (Devold, 2013). The service sector entails rendering of services which cuts across exploration, drilling, production, downstream and other services. The activities within the oil sector is highly regulated by different government agencies and this is very important because of the large influx of multinationals rendering services and owning licenses in the sector. Therefore, these regulatory agencies are necessary to protect the interest of Nigerian Government, Citizens and shareholders, in all oil and gas operations and investments. These agencies include Ministry of petroleum, Nigeria National Petroleum Corporation, Department of Petroleum Resources, Nigerian Content development & monitoring Board and many others.

Based on my experience within the oil industry, there are no generic operational structures for oil companies in Nigeria, but each company designs a structure that aligns with their vision and strategic goals. But generally, operations in the oil sector are widely classified as technical and support functions. Technical functions are the core aspect of operations which include drilling, refining, production, asset management, gas development etc., while support functions may include information technology, health safety and environment, human resources, administration, supply chain management, and lots more. The classification of various units under both technical and support functions differ from company to company. This classification does not infer that some units and job functions are more important than the other, since they all contribute collectively to ensure the attainment of the company’s strategic vision. Even though technical functions are the core operations, support functions play a critical role in the success of all technical functions. For example, without a robust and reliable technology infrastructure, the entire exploration and production activities would be
grounded. Also, it is important to clarify that the classification of job functions is largely dependent on the core operation of the organization. The operational classification earlier specified has to do with Oil companies that are involved in exploration and production. But for Oil service firms who provide services for Oil companies, their operational classification of core and support functions will differ based on the kind of service they provide.

Information technology is actively at the heart of all these oil and gas activities and it is a vital tool being used in managing processes, systems and functions within the sector (KPMG, 2013). Therefore, a knowledge of the operational and functional structure within these companies is necessary in order to properly understand how cloud computing is currently being adopted or potential areas of cloud adoption and their implications.

1.3 Research Significance

This topic is important for consideration because the tendency to embrace cloud computing is becoming very attractive due to the perceived benefits. These benefits cut across financial, technical, strategic and legal/transactional areas (Yigitbasioglu, 2013). From strategic point of view, cloud computing often helps organizations to effectively access modern tools, technologies and applications that would help achieve improvement in the organization’s systems and processes. Despite the opportunities for organizational effectiveness and benefits involved in embracing cloud computing, the need for the adoption and implementation strategy for this technology needs to be properly planned and implemented; especially due to the peculiarities that characterises oil and gas operations, which is the focus of this research (Perrons and Hems, 2013). Therefore, this topic is relevant because, the actionable knowledge in the form of recommendations generated would help decision makers (CEO’s, HR Managers, IT Managers etc.) within the Oil and Gas industry, to strategize and brace up for the realities of the impact of cloud technologies on oil and gas operations. This is important in ensuring that proactive strategies are implemented that would make sure that departments in these companies are adaptive to these emerging changes. The importance of this is because changes like this can generate negative reactions; if there is no collaborative buy in from all key stakeholders (Khajeh-Hosseini et al., 2010). The need for effective collaboration and engagement cannot be over emphasized in managing changes like migrating to a cloud based system, within the oil and gas sector.

Therefore, this research helped in generating relevant knowledge that will help decision makers in oil companies to determine their cloud adoption strategy. Strategic objectives that can be informed by this research include better planning for cloud migration, determining how to effectively collaborate with stakeholders, managing security and confidentiality and resolving job security, restructuring, competency development, complying with country specific regulations and others. This knowledge is meant to help decision makers in the oil and gas sector to have a clear guide they can always adopt when making a decision to adopt cloud based solutions. To achieve this, high-level of criticality and reflective thinking were applied, as I engaged all participants. This is important because the knowledge generated from this data must be highly reliable so that it can be relevant and applicable within the oil and gas industry. The outcome of the reflective process generated some outcomes which
were proposed to a key decision maker (who participated in the research) within my work environment, relevant government agencies and to another service provider firm where I was granted access to gather data for the research. The actionable steps taken are:

a) Engaged relevant government agencies on recommendations and justifications for having a national cloud policy for Nigeria. This was based on the need for regulatory clarity that will help inform the decision-making process of key stakeholders.
b) Key stakeholder within my work environment were engaged on the need for the development of a corporate cloud strategy.
c) Engaged decision makers within the work place and another service company on the need to mitigate security and confidentiality concerns by aligning with global best practices and standards. To achieve this, certifications such as ISO/IEC 27017 cloud security was recommended.
d) Created more awareness about this technology by presenting the findings of the research at the technical meeting of Nigerian Institute of Electrical and Electronics Engineers (Port Harcourt chapter). Also, I jointly authored an article (with a key decision maker) in the quarterly magazine within my work place on the importance of cloud based solutions.

The feedback and status of these steps are documented in the discussion section (chapter 5) of this thesis.

1.4 Thesis structure
The structure for this thesis is based on the format below:

Chapter 1 – Introduction
This chapter contains the focus of this research work, the vision, motivation and the justification for this research. This chapter also discussed the significance of the research, taking cognizance of existing research in cloud computing and outsourcing research. Also, discussed was the background of the setting (Nigerian Oil and Gas industry) where the research was conducted and the approach used in data gathering. Lastly, this section presented the overall structure of this thesis.

Chapter 2 - Literature Review and Theoretical Framework
The literature review section presents the knowledge I gathered from previous research about cloud computing, outsourcing, governance, technological adoption and relevant strategies. This review helped in understanding how knowledge has developed in areas relevant to the research topic. This was necessary to be conversant with current discussions in these research areas, to effectively identify gaps that this research is meant to fill or knowledge areas that require further development. This chapter also studied outsourcing theories in detail in order to identify their relevance to this research. The merits of these theories were adequately considered. After these considerations, the relational view was selected because of its relevance in all the phases of an outsourcing transaction.
Chapter 3 - Methodology

The methodology chapter discussed the relative ontology and social constructionism epistemological perspective that was applied in conducting this research; and, the reasons for selecting this philosophical stance was discussed. Since I am an emerging scholar practitioner, the application of action research methodology for this research was also addressed. Also, this chapter explained how data were qualitatively gathered and analysed. Lastly, this section also discussed how confidentiality and anonymity were achieved during the data gathering phase of this research.

Chapter 4 - Research Findings

This chapter presented the findings in the data gathering and analysis process of this research. These findings were presented using quotes from some of the research participants. Furthermore, these findings were discussed under the categories that emerged from the analysis of the data gathered.

Chapter 5 – Discussion

This section analysed these findings using relational view approach. Following which the knowledge from the application of relational view helped to determine robust strategies that will be suitable for cloud-sourcing within the oil and gas industry. The strategies discussed in this chapter include the need for a national cloud policy; corporate strategy, how to achieve collaboration among all cloud actors and how infrastructure concerns which tend to impede effective cloud adoption can be addressed. Some steps already taken in line with the need to take actions and their feedbacks were also presented. Also, this chapter discussed my reflections and lessons learnt as a developing scholar practitioner.

Chapter 6 – Conclusion

The conclusion section of this research recapitulated the essence of the research and the findings from the process, limitations that are inherent in the research process, implications of this research and the recommendations made. Also, how this research contributed to knowledge was also discussed and the other areas that require further research efforts.
Chapter 2 Literature Review/Theoretical framework

2.1 Background of outsourcing

2.1.1 Evolution of Outsourcing

IT outsourcing was first used in recent history in the 1950s in relation to the concept of time sharing and this practice lasted for over 25 years. But as technological advancements continued to emerge, new ideas in the outsourcing practice began to evolve. Consulting firms like Arthur Andersen pioneered remote management services in the 1980s (Gonzales et al., 2004). This service provided the platform to manage and monitor customers’ IT infrastructure from remote locations from a network operation centre (NOC). This was greatly embraced by companies because it provided them with the opportunity to ensure high availability of their system and to make sure that agreed service levels are achieved. But with the advancement in internet technology and software development, between 1980s and 1990s, new outsourcing models emerged. Organizations saw the opportunity created by outsourcing, which enabled them to focus on core or other business interests, while divesting their own facilities, personnel and operations (Gonzales et al., 2004).

Within the context of information technology service delivery, outsourcing has evolved through three generations. First generation outsourcing entailed extending functionality, by creating opportunities for remote sites to access mainframe computers using remote terminals and time sharing. Second generation (1960s -1970s) outsourcing involved the physical outsourcing of hardware and software. This was necessitated because the advancement in information technology and computing resulted in the procurement of IT infrastructure by companies. But because IT is not considered a core function in most of these organizations, they often secure the services of specialized firms like OEMs (original equipment manufacturers), to help maintain and administer these systems. Furthermore, the globalization and free trade economies of the 20th century ushered in the third generation of outsourcing, which is focused on offshoring and process outsourcing. This is necessitated by the need for these firms to be effective and globally competitive (Gonzales et al., 2004).

Jae-Nam et al., (2003) further explained that the focus of outsourcing in the 1960s, 70s, 80s and 90s were on hardware and software standardization and total solutions. Until the late 1990s, outsourcing was used to fill in the skill needs that were lacking within an organization, with cost saving being the major motivation in outsourcing decisions (Siepmann, 2014). IT outsourcing specifically has evolved over the years from a sole-sourcing and total outsourcing arrangement where one vendor is contracted with the responsibility of managing all IT services of their client, to a multivendor and multi-client arrangement. This has helped service firms to be profitable, by leveraging on the same resources in meeting multiple service level demands. But this has potential risks because the exposure of these service firms to IT services of multiple organizations can lead to unethical practices. No wonder, Mears and Bednarz (2005 cited in Hirschheim et al., 2009) buttressed the fact that companies are more selective today in their outsourcing decisions, based on the innovative tools and
resources available to IT executives in the management of their IT portfolios. This notwithstanding, outsourcing portends immense benefits which are worth exploring.

2.1.2 Outsourcing and strategies

So many factors can be attributed to the surge in the global sourcing trend. They include the impact of technological advancement, especially with internet technology that has ‘broken’ the geographical divide across locational boundaries; globalization, huge investment in infrastructure in some countries and low cost of skilled personnel in some countries (Kotlarsky, 2010). Also, improvement in economies, ease of financing transactions across the world, increase in multinational organizations and many other factors are contributing to the increase in outsourcing trend. Based on the outcome of Lacity et al’s (2010 and 2011) research which involved the review of a total of 251 articles, the motivating factors for outsourcing include cost reduction, the need to focus on the firm’s core capabilities, need to leverage on expertise/skills of others, business process enhancements, scalability, technical reasons, alignment of back office to organizational strategy, enhance innovation, harness expertise from other clime and many others.

The primary motivation for business decisions is the need for cost optimization, especially with the recent dwindling economic condition of most countries. No wonder cost reduction has been a major consideration in most outsourcing decisions. This is achieved because outsourcing provides for the achievement of the creation of economies of scale, leveraging on the expertise of the service provider, and reduction in the overhead costs associated with performing some of these functions (Oshri et al., 2011). Per Mella and Pellicelli (2012), outsourcing is used to strategically achieve cost optimization in these four ways:

1) The outputs of internal resources are maximized because their efforts are focused on what the organization knows how to do best.
2) The focus on core competence of organization’s help to achieve focus and which also help organizations to constantly strategize, in order to retain and exceed their competitive advantage.
3) Maintaining in-house specialization will require continuous investments and innovations.
4) It helps reduce the risk associated with rapid changes in the market/industry and technological advancements. This is achieved by shifting the cost of doing research and development to external organizations.

Some firms may find it financially difficult to develop certain capabilities in-house, hence the need to outsource. Furthermore, by leveraging on the capabilities of other firms, the product/process design cycle time can be decreased, especially when multiple firms are engaged to work on various components or phases of the system or process. Also, outsourcing helps the organization to focus resources and energy on core competencies that can give the company world class capabilities.

Apart from financial justifications for outsourcing IT functions, other reasons as researched by Smith et al., (1998) are business, technical and political. Business justification for
outsourcing is based on the need for the organization to simplify their business objectives, by focusing on their core competencies. This will also help in sharing and managing the risks associated with performing non-core competencies. Technical reasons for outsourcing also include the ease of accessing new technologies, leveraging on technical expertise of the vendor and the need to ensure that IT staff concentrate on the development of innovative solutions that can help achieve immediate value to the organization (Bolton, 1996).

Outsourcing has its own drawbacks, although the impact of these drawbacks largely depends on the industry in which the firm is operating, regulations, organizational size and many other factors. One of the challenges with outsourcing includes the reliance on external organizations to perform critical organizational functions. This can create bottlenecks, except if there are systems and processes which help manage and monitor the activities of these firms. If this is not handled properly the quality of service or product from these service providers can adversely affect the productivity of the client organization. Furthermore, confidentiality and security of organizational data is another major disadvantage of outsourcing. Also, it is important to note that a decision to outsource often creates tension within client organizations based on its impact on employees. Outsourcing may result in redundancies, changes in the existing structure within the organization, career prospects, job satisfaction and condition of service.

There are different strategies for IT outsourcing and they include external domestic IT outsourcing, external international IT outsourcing, internal domestic IT provision and captive IT outsourcing (Weinert and Meyer, 2005). External domestic outsourcing is the origin of IT outsourcing and it entails the engagement of an indigenous provider to render service. External international IT outsourcing is a recent trend which implies that companies are no longer limited to indigenous providers, but they can leverage on services that can be provided efficiently and cheaper internationally. Another aspect of IT outsourcing is internal domestic IT provision, where IT services are not externalized, but rather they remain within the organization as an independent working unit. Similarly, to internal IT provision, companies can set up subsidiary companies or oversee joint venture arrangement and this is known as captive IT outsourcing (Weinert and Meyer, 2005). Furthermore, sourcing arrangement is fast embracing significant strategic partnership and alliances, which is referred to as co-sourcing. This type of arrangement creates an opportunity for the client and the service firm to collectively share the risk and the reward (Hirschheim et al., 2009). Co-sourcing is achieved by leveraging on the competencies of both the client and service providers, to meet the client’s need. Therefore, the success of this arrangement is hinged on the ability of the client to build their in-house competence and capabilities, so as to avoid a situation whereby they rely solely on the vendor’s competence (Hirschheim et al., 2009).

Basically, most outsourcing deals always follow a six-phase cycle and these phases entail strategy, selection, negotiation, implementations, management and completion (Siepmann, 2014). The strategic phase involves the decision-making process where the organization decides to either outsource some or all its business functions or IT systems. At the selection phase the organization embark on the high-level selection process of the service firm that can effectively provide the service contained in the outsourcing scope and considering the cost at which such service would be rendered. The negotiation phase of outsourcing deals focussed
on fine-tuning the expectations between the organization and the outsourcing firm. This would also include ensuring that all relevant requirements are gathered, so as to prepare for the implementation of the project. The implementation phase involves the commencement of the transition to outsourcing. At this stage, the outsourcing firm would need to gather relevant data, mix with personnel performing relevant roles and functions and engage in interviews, so as to ensure a seamless transition. After implementation, the management phase of the process will commence. This is the phase at which the service firm takes ownership of the service, role or processes for which it was contracted. Finally, the completion phase may occur when the outsourcing contract ends or when the client decides to engage another outsourcing provider (Siepmann, 2014). The completion phase may never happen if there is cordial relationship between the outsourcing firm and the client. Cordiality in this sense implies that the outsourcing deal and the way it is executed provide a win-win situation for both the client and the outsourcing company.

2.1.3 The Role of IT Systems on Outsourcing

The role of IT within organizational environment over the years has changed significantly from merely the provision of the information backbone for the company, to that of a key business driver, whose function is rapidly impacting the way organizations do operate and compete (Ramakrishna and Lin, 1999). Rapid innovative transformation has occurred since 1980s in the information technology field and this is rapidly shaping how businesses are conducted. No wonder, organizations that need to be productive needs to invest and leverage on technology systems and tools that are available, in order to gain competitive advantage (Mousavi and Badrabady, 2008:56). Information technology is playing a very crucial role in process automation, data exchange, workflow management, messaging, communication, project management, database management and Big-data analysis, enterprise resource planning and many other functions. The essence of entrenching IT into organizational activities is because it helps in the achievement of speed, efficiency, automation and accuracy in organizational activities. This importance has resulted in huge investments in hardware and software, standards, tools and methodologies, by organizations.

Sääksjärv, M. (2010) further explained that, organizational advancement is not achieved primarily because of the capacity of new technologies, but the interplay between the organization and these new technological tools is what impacts organizational progress and advancement. This interplay is what is resulting into new organizational structures, paradigm shift, innovation and cost effective processes. It is important to emphasize the fact that the extent in which IT is entrenched in organizational activities, largely depends on the core function, of the organization. This is what will determine the level of priority to be given to investments in IT systems, priority given to IT services and how IT departments are perceived. In meeting the varying IT demands, organizations often have IT units or departments which see to the implementation, management, administering and monitoring of IT functions.
2.1.4 Outsourcing and Oil and Gas Industry

Oil companies are faced with the challenge of managing their portfolio, in a time with high-level of uncertainty, resulting from increasing operating cost and competition (Accenture, 2011). The oil and gas industry is characterized by the continuous need to maintain a balance, while meeting global demand, dealing with diminishing resources, crude price instability, and maintaining a manageable distribution and capital expenditure. The demand for efficiency in the oil industry is because the industry is responsible for about 40% of the global energy demand. The complex nature of oil and gas operations and the huge capital and operating costs, has always influenced decision making on implementation of policies and that would help these oil companies to be profitable and efficient (Ravago, 2007). Controlling costs has been a major challenge for the upstream sector, especially with the unstable nature of the price of crude oil and the increased need for environmental friendly exploration and production. These realities are also creating challenges in the areas of talent and supply chain management. Furthermore, the downstream sector is also under pressure in order to maintain margins, but this is a challenge in view of the global economic crisis and the structural decline in the demand from mature markets. It is important to emphasize that a lot of developing countries with a significant contribution in oil sector are faced with issues of inadequate talent resources, local content development policies, inefficiency in business processes, pool flexibility and scalability (Accenture, 2011).

In view of these factors, one of the measures being used to ensure efficiency and improved performance in the oil and gas industry is by embracing outsourcing. The complexity involved in the management of multiple business functions, is engineering the need to outsource non-core business functions. This is because oil and gas companies would likely ensure that their core business competences are managed in-house and the tendency to outsource back-end processes and some support functions is high. But it is important to emphasize that within the core business function of oil companies, most of the technologies involved in oil exploration are being provided by service companies like Schlumberger and Halliburton, thereby making them pioneers in the deployment of advanced solutions with relevant patents in E & P activities. Most of these specific technologies being outsourced from service companies for use in upstream activities are in the areas of geophysics, onshore and offshore operations/projects, drilling and well operations (Pellegrini et al., 2012). Specifically, areas with high outsourcing rates are engineering and design, ITO, human resources, finance and accounting and back office and shared services (Ravago, 2007). For example, British Petroleum reports that they saved 30% by outsourcing its accounting and finance functions to Arthur Andersen in the United Kingdom and they expect to make comparable savings from similar decision in the United States (Ernst and Steinhubl, 1997).

Alliance, which is a form of co-sourcing is also being used by oil and gas companies to confront operational and economic challenges, in order to build strengths from weaknesses, extract latent value from assets and help clients to retain and maintain their position in the industry. The typical alliances within the industry are consolidation joint ventures, strategic partnership with specialists, enhanced relationship with suppliers, new ventures operated by
other relationships and advantaged networks of producers and suppliers (Ernst and Steinhubl, 1997). Alliances with specialists help combine capabilities that are complementary such as reduced operational costs, geographic experience and large asset positions. About 75% of the capital expenditure in the upstream sector are sourced externally and often companies pay straight fee for these services or engage the services of contractors (Ernst and Steinhubl, 1997). But these relationships have evolved towards enhanced supplier relationships and outsourcing alliances, which gives room for sharing risks and rewards. For example, when Amoco in the Northwest Hutton field in the North Sea was contemplating to abandon a platform complex, Schlumberger which has been working for Amoco stepped in to broaden their existing relationship in order to boost production. This was achieved by setting up a joint task force which comprises both companies and both firms invested in ensuring that the field is enhanced and recovering their investments pro rata. Also, Schlumberger agreed to a gain sharing arrangement, instead of being paid on a fee for service basis (Ernst and Steinhubl, 1997). Similar partnerships can be seen in the $10 million investment of Halliburton in Mobil’s Parks Devonian field, in order to drill five horizontal wells in west Texas; and recoup their investment based on a percentage of production. In achieving this, Mobil provides knowledge about the field, assets, well site supervision and wellbore construction engineering. Halliburton served as the project manager, provided drilling and completions rigs, wellsite facilities and subsurface products and services (Ernst and Steinhubl, 1997).

One of the drawbacks of outsourcing in the oil and gas industry is that, it has allowed more research and development activities to be carried out by service providers since, most critical services and technologies are being managed by them (Pellegrini et al., 2012). This also results in situations whereby they focus on technologies, which they can easily market to their numerous customers, while leaving other areas untested. This is also resulting in the lack of in-house expertise by oil and gas companies on tracking new technological initiatives and adopting them in operational or project activities (Mitchell et al., 2012). Therefore, it is extremely important for oil companies to re-strategies on the need to retain technological leadership by increasing investment and partnership with service companies, research and development centers like universities (Pellegrini et al., 2012).

A major challenge with cloud computing within the oil sector is the general reluctance in the industry, regarding moving data outside the company’s firewall. This reluctance is not only caused by the tendency for data stored in the cloud to be compromised, but also the concern that trade secrets (especially sensitive data like well logs), needs to be protected (Perrons and Hems, 2013). Also, the scale of most applications being used in the industry is another source for concern. For example, 3D rendering and graphic accelerators are being used in exploration and production applications and based on the need for speedy access of these files due to their large sizes, it makes most oil companies prefer to keep the running of these applications within their network (Perrons and Hems, 2013). Furthermore, the largeness of these files and datasets makes it difficult to share files across different network boundaries because of the impact of latency. Beckwith (2011 cited in Perrons and Hems, 2013) explained that most modern seismic data centers contain as much as 20 petabytes of data and this is about 926 times the size of the library of congress. It is important to emphasize that Oil
companies have over the years invested hugely in IT infrastructure and legacy applications. Therefore, when the sunk costs for these investments are considered, it often creates a drawback in moving to another technology (e.g. cloud) entirely (Perrons and Hems, 2013:32). In view of these huge investments, the discussion of migrating to a cloud system in the oil sector has generally been centered on the choice of private vs. hybrid cloud models. Perrons and Hems (2013) explained the fact that the move to private and hybrid cloud models is just a temporary measure in the technological evolution of the oil and gas industry. This is because other sectors such as health care and retail, all encountered similar technical, regulatory and logistical challenges that are currently confronting the oil and gas industry in the journey towards embracing cloud computing (Perrons, 2015). Still, these challenges were surmounted, as the technology evolved and as a result of shift in the underpinning market conditions. Therefore, willingness to overcome these challenges will always help in proffering solution. Therefore, this research is also a way of not just celebrating the challenges but a means of contributing to the solutions.

2.2 Cloud-sourcing

2.2.1 Emergence of Cloud Computing

One of such technology that is fast shaping organizational functions is cloud computing. Between 1985 and 1990s, the emergence of corporate networks and email technologies resulted in the emergence of multinational corporations, thereby making the transferring of information across geographical boundaries easier (Sääksjärvi, 2010). This was further enhanced with the birth of multinational software markets and venture capitalism, which helped fuel the global capital economy (Sääksjärvi, 2010). Figure 1 shows the evolution of computing from the era of mainframes, mini terminals, client-server systems, internet and emergence of cloud systems. The birth of global economy, which is hinged on the development of corporate IT infrastructures helped organizations reduce the cost of coordinating their activities globally because of the ease of diffusion of work and organizations virtually. Therefore, this led to outsourcing and offshoring being entrenched in the strategies for productivity of organizations. The most rapid technological transformation was heralded by the internet (Freiberger and Swaine, 2000), and this created a friction-less digital global economy, which is hinged on open innovations and technology platforms (Sääksjärvi, 2010). Coupled with the development of web-enabled applications and systems, all limitations which tend to confine organizations to specific locations have been eroded. This rapid transformation provided the foundation which ushered in cloud computing systems.
Figure 1: Computing evolution

Cloud computing makes it possible to access software, infrastructure and platforms, as a service through public or private networks and in which services are scalable and can be subscribed on a pay per use basis (Perrons and Hems, 2013). This implies that users can access resources like computational power and platforms, storage and applications to users either through the internet or through private clouds. The companies providing cloud solutions are either offering cloud solutions solely (such as Salesforce) or traditional software companies like Microsoft that are diversifying into the cloud market. Also, IT service and hardware companies like HP and IBM and internet based companies like Google and Amazon are not left out in offering cloud solutions. Currently SaaS solution is the largest cloud service in the cloud market with providers like Salesforce, Oracle, Google, SAP and Netsuite; while IaaS is next with companies like Amazon Web Services (AWS), Rackspace, and Verizon playing dominant role. Lastly, PaaS has the smallest market share and these services are being offered by companies like Microsoft’s Windows Azure, Google’s App Engine, and Salesforce’s Force.com (Berry and Resiman, 2012). Most of these cloud providers are based in the United States, except for SAP that is a German based software company.

Cloud computing has boomed extremely because it helps reduce the start-up of financial overhead for companies and due to the huge technological investment by these cloud providers, it makes availability and scalability for applications and systems hosted in the cloud to be more enhanced (Bal et al., 2015). David Stuckey who is the leader of data center infrastructure practice of PWC says that there have been major technological shifts in the past, but these shifts often result in increased complexity and costs (PWC, 2011). But if cloud computing is implemented properly; it has the potential of replacing legacy systems and infrastructure, and adding value through cost reduction and improved agility (PWC, 2011). Cloud technologies also provide opportunity for on-demand services, which makes subscribers ‘pay as you go’ (Bal et al., 2015).
The National Institute of Standards and Technology defines cloud computing based on five characteristics, four deployment models and three service models as seen in figure 2. The cloud characteristics include: (1) On-demand self-service – This gives room for users to provision their computing needs without any intervention by the service provider. (2) Broad network access properties of cloud computing makes computing access to be available over wide networks and through standard procedures which enables heterogeneous thin or thick client platforms (e.g. mobile platforms, laptops and PDAs) and other traditional or cloud based services. (3) Resource pooling – This gives the provider the opportunity to meet several customer demands, by using multi-tenant model that helps in dynamically assigning physical and virtual resources. (4) Rapid elasticity – These capabilities help to automatically provision services, without any bottleneck (5) Measured Service – Cloud system gives room for effective monitoring, controlling and reporting of usage of the subscribed services.

Figure 2: NIST Visual Model of Cloud Computing Definition (Bal et al., 2015)

The three service models which cloud computing offers are software as a service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). SaaS provides customers the opportunity to use softwares offered by cloud service providers on a cloud infrastructure. PaaS gives the customer the opportunity to deploy their own application on the cloud infrastructure of a service provider, provided the application was created with the tools, programs and services that are supported by the provider. IaaS allows for provision of hardware, software and other infrastructure in order to deploy software application environment. This also allows for scaling up and down based on resource needs of the application. The deployment model for cloud computing can be private, community, public and hybrid cloud models (Bal et al., 2015). The model to be deployed would differ from organization to organization and this would be based on their strategic goals and varying needs.
The five major actors in cloud deployment as defined in NIST reference architecture for cloud computing are the cloud consumers, cloud provider, cloud auditor, cloud broker and cloud carriers (See figure 3). These actors (individuals or organizations) play important roles in all the phases involved in cloud deployments. Cloud consumers can be classified as individuals or organizations that adopt the use of cloud services (Software, infrastructure and platform) from cloud providers. Cloud consumers are the ultimate stakeholder because they are the main user of the cloud service. The consumer/client goes through all the service catalog of the cloud provider, request for relevant services, develop contracts or agreements to govern the process, and implements the new service. Also, cloud providers are the actors (organizations) involved in the process of ensuring that the requested cloud service is made available to the cloud consumer. They achieve this by building and managing relevant infrastructure, softwares or platforms that is the subscribed service will ride on and ensure that the service they render is in line with stipulated service levels, while taking responsibility for the security and privacy requirements for the service. Cloud brokers are involved as intermediaries in sealing the transaction between the customer and the provider and they also help the customer in navigating through the complex processes required to deploy the cloud services. Sometimes, the integration of cloud solution to an organization’s system may be very complex for the consumer (client) to manage, hence they may opt to engage the services of a broker that will serve as an intermediary between them and the provider. Also, consumers may appoint a single broker to help them in the management of diverse cloud services being provided by different providers. Cloud auditors are saddled with the responsibility of independently monitoring the performance and security of cloud solutions. Also, cloud carriers are organizations involved in providing the backbone network, communication and other means of transport technology that are required in the transfer for data in cloud based systems (NIST, 2013). The effective management of the relationship and interaction among these cloud actors is very crucial in the success of cloud adoption in any organization.
But before countries can maximize the benefit of cloud computing either as a conducive avenue for cloud provision or consumption, the following factors identified by Asia cloud computing association (ACCA) must be in place. These factors are (1) Regulatory conditions that also include protection of intellectual property (2) Good and affordable internet backbone, (3) Quality data protection policies (4) Reliable and accessible broadband (5) Power grid quality (6) Efficient business climate and (7) Risk (macroeconomic, security, social and environmental factors) (Berry and Reisman, 2012).

2.2.2 Cloud-Sourcing
Most studies on cloud technologies have focused on the technical aspects of the technology, benefits and risks; but with minimal discussion on the relevance of the technology as an outsourcing strategy. A decision to adopt cloud computing is an outsourcing decision because the organization (customer) would need to externalize and purchase some IT functions, resources and capabilities as a service from a cloud service provider (Yigitbasioglu, 2013). The implementation of cloud computing in organizations that are already aligned towards in-house management of all IT activities, processes and projects, is a form of outsourcing. This is because infrastructure, software and platforms being hosted on the cloud are still domiciled in a datacentre (apart from private cloud) that is being managed by another company (Schlattman, 2014). Therefore, a decision to migrate systems, processes and applications to the cloud, implies that the firm would lose control of some or all their IT systems or processes to another company. In view of this, outsourcing principles are to be considered when taking decisions to embrace cloud computing in organizations.

Although cloud computing entails externalizing functions and this is similar to ITO, but according to Leimeister et al., (2010 cited in Yigitbasioglu, 2013), there are some differences which need to be noted. The value chain is being transformed with the emergence of services
rendered online and service providers. The introduction of these new actors makes it complex to manage these relationships, but it also provides more possibilities when compared to a previously restricted arrangement. Also, the length of cloud computing contracts have a shorter life cycle (hourly, daily, weekly, monthly), when compared to most traditional IT outsourcing contracts. This gives room for more flexibility and reduced commitment on the part of the customer. Furthermore, cloud computing makes it easier to manage service request and scale up or down service (Yigitbasioglu, 2013). This gives the customer robust control over the service being rendered, when compared to traditional ITO.

The next few years will witness the advancement in demand for migrating services to the cloud and this would create a challenge for IT outsourcing providers. This implies that IT outsourcing providers that are not willing to embrace these changes are faced with the threat of losing their customers to cloud providers. But a significant outcome of 261 ITO customers and 489 CIOs interviewed by PWC, depict that the migration to cloud based systems in organizations would be a gradual process, and this implies that the cloud would coexist with traditional IT systems for some years (PWC, 2011). The benefits of transitioning to cloud based system as seen in figure 4, can be classified into financial, technical, strategic and legal/transactional benefits (Yigitbasioglu, 2013). Financial benefits can be in the form of cost savings in infrastructure and deployments, low cost of starting up (which is of immense benefits for small businesses). From a strategic point of view, cloud computing will help to effectively access modern tools, technologies and applications that would help achieve improvement in the organization’s systems and processes. Furthermore, the technical benefits include access to support and technical capabilities by experts. This help to ensure reliability, scalability and transition from legacy systems to be easy; especially because the delivery of this expertise is over the internet. Also, the transactional and legal dimension of the benefits of cloud system gives room for contract flexibility (hourly, weekly and monthly), unlike the rigidity entailed when contracting services for traditional IT setups. The transactional/legal dimension of these benefits also makes delivery of service to be achieved across different geographical locations.
Despite the immense benefit of cloud systems, it also has some potential flaws, which implies that the technology is not immune to failure. For example, Harris Corporation in the US had to close their cloud communication facility outside Washington DC in 2012, after operating for less than a year because most of their customers (government and private) prefer to host their mission-critical data within their own premises, rather than migrating them to the cloud (Yigitbasioglu, 2013). In view of this, to effectively outsource functions using cloud computing will depend on how the organizations effectively utilize risk mitigation techniques (Yigitbasioglu, 2013).

Security has been a major source of concern to most enterprise executives. No wonder that 8 to 1 top executives interviewed by PWC, indicated their preference for private cloud as compared with public cloud solutions (PWC, 2011). This concern is leading to the emergence of hybrid cloud solutions because this gives each organization the opportunity to determine which of their applications can be hosted on a public cloud, while those with strict security concerns may be held within a private cloud system. Furthermore, because cloud computing render’s services over a public or private network, a disruption in network connection, will automatically translate in service disruption. This risk is of great concern in emerging countries like Nigeria with poor broadband access. Also, downtime on the internet connection is not only limited to the client, it can also affect the cloud service provider. For example, in March 2009, Microsoft Azure experienced a downtime of 22 hours; and in April 2011 Amazon’s web service elastic compute cloud experienced downtime (Yigitbasioglu, 2013). Another risk associated with embracing cloud computing is interoperability. This occurs when an organization is trapped with an existing cloud provider because of the interoperability issues when the organization wants to change its cloud provider. This can also, occur when transitioning legacy systems from in-house applications to the cloud. Furthermore, auditability of data stored in the cloud is another major risk, which needs to be considered before deciding to outsource to the cloud. By law some businesses are expected to provide assurance to their clients about the conditions in which their data are stored. These
can be a challenge because the company cannot give full assurance because their client’s data are in the custody of another provider.

Also, there are other policy concerns that are associated with adoption of cloud computing and these concerns are data privacy and data localization. This is important because data privacy laws differ from one country to the other and this creates a challenge of achieving international harmonization when cloud providers are providing services to clients outside their country (Berry and Resiman, 2012). In providing cloud services personal data of clients may need to be gathered, stored and processed. Therefore, these processes must comply with the laws in the relevant environments. In order to minimize the impact of domestic data privacy regimes, some international collaboration efforts are currently in place to ensure a general framework that will help guide data transfer across borders. Some of these are the Organization for Economic Cooperation and Development (OECD) and the Asia-Pacific Economic Cooperation (APEC) forum (Berry and Resiman, 2012). OECD (2013) guidelines buttresses the need for member countries to always consider implications to other member countries when taking decisions on domestic processing or export of personal data. Also, it places the responsibility of ensuring secure and uninterrupted transfer of data across different member countries. This guideline also acknowledges the need for countries to enforce restrictions that may tend to compromise their national security and local laws. But, localization policies which tend to constrain cloud providers from locating their infrastructure in a location tend to forfeit the main essence of cloud technology. The independence of infrastructure location is paramount in cloud development; therefore any policy that tends to restrict it will create a limitation for providers. However, the need for location specific restrictions cannot be ruled out because of environmental peculiarities.

2.3 Relevant outsourcing theories

A decision to outsource is a complex one, due to the enormous activities and processes involved. In order to understand these processes and how to govern and manage them effectively, researchers often apply different theories. To harmonise these theories Perunovic and Pedersen (2007) conducted research on some outsourcing papers between 1990 to 2006, and their research was aimed at understanding the theories these researchers adopted in understanding each phase of the outsourcing process. These outsourcing phases are Preparation (P), Vendor Selection (VS), Transition (T), Managing relationship (MR), and Reconsideration(R); and their findings indicated that not all outsourcing theories are relevant in all phases of the process. Therefore, this section focussed on these theories, and their advantages and limitations in order to use it to gain further understanding of the outsourcing process. The outcome of the evaluation of these theories led to the choice of relational view for this research.

2.3.1 Transaction Cost Economics

The need for cost optimization has been responsible for the high application of transaction cost economics (TCE) as the most used theory in outsourcing (Perunovic and Pedersen, 2007). Cost consideration often takes the center stage in any business decision because
organizations need to justify the suitability of their decision, in view of the outcome of their cost benefit analysis. This has made Transaction cost economics (TCE) which was propounded by Oliver Williamson in 1975 to be the most influential of all outsourcing theories. TCE has been a very useful tool for decision making for outsourcing arrangements because it does not only guide current outsourcing decisions; it also helps influence future decisions. TCE is often applied when an organization wants to achieve efficiency gains in terms of transaction and production costs (Michael and Michael, 2011). The governance feature of this theory makes it very useful in managing relationship phase in outsourcing life-cycle. Furthermore, it effectively explains complexities associated with implementing and maintaining contractual agreements. Despite these benefits, TCE has some shortcomings and indulgencies. In applying TCE, a single transaction is often used as a unit of analysis, without considering other collaborative factors within the organization. This often makes this theory to be static, and hindering it from being dynamic to the ever-changing organizational realities; therefore, it makes the theory explains just few decisions (Lacity and Willcocks, 1995).

Transaction costs are all costs associated with searching and selecting a service provider, negotiation, contract formation and control (Vasiliauskiene and Snieska, 2009). Figure 5 shows clearly how transaction costs can be incurred in an outsourcing transaction.

![Figure 5: The structure of transaction cost factors for outsourcing contracts (Vasiliauskiene and Snieska, 2009)](image)

This theory influences business decisions by combining economic and management theories, in order to determine the kind of outsourcing relationships an organization can engage in with other firms. This theory focuses on the premise that the properties of a transaction is what defines the type of governance structure (market, alliance and hierarchy) that will be adopted (Mclevor, 2005). This helps in determining the boundaries (internal and external), that defines the limits of any business decision. Effective governance is required in order to infuse order, so as to help mitigate conflict and ensure mutual gains are realised (Tadelis and Williamson,
TCE is valuable in understanding why some institutional arrangements operate efficiently than others. This is because TCE assumes that the attributes of a transaction (asset specificity, uncertainty, frequency of transaction, ease of performance assessment) and the type of organizational structure will determine the level of efficiency that will be achieved (Yang et al., 2012).

As explained by McIvor (2005), the factors that often create challenges in outsourcing transactions are:

1. Bounded rationality – This is because human decisions are often limited in their ability to process information.
2. Opportunism – Individuals and organizations tend to always explore opportunities in other to achieve self-interest objectives.
3. Information Impact – This is based on the fact that information is not symmetric, hence one party will be more knowledgeable than the other.
4. Small numbers is bargaining – Some bargaining situations involve small requirements that may be difficult to estimate and making the cost of such service difficult to determine.

These challenges are often compounded when the transactions involve high investments (asset specificity), uncertainty in transaction scope and performance, and when such transactions are not frequently undertaken (Williamson, 1985). Asset specificity refers to the extent of infrastructures that are required in service delivery. Uncertainties can either be general or behavioural and this can be caused by change in market or business environments and communication gap among both parties, which may lead to uncertainties in the transaction (Xu, 2009). As shown in figure 6, the cost of a transaction and its acceptance largely depends on asset specificity and the level of uncertainty. In a situation when asset specificity and uncertainty is low, and when such transactions are frequently carried out, then such transactions will be governed by markets.

![Figure 6: Factors that influence transaction costs and acceptance (Source: Liang and Huang, 1998)](image-url)

Market governance implies short-term contracts that are discrete and which are aimed at ensuring a deal between two firms that will ensure efficient transfer of the property rights of the seller. Also, when asset specificity is at a medium-level, an intermediate governance approach is suitable. In a situation where asset specificity and uncertainty level is high, a
The hierarchical governance approach will be applied, in order to manage the transactional difficulties that may arise within the firm (McIvor, 2005).

Market governance involves little administrative control, a high-level of incentives and legal-rules contract law. A hierarchical governance structure uses considerable level of administrative control, low incentives and the courts are differential to management (Yang et al., 2012). A hybrid, intermediate or compromised mode is a point of compromise between market and hierarchical arrangements; and this mode is dependent on the level of control and the contracting approach that will be applied. The suitability of the hybrid mode depends on the efficacy of the governance approach to be deployed. Detailed and fixed contracts have multiple clauses and adaptive conditions that help to guard against opportunistic tendencies and manage dependencies that originate from transaction specificity (Yang et al., 2012).

![Figure 7: TCE Framework (Source: Yang et al., 2012)](image)

The TCE approach is focused on the assumption that organizations will choose the most cost effective option and this is the reason why the governance approach that will be used will depend on the cost of governance and the opportunistic risks involved. Therefore, the TCE framework ensures that the most efficient institutional structure which is supported by suitable governance mechanisms is very crucial in guarding against opportunism and ensures cost effective transactions. Therefore, in making outsourcing decisions the need for cost reduction and asset specificity are very vital. Williamson (1985) explained that organizations should outsource any activity in which carrying it out internally will require huge investment in arriving at the lowest unit cost. In arriving at this decision, contracts are used in ensuring that the interests of both the buyer and supplier are protected and that all potential risks are safeguarded. Also, the governance structure must ensure that the arrangement with the service provider ensures that services are delivered at agreed price, quality and quantity. These contracts must ensure that all issues associated with uncertainty, performance measurement, and asset specificity are addressed. In order to draft an effective contract, uncertainties play an important role. This is because companies that are averse to risk will demand for premium for bearing such risks and the extent premium is subject to the level of risks which is determined by the extent of uncertainties involved in the transaction. Therefore, effective contracts are determined by a trade-off between risk and incentives (Vasiliauskiene and Snieska, 2009). Furthermore, in addressing uncertainty issues, complex
contracts will need to be developed so that clauses and procedures will be applied in situations of unplanned changes. Also, performance measurement must be well detailed in the contract, so as to ensure that the smallest performance levels are captured (McIlvor, 2005).

TCE is very relevant to cloud-sourcing because of the financial benefits it provides in optimizing and reducing costs (Yigitbasioglu, 2013). This cost optimization is achieved because the customer only pays for services that are only used for. The risks of service provision are shifted to the cloud provider and most of the responsibilities associated with providing the service in line with agreed contract/SLAs are borne with the cloud provider.

2.3.2 Resource-based view of the firm and the importance of core competencies

This theory is premised on the assumption that an organization is structured administratively and this structure is what connects and coordinates all activities of individuals and teams within the organization. These connections are the resources that determine the productivity of organizations and this can vary from one firm to the other, thereby making firms to be heterogeneous (Penrose, 1959 cited in Neves et al., 2014). The main factors that determine the level of competitiveness of an organization are the resources and competencies that are internally available and unique to the organization. These resources are all assets, processes, information and knowledge controlled within the firm and by its employees (Roy and Aubert, 2001). These resources and competencies are embedded in organizational processes and individual knowledge acquired through experiences and formal and informal learning. When these resources are difficult to emulate, then the organization will have a competitive edge within the industry. The exploitation of these resources internally influences organizations to maintain confidentiality of their vital processes and minimizing the risk of depending on external providers (Roy and Aubert, 2001). But it is important to emphasize that the strategic value of resources an organization possess is also crucial, in determining the competitiveness of the organization. If a firm’s assets do not have any strategic value, it will be necessary for the organization to embrace outsourcing.

This theory emphasizes the disparity in the resources available in organizations and this need to be considered and effectively managed before any outsourcing arrangement can be successful (Barney and Hesterly, 1996). This theory is based on the proposition that when organizations lack valuable, rare, and inimitable resources and capabilities, they should search for external organizations, with relevant capabilities that will help cover their weaknesses (Perunovic and Pedersen, 2007). These required resources which are lacking can be acquired using a cloud-sourcing strategy. The required resources in these organizations can be acquired from providers who have these resources as a service in the cloud. The resource based view of the firm plays a key role in the preparation phase and vendor selection phase of an outsourcing process. But in applying this theory, it is important to distinguish between organizational resources and capabilities because they are often confused. The resources in an organization can be classified into tangible, intangible and personnel-based resources (Neves et al., 2014). Tangible resources are the financial capital and the physical assets of a company. These physical assets can include facilities such as plants, machineries,
inventories and raw materials etc. Intangible assets include (but not limited to) brand image, reputation, service or product quality. Also, personnel resources are the quality of personnel, in terms of their technical know-how, work culture, training, employee loyalty etc. Therefore, it is the combination, integration and utilization of all these resources that creates the capabilities of any organization. Depending on the organization’s structure and processes, these capabilities are deployed in the form of functional capabilities (IT, production, exploration etc.) and they can also be deployed across the organization to form cross-functional capabilities (Neves et al., 2014). The strategy used in harnessing and building capabilities from these resources is very crucial for sustained competitive advantage for an organization. But management researchers often criticise the theory for (1) lack of managerial implications (2) an infinite regress, (3) limited applicability (4) non-feasibility of sustenance of competitive advantage (5) no clear definition of what is a resource (6) an indeterminate value of resources (Kraaijenbrink et. al., 2010).

Organizational capabilities or competencies are often classified as core and non-core. Therefore, in making an outsourcing decision, the influence of core and non-core functions will play a crucial role in the decision being taken. Core competencies are functions and activities which are directly integrated into the development of product and services (Power et al., 2006). It is also a combination of the collective learning in the organization, such as diverse skills and multiple technologies that are integrated in the production process (Prahalad and Hamel, 1990). The core competence of an organization is so valuable because it does not depreciate with use like physical assets, but its value is more enhanced the more it is applied and shared (Solli-Saether and Gottschalk, 2009). Therefore, competencies are the combination of resources which distinguish an organization from others because these competencies are skills, activities, and systems that give the organization an edge because they utilize them better than any other organization. While non-core competencies are resources, processes and functions that are indirectly related to the production of products and services (Power et al., 2006).

![Outsourcing Model](Arnold, 2000)
The decision as to what activities to outsource is still controversial because, most outsourcing researchers believe that it is not proper to outsource core functions of an organization. Also, most research agrees that outsourcing non-core activities would help organizations to focus on their core competencies (Lacity et al., 2010; Holweg and Pil, 2012). Core competences are often developed in-house and outsourcing them will impact on the organization’s competitive advantage. In order to identify which activities or functions are core competences, the following must be noted: (1) The functions or activities that help the organization to access wide variety and markets; (2) Customer satisfaction can’t be achieved without the input of such activities or functions (3) The functions and activities must be difficult to imitate (Prahalad and Hamel, 1990). In view of this, competence theory suggests that activities that are core to an organization must be managed in-house while those that are non-core should be outsourced to organizations in which those non-core activities is their own core competence. The core competence of some cloud providers is the non-core competence in some other organizations, hence the need to adopt cloud-sourcing as a strategy.

A general outsourcing model that helps organization to separate between their activities was designed by Arnold (2000) as shown in figure 8. This model classifies outsourcing elements into four types which are outsourcing object, partner, subject and the design. Outsourcing subject entails the economic institution whose function is to make decisions relating to what or not to outsource. Also, outsourcing objects infers to all the processes involved in production activities. These activities are classified into core, core-close, core-distinct and disposable activities. As defined in Arnold (2000) model, the most important activity to an organization is the core activities and organizational activities decline from this level to activities that can be disposed. Outsourcing these activities make the organization to be able to focus more on their core activities, by transferring their decisions, rights and accountability to service providers or vendors. Outsourcing of non-core functions will also help the organization to connect with the core competencies of the vendor and which in turn helps in knowledge sharing among the two firms. Furthermore, from this model outsourcing these functions can also be outsourced in the form of business partnership, whereas other organizations helps in complementing the strategic efforts of the organization, in other to complement competencies that cannot be found in-house (Xu, 2009). But after clarifying between core and non-core competencies, the strategic goals and objectives for outsourcing decision should eventually be the determinant influence on which activities to be outsourced. Quinn and Hilmer (1994) suggest that before an outsourcing decision is taking, managers need to address the following questions:

1. Is there any potential for gaining competitive advantage if this function is outsourced?
2. Is there any vulnerability that may arise in case there is a failure in this outsourcing arrangement?
3. What structuring and control measures are required in order to ensure that the effects of these vulnerabilities are minimized?

The reason for this is that risks associated with outsourcing non-core activities are lower; hence they suggested the need for outsourcing of non-core competencies to precede outsourcing of core competence. This assumes that when an organization outsources their
core functions, it reduces their ability to innovate, increases the extent of competition and may also result in the disclosure of the critical technologies of the organization (Xu, 2009). Power et al., (2006) explained that before organizations can attempt to outsource their core functions, they need to first attain some level of maturity in their outsourcing processes and strategy.

Despite the fact that IT is perceived as an essential service in most organizations, IT functions are often the first victim of outsourcing decision. This is often a result of the fact that IT functions are perceived as service or support function (Akinbola et al., 2013). As buttressed by Solli-Saether and Gottschalk, (2009), some IT functions are perceived by decision makers as mere commodities despite the general perception that IT is an essential service. But they suggested that before IT outsourcing can be successful; the organization must be able to clearly define its IT requirements and must be competent enough in the monitoring of service delivery by their third-party providers.

Finally, as shown in figure 9, the TCE and Core competence models can be integrated into a general model, which can help in making outsourcing decisions. In applying this model to making an outsourcing decision, the following questions need to be addressed (Arnold, 2000):

I. Is this activity highly specific? If the answer is yes, then it means the market transaction cost for arranging this transaction will be very high and which economically makes no sense in outsourcing such activities.

II. How important is this strategic function and does it play a crucial part in the competitive advantage of the organization? If the activity doesn’t play role in achieving the competitive advantage of the firm, then the activity is highly eligible to be outsourced.
2.3.3 Agency theory and evolutionary economics

2.3.3.1 Agency Theory
The initial focus of this theory is aimed at managing the relationship between managers and stakeholders. But this has been extended over the years and it is being used in managing relationships between organizations (Jensen and Meckling, 1976). The main idea in this theory is the notion of goal incongruence between the vendor (agent) and the client (principal) (Tiwana and Bush, 2007). Agency theory is relevant in investigating how organizations can thrive when there is separation of ownership and controls, most especially when these firms have different goals and when their labour is divided (Logan, 2000). This
theory is premised on the perspective that the agent possesses private information that the principal needs to acquire at a cost or efforts. The principal in an outsourcing deal is the organization that delegates, their functions or services to another organization (agent). In a cloud-sourcing arrangement most of the control and management of the service are handled by the cloud providers. In view of this, agency theory is relevant especially when the goals of the cloud provider (agent) and principal differs from one another, hence the tendency for the cloud provider to exhibit selfish interest and exploit opportunities in the deal so as to minimize cost and increase their profit. This can create tension between the cloud provider and the client, especially when the principal party finds it difficult to measure and justify the costs for services being rendered by the agent. Therefore, to minimize these conflicts, agency theory is focused on developing the most suitable contract that effectively measures the performance of cloud providers (Logan, 2000). This is achieved by ensuring that there is detailed specification on how the project outcome will be evaluated and determining metrics that will be used to measure performance. The agents reward will then be tied to their compliance to these specifications. In doing this, agent’s behaviour needs to be properly monitored during the project. In measuring performance, predefined criteria should include milestones, costs, schedules and defect levels that are acceptable. This makes this theory very relevant in outsourcing, in order to effectively manage the relationship between the client and the vendor. Also, it is often applied at the preparation phase of an outsourcing transaction, especially when the providers are being screened. This is necessary to promptly define the vendors attitude and to determine which relationship management strategies would be applied.

2.3.3.2 Evolutionary Economics
This theory is an alternative to mainstream economic theory which focuses on the interaction of unboundedly clever agents and assumes that these agents achieve the needed mutual consistency (equilibrium) instantaneously. But evolutionary economic perspective emphasizes the adaptive process of simple people interacting through specific economic institutions (Friedman, 1999). In evolutionary perspective, equilibrium may or may not be achieved over time, but it focuses on the influence of time and circumstances as it influences the adaptive process.

The fundamental perspective behind evolutionary economic theory is that organizations at any time possess various procedures, capabilities and decisions that influence the actions and decisions taken within the organization. These decision-making processes are often influenced by engaging in diverse ‘search’ operations which helps them in discovering new approaches and innovative changes that can be adopted in their activities (Nelson and winter, 1982). When these decisions yield profitable outcomes the organization will grow. Therefore, this research is aimed at exploring how one of the innovative strategies (cloud-sourcing) can be adopted for effective oil and gas operations. The success of which will further lead to further evolution and improvement in the systems and processes being used within the oil industry.

Also, it is important to emphasize that the environmental factors in organizations market environment plays an important role in determining the outcome of decisions taken within the
firms. As buttressed by Nelson (2007), technological advancement plays a crucial role in driving the economic changes in individuals, firms and society. This theory is an offshoot of Darwinism and it is based on the following assumptions (Perunovic, 2007):

I. Individuals and organizations can effectively function when they function locally than globally.
II. Norms, rules and systems form the decision making of agents in organizations.
III. Agents imitate rules from other agents, in other to generate organizational learning and novelty.
IV. Interactions between agents are always generated from dialogic engagement among agents.
V. Despite the impact of significant degree of cumulativeness and path dependencies, imitation and innovative changes may be interrupted by eventualities.
VI. The changes expected from this evolutionary approach are often non-deterministic, open-ended and irreversible.

The major advantage of this theory is that it is directly focused on the process of changes in economic situations.

2.3.4 Relational view approach

Relational view is aimed at ensuring effective inter-organizational relationships that would help achieve the much-needed competitive advantage from outsourcing deals (Perunovic and Pedersen, 2007). The stakeholders involved in a cloud-sourcing arrangement within the context of oil and gas sector are oil and gas companies (upstream, downstream and mindstream), cloud providers and regulatory and other government agencies. These stakeholders play a very crucial role in ensuring the success of implementation of Cloud-sourcing within the industry. Oil companies being the customer, cloud providers are organizations with technologies, tools and resources for deploying cloud based solutions. While regulators and government agencies are key to ensuring that government policies are aligned to and they also play a crucial role in approving budgets for this project. Therefore, a synergy, which is hinged on effective relationship, is vital among these stakeholders. Hence, the need for a relational approach to be considered.

Relational approach is premised on the fact that organizational activities often span across different boundaries and they are also influenced by inter-firm routines and resources. Therefore, competitive advantage can be achieved by leveraging on the embedded relationships across organizational boundaries, rather than limiting these relationships within a single organization alone (Mclvor, 2005). This competitive advantage is achieved because it helps in combining resources between different organizations in a unique way that helps achieve advantage over competitors. The relational view proposes that organizations can leverage valuable resources from their customers, suppliers, universities and government agencies, in order to harness these resources to gain competitive edge (Mclvor, 2005). This is based on the fact that competitiveness of an organization does not necessarily depend on the
resources within a firm, but often depends on the different relationships embedded in different firms. The relational view is very useful in knowledge generation and that is why often-times innovation occur as a result of inter-organizational collaboration (Mclvor, 2005). This perspective is highly significant within the oil and gas industry, because as explained in section 2.1.4, outsourcing relationships are currently playing vital role in the success of oil and gas operations and projects. In the same vein, the success of a cloud-sourcing strategy is also hinged on how the relationships between the customer, cloud provider and regulatory and government agencies are leveraged on. Historically, innovative changes within the oil industry that are implemented without suitable strategy to manage all stakeholders, often fail. Therefore, the relational view approaches cloud sourcing within the oil sector not just as a mere transaction, but as a relationship aimed at achieving relational gains for all stakeholders.

The relational view is premised on the fact that, when organizations make investments that are relation-specific, it generates relational rents and gains when compared with organizations that do not make such investments. But it is important to emphasize that to commit to or sustain inter-firm relationship; social exchange theory is mostly applied by firms. This view is based on the perspective that exchanges of resources (social or material) forms the basis for human interaction. This process is a reciprocal process of social exchange and, which is based on economic cost benefit analysis considerations (Perunovic and Pedersen, 2007). In applying social exchange perspective, assumptions that reciprocating a benefit received, is necessary to sustain the continuous receipt of such benefits. So before establishing inter-firm relationships, firms or individuals should weight their investments and expected relational rents (Lee et al., 2010). Though, this theory is very relevant, but if not properly managed it may create avenue for ethical compromises.

Relational rents as defined by Dyer and Singh (1998) are profits that are jointly generated from a joint relationship and which cannot be generated if the firm operates alone. These relational rents can be generated through four sources, which are (Dyer and Singh, 1998):

1. Inter-firm specific assets – This is achieved through creating special assets in conjunction with an alliance partner. For example, an oil company can decide to leverage on existing assets of a cloud provider and build their own private cloud.

2. Knowledge sharing routines – This system helps in creating inter-firm knowledge sharing mechanism, which help in ensuring free exchange of information. Unhindered flow of information and knowledge is vital for effective stakeholder (customer, cloud provider and regulatory/government agencies) collaboration, which is a prerequisite for the success of any innovative change in a highly regulated industry like the oil and gas sector.

3. Complementary resource endowments – This occur when using the distinctive resources of firms in an alliance, in order to collectively generate rents that is greater than the individual rent of each partner. An example is when a firm with a great brand of products, partners with another firm with a robust distribution network in other to boost the competitiveness of these firms. Similarly, cloud adoption is based on
leveraging complementary resources, which are embedded in cloud provider organizations.

4. Effective governance – The governance approach in an alliance is very vital in determining the kind of value that will be derived from such relationships and to what extent the relationship will be sustained. It helps in ensuring reduction in costs of transactions and to create value for all parties (McIvor, 2005). The governance structure that is applicable in relationship governance either involves third-party legal professionals to enforce agreements or self-enforcing agreements in which parties involved use relational mechanisms in ensuring that all agreements are adhered to. Furthermore, section 2.5 explores relevant IT governance frameworks which are globally recognized that can be used in governing the cloud adoption process.

The applicability of the relational view is subject to some assumptions as explained by Turkem (2013) and the understanding of these assumptions will help in understanding when and how to apply the theory.

I. Learning effects – Individuals are always willing to learn in an alliance agreement, in order to ensure that their competencies and capabilities increase. However, sometimes the interests of organizations in an alliance agreement are not to improve competence and develop more knowledge, but to achieve a self-serving agenda. In view of this, mechanisms and controls need to be put in place to ensure that alliance arrangements are designed to achieve the desired objectives for the arrangement.

II. Resource heterogeneity – Alliance arrangements that are geared towards achieving competitive edge will be based on exchange or combination of complementary resources. But in situations where firms combine homogenous resources, their objective will mainly be for collusive purpose and not to access complementary resources.

III. Imperfect mobility – This assumption is premised on the perspective that alliances are only realistic when the objective is to access resources that cannot be easily sourced from the market. But when resources are easily traded and accessed in a sector or market, there will be no need to forming alliances.

IV. Voluntary Governance structures – The assumption for effective relationship is based on the condition that there is shared authority, whereby each alliance partner has equal control in allocating resources. This implies that there would not be a need for a central authority in managing the alliance.

V. Private and profit seeking firms – The drive for an alliance network is more feasible and applicable with firms that are profit oriented because the need to increase the relational rent is the major aim for most alliance transactions. Therefore, organizations that are non-profit or non-governmental organizations may not show interest in alliance networks.

Effective knowledge sharing is also very crucial in generating relational rents and it has been established as a major success factor in any outsourcing arrangement (Dyer and Singh, 1998;
Perunovic and Pedersen, 2007). But because organizations have generated inimitable tacit and explicit knowledge over the years on how to coordinate, combine and manage their capabilities, it makes knowledge sharing to be challenging. Even though these heterogeneous knowledge is crucial for continuous competitiveness of firms (Tiwana and Bush, 2007), the need to explore for more knowledge within and outside their organization boundaries cannot be overemphasized. Knowledge based theoretical perspective suggests that outsourcing decisions help to create platform for utilizing the skills and knowledge of vendor firms (Tiwana and Bush, 2007). It is important to emphasize that knowledge sharing does not happen by default, but it is achieved through the strategic decision of both the vendor and the client firm, and this decision will be influenced by the extent in which the vendor or client is willing to share knowledge about their operations and service delivery. Therefore, the integration of knowledge from different firms will be achieved when the creation of mutual/shared understanding between the vendor and the client is achieved. Both parties have a role to play in achieving knowledge exchange. The client must ensure that relevant knowledge are adequately documented and effectively communicated to the vendor. Also, the client must ensure that the choice of vendors in an outsourcing decision must be based on if the vendor has requisite knowledge for the service or function being outsourced; and if this knowledge can be easily transferred or exchanged. Therefore, in taking outsourcing decisions, firms must consider the strategic cost of forgone learning, cost of ensuring that knowledge is not misappropriated and the cost of knowledge transfer from the vendor (Zack and Singh, 2010).

<table>
<thead>
<tr>
<th>Theories</th>
<th>Advantages</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transaction Cost Economics</strong></td>
<td>It helps in the determination of cost justification for outsourcing arrangements.</td>
<td>It is static because it focuses on single transaction as unit of analysis, without considering other collaborative factors within the organization.</td>
</tr>
<tr>
<td></td>
<td>Helps in addressing complexities involved in managing outsourcing contracts</td>
<td>It often doesn’t consider long term interest of the firm because the focus of the theory is majorly on achieving cost savings.</td>
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<td></td>
<td>TCE governance structure creates boundaries that help in defining the limits of the client and vendor.</td>
<td>TCE theory fails when there is a mature market (in a mature market with multiple vendors, vendors cannot behave opportunistically because clients have more options)</td>
</tr>
<tr>
<td>Resource-based view of the firm and the importance of core competencies</td>
<td>This theory helps to achieve efficiency and effectiveness in the utilization of organizational resources.</td>
<td>Prioritizing function or process to outsource, if not handled properly can result in high risk, which may translate in loss of investments and productivity.</td>
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<td></td>
<td>It helps organizations in strategizing, planning or reconsidering the function or processes that can be outsourced.</td>
<td>Despite researchers trying to explain the meaning of organizational resource, the definition of resources still lacks clarity. Therefore, making the application of the theory to be limited.</td>
</tr>
<tr>
<td></td>
<td>Sustenance of competitive advantage cannot be guaranteed because of imitation of resources is always a possibility.</td>
<td></td>
</tr>
<tr>
<td>Agency theory and evolutionary economics</td>
<td>Suitable in managing the relationship between a client and vendor.</td>
<td>Due to the complexity of some transactions, it is difficulty to completely monitor and control the activities of the agent and which make give room for opportunistic exploitation by the agent.</td>
</tr>
<tr>
<td></td>
<td>Evolutionary Economics theory is directly focused on the process of economic changes.</td>
<td>The perception that the agent is always exhibiting self-interest tendencies is wrong because principals to can also be culpable.</td>
</tr>
<tr>
<td></td>
<td>Evolutionary economics did not recognize the institutional complexities of the economies of modern markets.</td>
<td></td>
</tr>
<tr>
<td>Relational view</td>
<td>Helps organizations to leverage on embedded relationships and resources outside their organizational boundaries.</td>
<td>The assumptions of relational theory often limits is applicability in some conditions. These assumptions are learning effects, resource heterogeneity and imperfect mobility.</td>
</tr>
<tr>
<td></td>
<td>It helps in ensuring knowledge sharing and transfer in any outsourcing arrangement</td>
<td>Current knowledge can become obsolete, hence the need to put processes in place that helps to increase learning.</td>
</tr>
</tbody>
</table>
Helps in minimizing cost of governance

Social exchange perspective sometimes makes relationship to be built on the objective of seeking rewards. This may encourage unethical practices in environments with poor ethical culture.

Relational view approach is applicable during all phases of outsourcing process.

It helps in achieving social relationships across different firms.

Table 1: Theories and their application (Perunovic and Pedersen, 2007)

In conducting this research, the relational view was selected and applied in this research. As explained earlier in this section, one of the key factors for successful cloud-sourcing is effective relationship and collaboration among all stakeholders; hence the choice of the relational view. As shown in Table 1, the relational view is very relevant and applicable in all phases of an outsourcing process (Perunovic and Pedersen, 2007) and it is most suitable in addressing the key issues raised in the research. The relational view was applied in this research by using this view to understand how cloud computing is being used to build strategic alliances in the oil and gas sector, the problems that arises from these relationships and how they can be managed. The relational view was also applied in understanding the role of suitable governance framework, social exchange and knowledge sharing in addressing the concerns associated with outsourcing to the cloud. In view of this, section 2.4 will considered various IT governance, operational, human resource and vendor (cloud provider) selection strategies that are relevant in managing these diverse relationships that cloud-sourcing tends to create.

2.4 Management Frameworks

The successful implementation of any initiative is a function of the strategy applied in executing such changes; and the fundamental factor that needs to be considered in deciding on innovative changes is corporate rationality. Corporate rationality guides managers into taking decisions that help to achieve economic efficiency (ratio of revenue to costs), profitability and ensuring the maximization of shareholder value. Therefore, in applying corporate rationality business decisions must be made at the business portfolio level, organizational functions and organizational processes (Mella and Pellicelli, 2012). Having taken a decision to outsource functions, relevant strategic frameworks need to be applied in the areas of ITO, Operations, Human Resources, Contracts, and Regulatory compliance. The need to understand these strategic frameworks is because most outsourcing arrangements that
failed are due to poor management and governance of the outsourcing arrangements (Oshri et al., 2011).

2.4.1 IT Governance
Any IT governance strategy applied in outsourcing must be a subset of the organizations corporate governance strategy (Beulen et al., 2006). In view of this, governance of outsourcing entails the responsibilities, roles, objectives, interfaces and controls that are needed to plan for changes and manage the introduction, maintenance, performance, costs and control of services provided by third parties. To achieve this requires collaborative process that is hinged on robust relationship between stakeholders (client, cloud providers, regulators etc.) involved in the cloud-sourcing adoption. To achieve this, the responsibilities of both clients and service provider as defined by the IT Governance Institute (2005) are:

1. Continuous review of the contractual terms in order to ensure viability of the contract and to guarantee benefits to both parties.
2. Governance schedule to be adopted must be explicitly stated in the contract.
3. Managing relationships with the aim of ensuring that the contract terms are achieved; using service level agreement (SLAs), Gainshare, Service credit regimes and Operational level agreement (OLA).
4. Develop proper structure that clearly defines roles and responsibilities that would be used in communication flow, decision making, issue escalation, management of disputes, service delivery and demand management.
5. Ensure a proper system is implemented for continuous monitoring of performance, cost, effectiveness and service quality.
6. Effective allocation of resources, expenditures and service utilization in order to align with prioritized needs.

The available IT governance framework structure that can be adopted for outsourcing are COBIT, ITIL/BS15000, ISO 27001, 9000 and CMMI. None of these frameworks contains all the controls that can govern service delivery, but collectively they cover the “what, how, and scope” of IT Governance, although with some duplications and overlap as seen in figure 10 below.
**COBIT** – Control Objectives for Information and related Technology is an ISACA control framework that was issued in 1996. COBIT helps organizations to ensure compliance with regulations, manage risks and align IT strategy with the goals of the organization (Becker and Bailey, 2014). This framework comprises of 5 IT domains, 37 processes and numerous control objectives. COBIT is relevant in Cloud-sourcing because it contains processes that are relevant in the management of third party services, in order to make sure that their roles and functions are well spelt out and that they continue to meet up with stipulated requirements. Using COBIT to achieve this will involve, identifying the requirements of cloud providers, define and develop service contracts, organize supplier interfaces, management of service contracts, monitoring contract execution, service level reporting and process monitoring (Beulen et al., 2011).

**ISO 27017 and ISO9000** – This framework (ISO 27000) is the international best practise that is being used for Information Security Management System (ISMS). The International Standards Organization (ISO) 27000 is suitable because of the series of standards and tools it proffers for risk assessment. Just proposed is ISO/IEC 27017:2015 which provides guidelines for information security controls applicable for cloud adoption and provisioning. This standard provides additional guidelines for relevant controls that were specified in ISO/IEC 27001 and ISO/IEC 27002. This ISO standard is relevant to Cloud-sourcing because it helps to identifying the risks to an organization’s information and communication systems from business processes that are migrated to the cloud. Ensure that these security issues are documented in agreements that ensures that all the security requirements are adequately covered, ensuring information backup and access control (Becker and Bailey, 2014). Furthermore, ISO standards also help to provide framework that can help achieve quality
service delivery when ISO 9000 is applied. ISO 9000 is a series of quality standards that help ensure there are no defects through the execution of organizational processes and functions. This standard is also relevant to cloud computing because it defines quality evaluation requirements in IT service delivery life cycle.

**ITIL** – This is a framework developed by the British central computer and telecommunication agency (CCTA). Since, 2001 this framework is being distributed by the Office of Government of Commerce (Beulen, et al., 2011). The ITIL v3 process can be applied in managing the outsourcing process into four phases (Mobarhan et al., 2011):

**Phase 1: Incident and problem management** – Incident management process helps the organization to deal with incidents (failures, questions or queries) reported by organizational users of an outsourced service. The main aim of this process is to ensure smooth and prompt restoration of service in line with agreed SLA. While, problem management is focused on understanding the root cause of the problem in order to ensure that such incidents does not reoccur.

**Phase 2: Financial, Risk and Service level management** – The second phase includes financial management and it helps organizations to manage costs, account for expenditure, and their budget process. It is important to emphasize that financial management is a prerequisite for service level management and it will also help the organization to justify the need to outsource their processes. Also, risk management process will help the organization to identify risks, their impact and how to mitigate them. This is a very vital process that is required in achieving the organizational objectives for outsourcing. Another vital process is service level management. Service level agreement (SLA) is a critical document that specifies the scope of the outsourcing tasks, terms and conditions, performance baselines, quality metrics and potential causes of service disruptions (Oshri et al., 2011). SLAs are expected to accommodate provisions for conditions in which service can be disrupted and also accommodate changes that may occur from change in market conditions, regulations etc.

**Phase 3: Supplier, Change and Security management** – Supplier management is important to effectively manage the relationship with service providers in order to ensure that they render service as expected. Change management is also very crucial because every outsourcing decision often leads to transition from existing system to another, hence the need for change management is very crucial. Also, in this phase security management process is also involved because the security is a major threat to outsourcing decisions, hence the need to manage confidentiality and security of data, in order to avoid any form of compromise of organizational data.

**Phase 4: Service evaluation** – This is very important to ensure that the organization is getting value for investment in an outsourcing deal; and this is achieved by constant evaluation of quality of service.
Despite the applicability of the ITIL framework in cloud governance it is not a complete out of the box solution for managing cloud environments (Nieves, 2014). Therefore, the need for it to be refined and customized to suit, the peculiarities of each organization in line with their detailed governance requirements.

**COSO – ERM Framework** - The Committee of Sponsoring Organizations of the Treadway Commission (COSO) use their Enterprise Risk Management (ERM) framework to cloud computing. This governance framework helps focus on the following processes. (1) Internal Environment – This entail how the risks and Control measures are handled (2) Objective setting that ensures that the technology aligns with organizations objectives (3) Identification of events which can serve as opportunities or risk to the process (4) Risk Assessment and (5) Risk response strategy to be used to mitigate the risks, (6) Control activities that guide both the client and vendor (7) Effective flow of communication (Becker and Bailey, 2014).

**ENISA** - This guideline was published by The European Network and Information Security Agency so that it can be used to access the security risks and advantages of cloud adoption. These risks involved in this guide include technical, legal and other organizational issues. Also, the framework helps in appraising these risks, compare the services being rendered by cloud providers and how to obtain assurances from them. It also includes lists of areas that should be captured in contractual agreements that should be included in a cloud transaction. These include confidentiality, data security and transfer, limitation of liability and protection of intellectual property (Becker and Bailey, 2014).

2.4.2 **Operational and Service level management strategies**

The success of any outsourcing deal is hinged on the strategy being used to manage the outsourcing operations. Outsourcing at the operational level focuses on activities involved in how outsourced services are rendered and this also includes how relationships between the client and the vendor in outsourcing activities are being managed, maintained and sustained (Boulaksil and Fransoo, 2010). The main purpose of SLM is to ensure that service performance is measured in a manner that is consistent throughout the entire organization, so as to ensure that the service generated meets business objectives (Mobarhan et al., 2011). The strategies that can be applied in service level management as defined by Halvey and Melby (2007) entails proper definition of service level objectives, establish service levels (using historical information, existing SLAs, benchmarking etc.), define service level agreements, discuss and clarify performance excuses, ensure innovation in SLAs, report SLA by monitoring and measuring performance, review service levels and determine remedial actions to be taken.

There are enormous risks associated with meeting up with agreed service levels and oftentimes these risks are associated with divergent technologies, increased customer requirements and complex organizational systems. To minimize these operational risks, organizations need to put more focus on people and processes involved in the outsourcing deal (Brasche, 2004). This is important because most cloud providers attend to the needs of their multiple clients through a shared pool of resources. Therefore, it is very crucial to manage these resources in order to ensure that the operational demands of a client do not impact on the other, and this can only be achieved when right systems are put in place, and
ensuring that processes and procedures are clearly defined. Service management applications (e.g. Remedy and Peregrine) can also be of immense benefit, by using it in task assignment, monitoring and tracking.

### 2.4.3 Human Resource strategies

A strategic framework is important to manage the impact of cloud-sourcing because a decision to outsource to the cloud may impact the employment or change the roles and responsibilities of employees. This is very important and if not managed carefully can result in industrial disputes. Therefore, effective human resource strategies are a function of effective collaboration between the client, service provider, regulators and other relevant stakeholders. In a situation, whereby a decision to cloud-source would require transitioning employees to a cloud provider (or other similar arrangements), the number of employees involved, employee communication, timing of implementation, and trade union reactions need to be discussed. A major input to this discussion would be the motive for Cloud-sourcing, the kind of service or function being moved to the cloud, the capability of the company to more efficiently work with the service provider, employee morale and job satisfaction, and comparison of customer and service provider’s compensation and benefits (Halvey and Melby, 2007).

#### a. Due diligence

In doing this the need for due diligence cannot be over emphasized and this implies that before the client can issue a RFP, the HR and line managers need to have done a background analysis on the impact (short, medium or long-term) of the cloud adoption decision on the workforce. This is crucial because offshoring decisions may not result in a transition, but in redundancies. The first step is to prepare the list of all employees that provide services within the process or function that is to be outsourced. This would be followed by an assessment of each employee based on an assessment matrix developed by the organizational management (Halvey and Melby, 2007). After defining the affected employees, their compensation and benefits needs to be discussed based on relevant laws and industry practices. Furthermore, in order to apply due diligence, redundancy and severance policies prior to transitioning to outsourcing. This is very important, especially in the case of offshoring and cloud-sourcing because of the difficulty that may be encountered to transfer employee services across geographical boundaries.

#### b. Compensation and benefit analysis

A major factor to be considered during outsourcing decisions is compensation and benefits for employees whose service may be affected by the decision to transit to cloud based system. This is because a failure to manage this phase properly can trigger industrial issues; if employees are not properly compensated in case of severance or if the proposed wage is not commensurate with the current wage of the personnel. Client and service providers need to share their compensation benefits and policies in order to form a basis for the discussion (Halvey and Melby, 2007). This process should be conducted in collaboration with industry regulators and with sincerity and openness thereby ensuring that no benefit items are omitted in the cause of the analysis.
c. **Review of current severance policies**

Prior to undertaking any cloud-sourcing decisions, the client needs to evaluate current severance policies, in order to estimate the cost implication because this cost can add up to the overall cost of the transaction. A review of severance plan and policies is very important because most of these plans may not capture outsourcing decisions, the various outsourcing options and the severance implications. It is important to emphasize that most offshoring decisions if not handled carefully can result in redundancies. But a clear example of a success story is Barclay’s decision to outsource 523 UK jobs in 2004, without resulting in compulsory redundancies. This was achieved by redeploying 69% of affected employees, while the remaining 31% were managed through voluntary redundancies or natural attrition (EMCC, 2006). This successful engagement was achieved through a collaborative effort among all stakeholders, but this process was facilitated by the human resources department, using the framework in figure 11 in partnership with Right Couttt. This further emphasises the need for cloud-sourcing decisions to be viewed from the relational view so as to ensure a seamless transition that is devoid of conflict.

![Figure 11: Framework model for restructuring resulting from outsourcing (Source: Right Coutts, 2004 cited in EMCC, 2006).](image)

*d. Relevant laws and regulations*
Also, preceding any Cloud-sourcing agreement is the need to be conversant with relevant federal, state or local laws, regulations and policies that are relevant to outsourcing. Similarly, it is important to determine the impact of such Cloud-sourcing decisions on these regulations and laws. For example, in the United States relevant laws such as Worker Adjustment and Retraining Notification (WARN) Act of 1988, Federal, State and local anti-discrimination and fair employment laws and Employee Retirement Income Security Act (ERISA) of 1974 needs to be considered before taking any Cloud-sourcing decision. Also, if the outsourcing deal involves Europeans it must be done with consideration given to Acquired Rights Directive and Work Council regulations. This regulation involves specific notices that must be issued, requisite authorization and consent requirements (Halvey and Melby, 2007).

2.4.4 Vendor Selection

Vendor selection is a crucial aspect because the wrong choice of vendor (cloud providers) can lead to a failure of the whole Cloud-sourcing project. The common steps that are required when selecting vendors include determining the evaluation criteria to be used, selecting participants that would be involved in the ranking of vendors, determining the scoring system to be used, weighting the key criteria and signing off the implementation procedure (Halvey and Melby, 2007). The choice of vendors would be influenced by the type of industry the organization is operating and the motives for Cloud-sourcing. The choices available in vendor selection are domestic versus offshore, local versus global and niche versus broad (Oshri et al., 2011). But this choice would be made based on the capabilities of each service provider. Levina and Ross (2003 cited in Oshri et al., 2011) categorized these capabilities as detailed below:

1. **Client specific capabilities** – These capabilities are resources and routines that align the client’s outsourcing objectives to the vendor’s processes. This implies that the service provider/vendor to be given the process or function must have a clear understanding of the business model of the client.
2. **Process Capabilities** – Process capabilities are routines that are specific to the process and methodologies that are specific to the function to be outsourced.
3. **Human resource capabilities** – This entails the capability of the vendor to ensure it recruits, retains and trains their employees in order to be competent to render effective service in line with the client’s needs.
In addition to this broad categorization, Feeny et al. (2005 cited in Oshri et al., 2011), identified 12 major capabilities (See figure 12) that must be considered during vendor selection for an outsourcing contract (which is also applicable during Cloud-sourcing). This includes leadership capabilities which assure the client of effective service delivery throughout the outsourcing life cycle. Also, business management capability is needed to make sure that the service provider delivers products and services in line with the business plan and agreement between the client and the vendor. The need for domain expertise which requires in-depth knowledge of the sector or industry and being able to apply this knowledge in fully grasping the client’s needs, so as to ensure that outsourcing objectives are achieved. In order to accomplish this, the cloud provider must possess sound sourcing capabilities and behavioural management ability to acquire competent team and being able to motivate them in delivering quality service. Other capabilities required by cloud providers, which clients must look out for are their portfolio and project management capabilities, technology exploitation, process improvements, customer engagement, planning and contracting process, organizational and governance structures.

2.5 Key issues that are associated with the research

Based on the knowledge gathered from these literatures, the need for operational effectiveness and improved productivity has been the underlining motivation why organizations are embracing outsourcing arrangements. But the consideration on what functions or process will be cloud-sourced is based on what the organization wants to achieve from the cloud-sourcing arrangement. In the context of the oil and gas industry, the global decline in the price of crude oil is necessitating the need for cost optimization initiatives, aimed at ensuring that production cost per barrel of crude is kept as low as possible. This makes cloud-sourcing decisions attractive in the oil and gas sector, based on the general assumption that cloud-sourcing helps reduce cost (Mella and Pellicelli, 2012). Furthermore, companies embrace outsourcing in order to achieve needed flexibility and minimize risks associated with a function or process.
In taking these outsourcing decisions, cloud solutions are very attractive because it can help achieve cost reduction, simplicity in managing and administering IT services, and scalability because organizations can subscribe to only the service(s) they are using. In view of these benefits, coupled with the need for more efficiency in oil and gas operations, adoption of cloud solutions is suitable for deployment within the industry. However, these benefits have some associated challenges which were gathered in the literature review process. These challenges include data security concerns, suitability of cloud services for large scale operation, concerns of job reduction, knowledge transfer, compliance with regulatory requirements and impact on competence development for client employees. Therefore, this research focussed on ways in which these challenges can be minimized in order to ensure a successful cloud adoption in oil and gas operations. As buttressed by Weinert and Meyer (2005), cloud adoption will result in varying client-cloud provider relationships (depending on the magnitude of cloud adoption), but there are limited research in this direction. In view of this, this research explored how best Oil and Gas companies can leverage on the strategic relationships that are created when functions are outsourced to the cloud. The research also focussed on how these inter-firm relationships can be leveraged to address the key issues associated with this research.
Chapter 3 Research Methodology

This section presents the systematic framework through which the research was conducted and this entails presenting the assumptions, methodology and method that were used in the conduct of the research. The research methodology is essential in guiding the research process throughout the research phase, in order to ensure that the research objectives are achieved and also to help clarify the assumptions underlining the methodology adopted for the purpose of this research. All these will be addressed in this chapter.

3.1 Philosophical Background

The need to have a clear understanding of the philosophical approach used in the conduct of this research is very crucial. This is because the ontological and epistemological stance of researchers is vital in the knowledge creation process (Kamil, 2011). This is because it will assist in understanding how the research was approached, theories applied and how the research was designed. Therefore, this section discussed the ontological and epistemological perspectives that underlined the assumptions made and how the research process was guided. This research was conducted based on relativist ontological perspective that assumes that organizational issues can be tackled from different perspectives and these views must be heard and discussed in order to reach an agreement on what is perceived to be the truth. This is important because the perception used in addressing this issue is based on the view that truth is not absolute and there cannot be a universal standard for understanding reality, knowledge or truth (Porra, et al, 2014).

After defining the ontological perspective to be adopted, it is also important to clarify the epistemological stance that was adopted for this research. This is important to understand what counts as knowledge, the justifications for the knowledge generated and the researchers’ relationship with the research field (Creswell, 2013). Social constructionism epistemology was used for this research because it affords the opportunity of gathering opinions and experiences, using knowledge gathered from stakeholders. Social constructionism ensures that the interaction of individuals within a society helps in knowledge generation process. Also, it encourages the conversation process so that the needed opportunity to maintain, modify or reconstruct subjective reality (problems that can be shared unproblematically with others) are achieved (Andrew, 2010). In view of this, the research was addressed by not just merely gathering facts, but to focus on the different meanings and interpretations people share as it relates to the issue being studied. In view of this, I leveraged on stakeholders experiences, judgement and understanding of the issue and not just relying on some general laws as a yard stick for analysing the situation. The relevance of social constructionist epistemology is based on the fact that the decision to adopt an IT solution is far beyond a rational decision, but it is a complex situation that is highly subjective to social influences (St Amant, 2009). This is because, the adoption of innovative technologies is a product of the subjective reasoning of employees and how this technology will influence their work and their organization. Technologies are adopted and applied by individuals or groups, and the meaning they make of the essence of using such system or solution plays a vital role on how such technologies will be effectively utilized for organizational effectiveness.
In view of the social constructionist epistemology adopted for this research, qualitative method of inquiry is more suitable. This is necessary in gathering textual or linguistic data which will help in ensuring that experiential accounts of individuals or groups are gathered and analysed (Burr, 2015). But this will be handled within the context of action research methodology because the aim of this research is not just to study the issue of outsourcing oil and gas functions in the cloud, but to drive changes that will help in improving organizational productivity and effectiveness. In view of the epistemological stance adopted, reflexivity was the key skill adopted in the data gathering and analysis phase of this research. The subjective nature of perspectives expressed makes the need for reflexivity to be of high priority because truth cannot be established from just a single view. Therefore, reflexivity as enshrined in social constructionism epistemology ensures that equal status is assumed between the researcher and respondents (Burr, 2015). This is necessary to ensure that the research process encourages in-depth thinking and collaborative engagements that will ensure that relevant knowledge are generated.

3.2 Action research
At the ‘heart’ of this research was the application of action research because it helped me in ensuring the integration of theoretical knowledge and practical realities in the conduct of the research. This aligns with my social constructionism (interpretive) epistemological view, which places emphasis on the need for organizational realities, cultures, norms and individual opinion are captured in the conduct of the research. Action research is a research methodology that is aimed at initiating action in an organization, community or network (industry stakeholders) through collaboration with participants and stakeholders (Greenwood and Levin, 2007). The three elements which make a research undertaking to be action research are action, research and participation (Greenwood and Levin, 2007). Therefore, the main essence for adopting action research is the fact that it focuses on implementing changes that can help in improving organizational effectiveness. Organizational change programmes can be limited, focused or holistic changes (Coghlan and Brannick, 2010). Limited change programmes are focused at addressing specific organizational issues, while focused changes are aimed at addressing some aspects of organizational activities and holistic change programme are designed to address all or most organizational issues. Action research was adopted so as to drive the change needed to ensuring that embracing cloud solutions offer the best value for both the oil companies and her employees. Therefore, by applying action research I engaged industry stakeholders (which included selected IT personnel, IT Manager/supervisors, service providers, and regulators), in constructing the issues, reflecting on them, plan action in the form of recommendations, follow up to ensure implementations of recommendations and specifying lessons learnt. This helped in ensuring that my views and assumptions were subjected to dialogic engagement and systematic self-inquiry (Cassell and Johnson, 2006), in order to ensure that I get adequate clarification from others on the perspectives they express.

Also, the application of action research helped in building the much-needed collaboration that is required between me and the research participants. Action research helped ensure that I was self-reflective through double loop thinking, thereby yielding relevant outcomes. The
outcomes of this research process were proposed to major stakeholders within my work place and in other relevant organizations, in order to ensure that they are implemented or considered for future implementation (Susman, and Evered, 1978).

The core characteristics of action research which makes it suitable for this research work are (Greenwood and Levin, 2007):

- It is a methodology that is context bound and helps to holistically tackle real life situations.
- Knowledge generation in action research is a product of collaborative communication and engagement process between the researcher and other stakeholders, in which all inputs are taken seriously.
- The action research process is enriched by the diversity of experiences, views, competence and background of all participants in the research process.
- The inquiry process helps to drive social action and oftentimes result in generation of new knowledge entirely.
- The validity, reliability and credibility of this research, is dependent on whether the actions taken based on the outcome of this research will solve challenges with outsourcing functions in the cloud.

In driving this change, using action research methodology, I had to identify the need for change, define anticipated future states, review the present situation in line with future expectations and get involved in the transition process (See figure 13). It is important to emphasize the fact that this research is a form of action in itself, because it serves to initiate a process of intervening in the challenges associated with cloud adoption in the oil and gas sector. Also, the iterative nature of action research does not make the research to be an end in itself, but a continuous (iterative) process which ensures continuous reflection and taking of necessary actions.

![Diagram of the process of change](image)

**Figure 13: The process of change (Coghlan and Brannick, 2010).**
The need for change in this research is to prepare oil and gas companies on the external forces of change such as cloud computing on oil and gas functions and effectiveness. Since, oil and gas companies do not have control over technological advancement such as cloud computing, it becomes imperative for them to adopt strategies that will help in managing the transition process. After establishing the need for change, the action research process, engaged identified stakeholders in defining the expected future that is anticipated after an oil company migrates some (or all) of their functions to the cloud. This is very essential in providing focus for the research and to build consensus among interviewed stakeholders. The data gathering, analysis and reflection process focused on appraising the present state of outsourcing to the cloud in the oil sector and identifying policies, strategies, structure, attitude, processes and culture that needs to be changed or reviewed in other to achieve the desired outcome. Active engagement with identified respondents, experiences, best practices and reflective thinking are essential in ensuring that this phase updates or generates the much needed knowledge that is required to generate an actionable outcome that can be implemented. The last phase in the action research change process that was used was managing the change transition or change implementation. I ensured that the knowledge generated are implementable and relevant within the oil and gas sector. This is important in ensuring that the knowledge is tested in order to ensure its validity. Central to this change cycle is constant review, which ensures that I constantly reflect in order to continuously construct, plan and evaluate all phases of the research (Coghlan and Brannick, 2010). In conducting this action research concept, theories (with emphasis on relational view approach) played a crucial role in guiding the research process into knowing how to diagnose an organization and to determine the best course of action. The outcomes of action research is also important to further develop relational view by taking actions that will further help in evaluating the validity of the perspective applied and evaluate the consequences.

The outcome of this process helped in the generation of new knowledge or revising existing theories (Susman, and Evered, 1978). The findings were presented to some stakeholders for implementation in their organizations (including my work place) and appendix V- VI provides evidences of these proposals and some of the feedback so far. The main benefit of action research in practice is the fact that the implementation of actions or interventions that emanated from the research process is the most suitable way of improving practice, achieving organizational learning, drive innovation and achieving organizational advancement. But I need to emphasize the complexities associated with getting actions to be implemented within the oil sector, especially due to the uncertainties resulting from the dwindling price of crude oil. Actions were proposed but their implementation is at the discretion of these key stakeholders; however, I have been receiving positive feedbacks from them. Therefore, the implementation of some of the recommendations requires continuous subtle and non-coercive engagements in order to ensure these actions are implemented in due course; but their impact may take few years to materialise.
3.3 Qualitative Methods
The knowledge action research is meant to generate is majorly about practical knowing about the actions being taken in the research setting. This was achieved through engagement with identified stakeholders and this also implies that the main data were generated through focus on language, facial expressions, questions, tones and volumes and other subjective means of understanding the issue (Cassell and Johnson, 2006). This is known as natural language data and it helps to ensure that we gain insight into organizational realities through language (Easterby-Smith et al., 2012). This was achieved through a qualitative approach which entails conducting detailed and in-depth interviews, active engagement with participants, and observations. In doing so, this qualitative approach which includes interviews, observations and other formal or informal engagements (interactions) were applied.

30 participants consented to be interviewed when maximum variation sampling strategy was applied. Maximum variation helps to document the diverse variations that are embedded in perspectives expressed by individuals (Creswell, 2013). The inclusion criterion for research participant was anyone who is conversant with or has used cloud solution. Individuals who are not thinking about, or have not used any cloud technologies were excluded because wide knowledge of participants about the subject matter is important in ensuring reliability and validity of the research outcome.

3.3.1 Data gathering
To get interested participants for this research, an email was sent to colleagues, selected professionals within Oil and gas companies (Upstream, mid-stream and downstream), Cloud providers (industry consultants, service providers and OEMs), and regulators in Nigeria. The need to gather participants within this wide range was based on the need to ensure that the research data is balanced and not a one-sided approach. Professionals within the core Oil and gas functions are personnel who provide, support or use any IT service within the oil industry. Cloud service providers are firms that provides both IT and cloud related services within the oil and gas sector. This also includes original equipment manufacturers (OEMs) that provide proprietary tools that are used in driving the core functions (e.g. drilling, facilities and production) within the industry. It is necessary to note that participants in companies that provide IT services without cloud solutions were also interviewed. Regulators are personnel working with relevant government agencies that are saddled with the responsibilities of enacting policies and guidelines that protect the investments of both government and investors.

The criteria for contacting and selecting these participants are their knowledge about cloud solutions and robust experience within the oil and gas sector. Participants for this research were initially contacted through email which contains information sheets and consent form (as shown in appendix I and II respectively). These participants were then followed up using phone calls, in order to provide more details about the research and to clarify any aspect of the research that they may not be clear about. Snowballing technique was also used in trying to leverage on existing participants in getting more interested participants. In line with the guidelines in the information sheet participants were given a month to indicate their interest by filling in the consent form (See appendix II), in line with the university regulations. After
the conclusion of this process, 30 Participants indicated interests in participating in this research. Tables 2 – 4 shows the classification of these participants based on their sector within the industry and the number of participants interviewed in various companies. All the participants that consented to participate in the research were men; because the Nigerian oil and gas sector and service provider firms are often male dominated, especially in technical functions. As soon as the consent forms of these participants were received, the participants were allowed to select their preferred choice of day, time and location they want to be interviewed.

<table>
<thead>
<tr>
<th>Participants</th>
<th>Stakeholder Organization</th>
<th>Role</th>
<th>Cloud Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cloud Service provider</td>
<td>Senior System Engineer</td>
<td>Service level, Relationship and workflow management</td>
</tr>
<tr>
<td>2</td>
<td>Oil and Gas company</td>
<td>Network and communication management</td>
<td>Provide network backbone for the cloud</td>
</tr>
<tr>
<td>3</td>
<td>Oil and Gas company</td>
<td>Infrastructure and Database Support</td>
<td>Service support</td>
</tr>
<tr>
<td>4</td>
<td>Oil and Gas company</td>
<td>Infrastructure Support</td>
<td>Provide network backbone for the cloud</td>
</tr>
<tr>
<td>5</td>
<td>Cloud Service provider</td>
<td>Head Engineering</td>
<td>Technical and Relationship management</td>
</tr>
<tr>
<td>6</td>
<td>Oil and Gas company</td>
<td>Information Management analyst</td>
<td>Personal Usage</td>
</tr>
<tr>
<td>7</td>
<td>Oil and Gas company</td>
<td>IT Coordinator</td>
<td>Service Support</td>
</tr>
<tr>
<td>8</td>
<td>Cloud Service provider</td>
<td>Chief Information Officer</td>
<td>Level III Support and Relationship management</td>
</tr>
<tr>
<td>9</td>
<td>Oil and Gas company</td>
<td>Head, Information Technology (Flow Station)</td>
<td>Client, Workflow and Process Management</td>
</tr>
<tr>
<td>10</td>
<td>Cloud Service provider</td>
<td>Chief Information Officer</td>
<td>Strategy Implementation</td>
</tr>
<tr>
<td>11</td>
<td>Cloud Service provider</td>
<td>Data Management expert</td>
<td>Managing Application as a service and backend administration</td>
</tr>
<tr>
<td>12</td>
<td>Oil and Gas company</td>
<td>Server and Storage Administrator</td>
<td>Technical</td>
</tr>
<tr>
<td>13</td>
<td>Oil and Gas company</td>
<td>IT Support</td>
<td>Workflow</td>
</tr>
<tr>
<td>14</td>
<td>Regulator</td>
<td>Network Engineer/system administrator</td>
<td>Support and Administration</td>
</tr>
<tr>
<td>15</td>
<td>Oil and Gas company</td>
<td>Manager, Project Control</td>
<td>Technical</td>
</tr>
<tr>
<td>16</td>
<td>Cloud Service provider</td>
<td>Head of Projects</td>
<td>Cloud deployment, Support and Service level management</td>
</tr>
<tr>
<td>17</td>
<td>Oil and Gas company</td>
<td>Supervisor, Business Applications</td>
<td>Technical</td>
</tr>
<tr>
<td>18</td>
<td>Cloud Service provider</td>
<td>Engineer</td>
<td>Technical</td>
</tr>
<tr>
<td>19</td>
<td>Oil and Gas company</td>
<td>Head, IT Systems</td>
<td>Technical and User support</td>
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<td>20</td>
<td>Cloud Service provider</td>
<td>Manager, IT Infrastructure</td>
<td>Cloud Hosting and client Support</td>
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<tr>
<td>21</td>
<td>Oil and Gas company</td>
<td>Manager, Information Systems</td>
<td>Strategy and resource allocation</td>
</tr>
<tr>
<td>22</td>
<td>Cloud Service provider</td>
<td>Senior System Engineer-Sales</td>
<td>Pre-sales, Relationship management and Technical</td>
</tr>
</tbody>
</table>
Table 2: Participant’s profile

<table>
<thead>
<tr>
<th>Participants working in Oil companies</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Participants working with providers of cloud and technology services</td>
<td>13</td>
</tr>
<tr>
<td>Regulators</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 3: Number of participants interviewed in each group

<table>
<thead>
<tr>
<th>Company</th>
<th>Industry</th>
<th>Number of participants interviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company A</td>
<td>Oil and gas company</td>
<td>11</td>
</tr>
<tr>
<td>Company B</td>
<td>Cloud Service Provider</td>
<td>1</td>
</tr>
<tr>
<td>Company C</td>
<td>Oil and gas company</td>
<td>1</td>
</tr>
<tr>
<td>Company D</td>
<td>Oil and gas company</td>
<td>1</td>
</tr>
<tr>
<td>Company E</td>
<td>Regulator</td>
<td>1</td>
</tr>
<tr>
<td>Company F</td>
<td>Oil and gas company</td>
<td>1</td>
</tr>
<tr>
<td>Company G</td>
<td>Cloud Service Provider</td>
<td>2</td>
</tr>
<tr>
<td>Company H</td>
<td>Cloud Service Provider</td>
<td>1</td>
</tr>
<tr>
<td>Company I</td>
<td>Cloud Service Provider</td>
<td>1</td>
</tr>
<tr>
<td>Company J</td>
<td>Cloud Service Provider</td>
<td>2</td>
</tr>
<tr>
<td>Company K</td>
<td>Cloud Service Provider</td>
<td>1</td>
</tr>
<tr>
<td>Company L</td>
<td>Cloud Service Provider</td>
<td>1</td>
</tr>
<tr>
<td>Company M</td>
<td>Cloud Service Provider</td>
<td>1</td>
</tr>
<tr>
<td>Company N</td>
<td>Cloud Service Provider</td>
<td>1</td>
</tr>
<tr>
<td>Company O</td>
<td>Cloud Service Provider</td>
<td>1</td>
</tr>
<tr>
<td>Company P</td>
<td>Cloud Service Provider</td>
<td>1</td>
</tr>
<tr>
<td>Company Q</td>
<td>Regulator</td>
<td>1</td>
</tr>
<tr>
<td>Company R</td>
<td>Oil and gas company</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 4: Number of participants interviewed in various companies

3.3.2 Interview procedure

The method used in interviewing participants was determined based on the work location of the participant, how much time the participant can spare and other personal preferences of
each participant. Based on the fact that I am currently based in a field location in the southern part of Nigeria, and most crucial stakeholders within the Oil and gas sector are based in Lagos State, which is the financial capital of Nigeria, videoconferencing and Interviews via telephone were adopted alongside face-to-face interview. Basically 23%, 40%, and 37% are the proportion of face-to-face, Video Conference and telephone interviews respectively. Face to face interviews were very useful in engaging participants that are within reachable distance. The face to face interview provided ample opportunity to meet some of the participants personally and to engage them on the research topic. Based on the face to face nature I could capture participants’ non-verbal communication by being sensitive to facial expressions, loss of eye contact, and gesture and this helped in informing how to engage them and the quality of their feedback. My experience during face to face interview was similar to using video conference (Skype and Cisco unified communication) to conduct remote interviews. Though participants were far away the video experience provided a similar feel as if it was face to face. Telephone interviews were only used when it was difficult to access the participants directly. The drawback is that non-formal communication could not be captured during these interviews.

In conducting these interviews, a semi-structured approach was applied, so that maximum data can be gathered from interviewees. Appendix III shows the research instrument used in interviewing the participants. Also, these interviews were not limited to the research instrument, but laddering skill was also applied to ensure that further questions were asked as the interviewee provides answers to questions asked. Averagely, the interviews lasted for approximately 30 minutes. The duration of each interview largely depends on the calibre of the interviewee, their in-depth knowledge about the research topic and how much time they were willing to spare. These interviews were recorded and archived in line with the University of Liverpool data protection act of 1998. The scope of data that was gathered from these participants on this research was focused on key questions raised in sections 1.1 and 2.5 that are aimed at understanding how ‘cloud-sourcing would impact functions within the oil and gas industry. Interviews can either be structured or unstructured. Structured interviews are suitable when conducting market research and unstructured are used for achieving free ranging conversations (Easterby-Smith et al., 2012). But for this research, a semi-structured approach was applied in order to achieve a guided open interview. By conducting interviews, I was able to unravel hidden perspectives, facts and to also determine the diverse perspectives being exhibited by respondents.

The strategy for approaching these interviews was to prepare sets of questions which relates to the research topic and ask each respondent the same questions under the similar conditions (same tone, voice, composure etc.). In addition to this, free ranging questions were also asked in other to ensure that respondents express all their views, perspectives and opinions about the research topic. Also, the less structured approach helped in taking discretionary decisions during interviews, in knowing the lines of questioning to further explore or lines of inquiry to be discarded. To gather requisite facts during an interview requires high level of skills, since most times respondents may not be able to articulate their views and some may not wish to divulge sensitive information. In view of this, the interviews were conducted by focusing on
identifying relevant facts in the conduct of the interview and document it. Also, lines of inquiries were made flexible, in other to ensure that the questioning process adapts to the peculiarities of each respondent. Also, laddering skill was applied in order to ensure that respondents do not just provide generalized answers to questions asked, but probing further in order to unravel the assumptions and perspectives that underline the views they expressed. Furthermore, the interview process gave respondents an upper hand, by ensuring that my views were not enforced on respondents, in order to help achieve open communication. The interviewer who is the researcher ensured to talk less and do more of listening, in order to ensure that all cogent data are captured. To ensure that these interviews were successfully conducted, I addressed the concern raised by Easterby-Smith et al. (2012), which is the need to build trust. This concern was addressed by using appropriate language, being careful of social interactions, allowing participants to choose the most suitable locations and ensuring confidentiality and anonymity of respondents in the conduct of the data gathering process. Also, the engagement process was characterised by creating conducive environment for open communication that helped in achieving quality mutual engagement (Marshall and Reason, 2007).

3.3.3 Data analysis
The analysis of gathered data in this research commenced as soon as data collection began and the primary skill required for this process was critical reflection. This was done by identifying themes, categories, or patterns that emerged and which were documented in this research outcome. In conducting the analysis of data, I adopted the following steps proposed by Easterby-Smith et al. (2012).

a) Familiarization – At this phase, the interviews were listened to severally, in other to capture both recorded and unrecorded data that were expressed. The familiarization process was done by ensuring that there is no deviation from the research focus, in order to ensure that data being focused on are those needed in achieving the research objectives. In view of this, the recordings of these interviews were later transcribed during this phase and facts from these interviews were reviewed and carefully reflected on, so as to code them by identifying keywords, phrases and common statements in the interviews. All these data were later transferred in excel spread sheets and Atlas.ti software which were used for qualitative data analysis (figure 14).
b) Reflection – The reflective phase ensured that clear understanding were derived from all the data gathered in order to make proper sense of the views expressed. This was achieved by reflecting on the content (gathered data), process and the research premise (Coghlan and Brannick, 2010). The reflective process involved in-depth thinking, evaluation and critiquing of gathered data, vis-a-vis findings from reviewed literatures, theoretical framework and common sense explanations. The reflective process was aimed at determining if the views expressed support existing knowledge, if it challenges it and if it sheds more light on gray areas in the research field. To reflect effectively, I applied journaling technique by applying Schein’s (1999) ORJI framework. This technique helped in my Observations, Reactions to what I observed, analyse the observations and my reactions in order to make Judgements and determine areas of Interventions that are required (Coghlan and Brannick, 2010:28). It is important to note that reflection is not just a phase in the data analysis process; it is a process that is relevant and was applied in all the phases of this research. Some of these reflections were documented in appendix VIII using template designed by Alan Chapman (2006). Reflection 1 in appendix VIII contains a summary of one of my reflections during the data gathering and analysis process, and this helps in providing evidence that my reflective process in the cause of this research was rigorous. More details about my reflections and lessons learnt were presented in Chapter 6 of this thesis.

c) Conceptualization – The conceptualization process helped determine identified concepts that can be derived from the data and which can be used to further
understand the issue (Easterby-Smith et al., 2012). All the concepts identified from views expressed were articulated as explanatory variables and they were coded accordingly. Codes are words or phrases that help to summarize salient facts in qualitative data. The coding process entails aggregating the interview transcripts into smaller categories of information and seeking evidences to buttress them and also assigning label to the various codes (Creswell, 2013). A spreadsheet database and ATLAS.TI were used to help in the coding process by classifying all the data gathered in order to categorise them and ease the coding process. These codes were then compared with themselves in pattern coding phase by Saldana (2008), this is necessary to ensure consolidation and to further categorise the data. The third phase of coding involves axial method, which ensures that new categories that are identified are analysed on how they relate to existing codes. Axial codes help in determining the categorization and sub-categories of the various concepts expressed. These processes resulted in the findings that are presented in the next section of the research work. Atlas.Ti was beneficial in achieving this, because it provided a suitable interface that is required to code words or phrases (as shown in figure 14) so as to determine similarities and differences in opinions, as well as how often the views are expressed during the interviews. After coding, Atlas.Ti further helped in the reflection process, by providing the tools required for presenting the relationships between the codes identified. Atlas.ti helped in presenting the relationships between identified codes, quotes and comments in the form of a network view (as shown in Figures 15 and 16) and this helped immensely in the reflective process and in drawing conclusions from the data gathered.
Figure 15: Network view of data analysis 1
d) Re-coding – This emphasize the fact that the analysis process must be iterative, in ensuring that the catalogued concepts are subject to further interpretation in other to ensure that other views are expressed.

e) Linking phase – The linking phase helped to bring out themes or patterns that have emerged from the various concepts and developed it into theoretical codes. At this point draft views began to emerge that were used to support or challenge existing relational view. These data were used to deduce propositions that interrelates the different categories derived during the coding process.

f) Re-evaluation – The re-evaluation phase helped to subject the entire analysis process to further scrutiny, in order to ensure that the analysis process was properly conducted and to subject it to scrutiny by other participants in order to achieve double loop thinking and learning.

It is important to also re-emphasize that the analysis of data was done simultaneously as data were being gathered because the research was focused on addressing real-life situation.

3.4 Confidentiality and Anonymity

Ethical compliance is a major requirement for ensuring credibility of the research process and one of the ways of achieving this is through adhering with confidentiality policies of the University of Liverpool. Therefore, in the conduct of this research, confidentiality of
participation is key and was held in high esteem. All electronic data were password protected with complex passwords. In general, data files, transcriptions, and audio recordings were not stored on a personal or office network but only on external hard disks in locked cabinets at my professional workplace (office). For the short periods when the data will need to be stored on my personal computer, for example during analysis and processing, I ensured that the files were stored on the local hard disks and NOT on shared drives. This helped in preventing accidental or unwanted external access as my personal computer is password protected.

Electronic-handlings of magnetic and optical media were conducted according to strict procedures to protect the privacy of participants. Should the publication of direct quotations from respondents become necessary, I ensured that the content does not lead to the potential identification of the source. All processing of personal data complied with the terms and principles of the Data Protection Act 1998, with the terms and conditions stipulated by the University of Liverpool Data Protection Guidelines. All interviews were anonymized during transcription and pseudonyms were used to prevent the identification of places and people in the study.
Chapter 4 Findings

4.1 Categories from gathered data

This section focused on presenting the categories and themes which emerged from the coding and data analysis process. The facts presented in this section represent an unbiased knowledge gathered during the data gathering and analysis process. These facts were backed up by some quotes extracted during the interview process, though the identities of participants were preserved to maintain anonymity in line with ethical agreement.

4.1.1 Understanding of cloud benefits and options

As gathered during interviews, 9 out of 15 interviewees from oil & gas industry, 11 out of 13 cloud providers and 2 out of 2 interviewees working with regulatory agencies agreed that cloud solutions provide immense benefits to organizations, when compared with legacy IT systems and these views also align with findings from Yigitbasioglu et al (2013) research. Diverse benefits were expressed, as influenced by the background and experience of individual participants. The first benefit which these participants mentioned is that cloud adoption is based on the need to achieve cost optimization. The instability associated with the price of crude oil over recent years had made the need for optimizing cost to be a common slogan within the oil industry. This global decline in the industry necessitated the need for reduction or optimization of cost and this has taken center stage in most decision making within the oil and gas sector. It is widely believed that cloud based solutions are cheaper (lower CAPEX and OPEX) when there is a need to manage cash flow and to ensure cash efficiency that guarantees cost optimization. The ease of cash flow is achieved through ease of paying subscription daily, weekly, monthly. This implies that services can be provisioned for as low as one day per year and this helps organizations to be able to effectively manage cost of IT services. Cost reduction is also achieved through savings on licences, upgrades, minimal hardware requirements, and ease in project implementation. By adopting cloud solution, the cost of resource over or under provisioning is being pushed out to cloud providers.

Another benefit of cloud adoption revealed by participants is the ease it provides in the management of infrastructure. This benefit was expressed by 6 out of 15 interviewees from the oil & gas industry, 10 out of 13 of cloud suppliers and 2 out of 2 interviewees working with regulatory agencies. Cloud solutions make maintenance and upgrade tasks to be done seamlessly, based on the technical expertise, tools and technologies available to the vendor. In-house upgrade and maintenance processes require huge planning, complex processes, downtime (depending on the extent of upgrade) and cost of implementation. But all these concerns and responsibilities will be shifted to the vendor providing the cloud service. This therefore makes cloud option to be more preferred. Furthermore, infrastructure, software, applications and other services can be easily provisioned and administered from the cloud with minimal support. This makes administrative responsibilities of infrastructure
management to be easier when compared to in-house management. Instead of managing multiple servers in different locations, cloud solution helps to centralize and ease the management of these resources. Also, cloud solutions help organizations to be more agile, by provisioning solutions and deploying technologies at a very fast speed that will help address the varying needs of the Oil and gas industry. Agility of IT systems and solutions is based on the need to align with varying regulatory needs, health safety and Environmental requirement, need for production optimization and other factors that may hinder the productivity and sustainability of the organizations. This agility is achieved through flexibility of IT services in the cloud as compared with legacy IT systems. Also, cloud system ensures that these solutions are continually provisioned and increased as operational demands grow. Furthermore, service availability is required in ensuring service reliability, which is a prerequisite for business productivity. Oftentimes the inability to meet up with 24/7 power generation results in down time in Nigeria, but by outsourcing systems to the cloud enhanced service availability can be assured. This is because the responsibility to ensure 99.9% uptime will be shifted to vendor that is providing the cloud service. Also buttressed is the fact that cloud solution helps in achieving effective time management because cloud helps to ensure effective productivity of IT employees, by ensuring that they focus their time and expertise on specialized and more complex tasks than routine functions which can easily be managed through a cloud-sourcing process. The following quotes from the interviews conducted, exemplify the benefits of cloud solutions:

A. Cloud Provider Feedback

“The influence for going into the cloud is cost considerations because you do not need to acquire new infrastructure; but for some they just want to test new technology waters”. - Senior Systems Engineer

“The current trend of moving some applications to the cloud is based on the need for central management of HR functions and cost is also a major factor of going into the cloud”. - Data Management Expert

“Cloud solution helps to achieve ease in the management of infrastructure helps to achieve cost savings on licensing, upgrades and infrastructure. Also, this technology will help in achieving needed technical efficiency”. – Head Engineering

“Availability to end users, Cost efficiency, Reliability and flexibility are the benefits entrenched in the use of cloud computing”. – Chief Information Officer

“Cloud is cheaper and helps to achieve ease of management of resources. Instead of managing multiple servers in different locations cloud helps to ease the process”. - Engineer

B. Oil and Gas professional feedback

“Cloud is an emerging reality of the future approach to how IT services are being delivered and it is what will define the IT landscape in 5 to 6 years’ time. Therefore, we took advantage of this technology in order to achieve early starter advantage. Other factors are cost related and flexibility in management of IT staffs, but the most
pronounced of all these benefits is the need to cut cost without sacrificing quality and innovation” - Head of IT in E &P Company

“Cost of resource over/under provisioning is being pushed out to cloud providers and this helps to achieve ease of managing cash flow (ease of paying subscription daily, weekly, monthly)”.

– Supervisor, business Applications

Based on the benefits derived from cloud computing, cloud solutions are currently being used in performing specific operations and functions in the Nigerian Oil and gas sector. The current use of cloud solutions cuts across both technical (core) and support functions as mentioned by participants. Cloud solutions are currently being deployed in processes and functions like data backup, performance management, production and technical data management, desktop applications, surveillance systems and human resource management. One of the impact of cloud solutions in oil and gas operations is in the management of real-time data transfer, monitoring and analysis. This was buttressed by 5 interviewees (with versed experience in core oil and gas operations) working in oil and gas companies and 5 others providing cloud services within the industry. Real time data transfer, monitoring and analysis, is applicable in drilling operations and the management of production data. The application of cloud solutions for some of these functions is based on the fact that core oil and gas functions are often being handled by OEMs and service companies; and these companies already have cloud solutions which are already part of the processes used in deploying their technologies. Cloud is also being used in remote monitoring and management of SCADA (Supervisory control and data acquisition) systems. For example, the cloud is currently being used in rendering remote support for well control systems SCADA on some oil and gas floating production storage and offloading (FPSO).

Also, cloud is relevant in data pooling because it helps organizations to share seismic data within oil and gas projects and operations. Currently, some IOCs (as evident from feedback from participants and observations made) are subscribing to Energysys, which is the first cloud based application designed specifically for oil and gas operations in the area of production allocation standard, corporate, environmental and reservoir reporting (http://www.energysys.com/apps/). Furthermore, cloud solutions are currently being applied within the industry in HR functions (Performance, competency management and payroll administration), security surveillance systems, IT systems such as messaging and desktop publishing applications (Office365) within the industry. But some core functions like asset management are currently being managed in-house because it involves reservoir simulations and scenario analysis, which requires intensive processor and graphics requirements, coupled with the fact that the data being analysed are big data. This finding further confirms Perrons and Hems (2013) on the challenges associated with cloud in oil operations. For the few companies using cloud solutions within the industry in Nigeria, their adoption of the cloud is more pronounced in support functions as compared to core functions and this is based on the perspective that currently oil and gas companies are more comfortable managing their very
critical data in-house. But the fact remains that since an organization is using cloud solutions for some functions, implies that such cloud solutions can be applied in other oil companies.

In deploying cloud solutions, the current model of cloud computing in use in oil companies that have already adopted the technology is the hybrid model. This was the feedback expressed by 12 out of 15 interviewees from the oil & gas industry, 6 out of 13 of cloud suppliers and 2 out of 2 interviewees working with regulatory agencies. This model consists of a combination of on-premise infrastructure and private or public cloud solutions. No organization has a full-fledge private or public cloud infrastructure, but the oil companies that are already adopting cloud computing are combining their in-house infrastructure with some cloud service. This confirms Reeves and Hilgendorf (2012) assertion that a hybrid-IT operating model will be more embraced as cloud technology continue to be embraced because it gives organizations the opportunity to host their critical applications in the private cloud and use public cloud services to increase their business and IT agility.

Oil companies (especially multinationals) have over the years invested a lot in building huge datacenters, hence the reluctance towards embracing cloud system; and this also confirms Perron and Hems (2013) view. Furthermore, the use of hybrid model is still going to be adopted within the oil sector for a while, until concerns (security, loss of control, confidentiality and regulatory compliance) associated with migrating to public cloud model are tackled. It is also, important to emphasize that the type of model to be adopted for cloud services in the Nigerian Oil sector will also be influenced by the size of the company. Five out of 15 interviewees from oil and gas companies and 6 of 13 from cloud provider firms emphasized that multinational oil companies can leverage on their robust infrastructures and data centers which spreads across different continents, available resources, competent employees and global presence to build a private cloud system. This is beneficial for multinationals because it helps to achieve central management and administration of functions and services and this in turn will translate into more efficiency and productivity. But small oil companies (marginal field operators and service companies) will rely more on hybrid or public model. The conclusions on which cloud model will be widely adopted, will greatly depend on the current and future regulations within the sector, protection of intellectual and knowledge assets, confidentiality and security issues, improved awareness, and growth in the general infrastructural development in the country. But most participants as detailed above agreed that hybrid cloud models will still be majorly used in the future. The following quotes from interviews emphasize that oil companies cannot do without having some form of in-house IT systems.

A. Cloud Provider Feedback

“Hybrid model will be used more in the future because it provides more opportunity for flexibility and adaptation”. – Systems Integration Consultant

“In the near future the factors that will influence cloud model are company size, project size and duration etc. Big multinationals can afford private cloud, while mid-size or smaller companies may go for either hybrid or public model. Also, the suitable
model will be decided at company level and it will be influenced by strategic goals and objectives of the organization”. - Data Management expert

“Hybrid model will be more used in the oil and gas support. Even though there will be a gradual shift to public cloud as the technology evolves more”.
– IT Infrastructure Manager

B. Oil and Gas professional feedbacks

“In house IT systems will still be needed, while cloud is being adopted, hence the need for preference for hybrid cloud model” - Application developer

“Cloud model will depend on organization specific objectives and they must conduct a need assessment before deploying cloud solutions. Organizations that want to protect their trade secrets may opt for private cloud, while hybrid or public cloud can be used for shared and general data respectively”. - Communication specialists

“Hybrid is currently being used. But future model will depend on the location (country) of the Oil company. Oil and gas companies in North America may adopt more of public because of their robust infrastructure. But for Nigeria Hybrid or private model will be used more”. – Head, IT

4.1.2 Challenges and Risks in Cloud Solutions

Despite the applicability of cloud solutions, participants expressed that the level of awareness of cloud solution in the Nigerian Oil and gas sector is moderate, but with low level of adoption. Sixteen out of 30 interviewees expressed the view that the level of cloud adoption is low, while 14 participants don’t have facts to arrive at any conclusion. The moderate level of awareness is based on the fact that Nigeria is still a developing nation; hence the extent of exposure to technological innovations cannot be compared with that of developed countries. Despite the environmental condition that influences awareness about technology, the fact remains that the biggest international Oil and gas companies (IOCs) in the country have their international headquarters in developed countries like United states, Switzerland, France and China just to mention a few. The influence of these parent companies, play a major influence in the extent of awareness about new products and technologies because the conceptualization and implementation of most of these projects are driven from the corporate head office of these Oil and gas companies. Furthermore, the extent of awareness on cloud solution is based on the background of participants and since most people interviewed are technology savvy employees, they have relatively good understanding about cloud solutions. But this cannot be said for other professionals within the industry who do not have some form of cloud knowledge because they were excluded from this research.

It is a known fact that the risks and implications of cloud adoption play a significant role in causing the low adoption of cloud solutions. The reasons given for this low adoption are the conservative culture within the oil industry, regulatory considerations, perceived fear, and
suitability of cloud solutions for core oil and gas functions and the influence of Government as a major stakeholder in most IOCs. Five interviewees with extensive working experience within the industry expressed the view that the Oil and gas industry (especially in Nigeria) is typically a conservative industry, which is often careful in embracing technological advancement.

“The oil and gas sector is largely conservative and hardly embrace technology easily, despite their level of high technology awareness”.
– Manager, Information Systems (Oil and Gas Professional)

“Oil sector is always shy towards technological advancement, hence their foot dragging towards cloud adoption.”
– Head, Information Technology (Oil and Gas Professional)

This finding is a confirmation of perspective expressed by Perrons (2015:223) while referring to the energy industry as a slow adopter of innovation. Technologies are often embraced when they have been piloted by other companies (mostly in other sectors) and all grey areas have been clarified. The conservativeness within the sector (especially in Nigeria) is making oil companies to be less adaptive to change. Despite this culture of delay in embracing technology (Aviles, 2015a), technological changes are inevitable and that the industry culture cannot hinder the further emergence and adoption of the technologies. Therefore, continuous change is inevitable and this also applies to cloud adoption. It is important for decision makers within the sector to face technological reality and begin to strategize and plan towards cloud adoption using any suitable model or strategy that best addresses their organizational objectives.

Furthermore, perceived fear resulting from security and confidentiality, loss of control of functions being managed in-house and protection of organizational intellectual assets were the main reasons expressed by participants as the reason for the fear of adopting cloud based solutions within the oil industry. These views were expressed by 11 out of 15 interviewees from the oil & gas industry, 9 out of 13 cloud suppliers and 1 out of 2 interviewees working with regulatory agencies. This finding further confirms Perrons and Hems (2013) assertion that the need to protect trade secrets and intellectual assets is a major hindrance to cloud adoption. Also, some core oil and gas operations such as seismic data interpretation and analysis, reservoir simulations and well data are preferred to be managed in-house than being handled from the cloud. This is because these operations involve analysis of Big data that can be in hundreds of gigabytes or even terabytes and the internet backbone currently in the country will not be sufficient in handling such operations seamlessly in the cloud. This was expressed by 4 interviewees with versed experience in managing technical data within the oil and gas industry. This challenge is not limited to Nigeria alone, but was also buttressed by Perrons and Hems (2013) in their research.

Another implication of adopting cloud solutions is the issue of staff orientation and their management. Cloud-sourcing currently in Nigeria is majorly a form of offshoring and this implies that adoption of cloud computing has the potential of taking away jobs from locals because jobs domiciled in the country would be moved to another country where the cloud provider is located. This was the outcome of the feedback from 11 out of 15 interviewees.
from oil & gas industry, 7 out of 13 cloud suppliers and 1 out of 2 interviewees working with regulatory agencies. Furthermore, 9 out of 15 interviewees from the oil & gas industry and 7 out of 13 interviewees working for cloud provider firms admitted that responsibilities of IT professionals will reduce; especially backend roles like server and storage administration, maintenance and roles that are routine like will be more managed from the cloud when cloud adoption increases. Also, cloud solutions can negatively impact on functions that will be automated because of cloud adoption. Functions like data transmission, manual surveillance, system monitoring, human resource functions and many others may be impacted and this may translate in job reduction. Furthermore, loss of job is also premised on the perspective that migrating to the cloud makes organizations to lose control over their critical infrastructure and data. But it is important to emphasize that as technology adoption is shrinking some job functions, it creates new opportunities in other areas of the business. Therefore, the adoption of cloud solution does not necessarily translate in redundancy. In view of these, the way the impact of cloud adoption is managed depends on how the organization intends to manage the situation either by assigning the employee to another relevant unit or subsidiary, plan with the employee on a phased exit or declare such employees redundant.

A. Cloud Providers Feedback

“Implementing Cloud computing will make IT departments to shrink; while these employees can be redeployed to other functions” - Head Engineering

“Cloud computing is a paradigm shift on how IT is being provisioned which will result in staff reduction. Routine work such as maintenance, daily backups etc. can be easily handled in the cloud.” – Head of Projects

“Job roles will be reduced or relegated to the background in the oil sector. But it will help create an advantage for local cloud providers”. – Chief Information Officer

“Implication can be an advantage and threat. It is an advantage for cloud service companies but a threat for IT professionals in the oil and gas sector”
- IT Support.

“Less IT roles will be required in the near future and this may result in reduction of IT staff strength.” – Systems support

B. Oil and Gas professional feedbacks

“Responsibilities of IT professionals will reduce especially for infrastructure and this implies less jobs”. - IT Coordinator

“Cloud computing is a disruptive technology and the implications cuts across finance, infrastructure and stakeholders” - Supervisor, Business Applications

“Personnel with basic IT skills and maintenance tasks will no longer be performed in country”. - Server and Storage Administrator
Also, 13 out of 15 interviewees from oil & gas industry and 8 out of 13 interviewees working for cloud provider firms advocated the need for a change in the skillsets of personnel and to ensure that these competencies are aligned with business realities and to effectively harness and exploit these skills for other relevant functions. The source of concern when adopting new technology is the extent at which the new technology will automate processes and how this automation will impact on the current workflow, responsibilities and influences of employees (Munkvoid, 2012). When this is perceived to be negative, employees tend to involve their respective unions and when these trade unions are not properly engaged the whole process maybe scuttled. Based on observation, the Oil and gas industry in Nigeria has very strong union known as PENGASSAN (Petroleum and Natural Gas Senior staff association) and NUPENG (Nigerian Union of Petroleum and natural gas workers), the effective management of the impact of this change depends on how these unions are engaged in the transition process. The influence of these trade unions (PENGASSAN and NUPENG) within the Nigerian oil and gas sector is very huge because the country cannot afford downtime in the sector because the sector is the largest source of revenue.

Another major risk that was expressed by 11 out of 15 interviewees from the oil & gas industry, 9 out of 13 cloud suppliers and 1 out of 2 interviewees working with regulatory agencies was security and confidentiality concerns. This concern confirms the findings from PWC (2011) report that cloud security is a major concern for organizations. Participants emphasized that cloud solutions tend to create security concerns based on the fact that organizations fear the compromise of their crucial data, trade secrets and other information which gives them competitive edge and which are crucial to the day to day running of their organization.

“We are currently no using cloud solution in our organization. This is largely due to security concerns and the need to protect the company's intellectual assets”.

– Information Management Analyst (Oil and Gas professional)

“...security concerns have been a challenge in adopting cloud”.

- IT coordinator (Oil and Gas Professional)

“...Privacy concerns are associated with cloud computing”

- Head of Projects (Cloud Provider)

Also, it is not sufficient for this data to be secure it is important for them to be kept confidential. Security breaches do not only impact on the clients, but it can also be a source of litigation, which may eventually impact the provider when they are sanctioned or penalised. There is no evidence to show that Oil companies in Nigeria have so far been exposed to security and confidentiality breaches, but the emphasis on security as being a major risk of outsourcing functions in the cloud is a strong perception that is born out of loss of control associated with transitioning from in-house management of IT systems to cloud based systems. Organizations have firm control of their infrastructure and systems when they are managed in-house, but the moment they are outsourced to the cloud the fear of their data being domiciled at the vendor’s data center is a major concern for the client.
“Skepticism resulting in low cloud adoption is majorly as a result of security and loss of control of their infrastructure or data to another firm”.
– Manager, IT Infrastructure (Cloud Provider)

Despite the security concerns within the oil sector as regarding cloud adoption (especially public cloud), some strategies currently being used by the companies that have adopted cloud solutions within the oil sector were identified by participants. The need for layered security was advocated and client must ensure that the cloud provider provides evidence of the different mitigating controls that they have put in place that helps in safeguarding and preserving the integrity of the data hosted with the provider. These security measures should include physical security measures such as closed-circuit monitoring, access control etc. The specific security requirements will be based on individual client expectations and this will be influenced by the strategy guiding the client’s cloud adoption. Also, in ensuring secure access to data hosted in a cloud system a three level authentication was buttressed by 3 interviewees working in cloud provider firms. Generally, authentication can be classified into three categories which are Knowledge based, Token based and Biometric based authentication (Sophia, 2015). Knowledge based involves password generated by an individual and, which is known to each user or administrator. Token are one time password (OTP) which are generated specifically for each authentication session and biometric authentication uses the physical uniqueness (features) of individuals for authentication. Therefore, to effectively guard against compromise of data hosted in the cloud, three level authentication system needs to be in place. In the same vein, majority of participants emphasized the need for proper and complex encryption. Eight participants emphasized that cloud providers must ensure to have strong and complex encryption system in place in order to ensure data security. The encryption key must be very complex and encryption must be implemented in end to end basis. End to end encryption means that data must be encrypted when in flight (during transmission) or when at rest (when it is not in use). Also, the vendor must show the degree of multi-tenancy that is provided in their cloud infrastructure in order to ensure that each client activity and session is invisible to other tenants.

A. Cloud Providers Feedback

“Security concerns is basically about perception, but security strategies must be centred around aligning with global standards and best practices”
– Manager, IT Infrastructure

“Security measures must ensure multi-tenancy. Layered security must be put in place. Relevant security tools should be provided. Client has a responsibility of ensuring that credentials are kept properly. End to end encryption of data when in flight or at rest is very important”.
– Senior systems Engineer Pre-Sales

“Internal audit of the cloud provider will help minimize security breach; also vendor should be asked to present their detailed network architecture. Access rights must be given to relevant personnel”.
– Head of projects
Physical security is ensured using CCTV cameras. CCIE personal are engaged to manage security at all network levels. Tokens are being used to guarantee confidences. Secrecy document and POCs are often issued. – Head Engineering

“Since, single sign on identity management solutions have been implemented. Confidentiality Agreements were signed with the vendor and the vendor should also ensure that they have signed agreement with their employees in order to ensure internal”. – Data management Expert

“Encryption should be very strong. Also, the provider needs to disclose the location of cloud data to the client. Also, both client and provider need to be conversant with the local laws as regards data transfer across borders in the countries where these data are domiciled. Lastly, cloud providers must adhere to Global best practices and standards”. – Chief Information Officer

“There is a need for two to three level authentication security measure coupled with strong encryption. Client has the responsibilities to compare and confirm specific security requirements before subscribing to any cloud service. Also, client must ensure that the service provider security design meets their security requirements”. – Senior Systems Engineer

B. Oil and Gas professional feedback

“Security strategy in our organization is based on strong contractual agreements, detailed technical papers in contractual documents, evidence of service provider certifications, service level and confidentiality agreements”.

- Head, Information Systems Infrastructure

“Security concerns on cloud computing is irrespective of the location of the cloud service provider. Also, cloud computing takes away jobs from locals because jobs domiciled in the country would be moved to another country; hence the need for regulatory considerations”. - Network and Communication Engineer

“Client must confirm the security strategy of the cloud provider, before they subscribe to the service”. - IT Coordinator

Another implication of cloud adoption is the fact that it often results in having different login interfaces to be used in accessing these applications, which also creates security concerns. This implies that the more cloud solutions organization’s adopt the more different interfaces end users may need to be accessing. In addressing this concern, 3 interviewees confirmed that their organization is currently using a single sign-on solution that will ensure that with a single credential, users can login to different cloud platforms.

Furthermore, apart from the fact that cloud providers have the responsibility to ensure data hosted with them are secure, the client also has the responsibility of defining all their security requirements and expectations prior to subscribing to any cloud service. This is important to ensure that client and service providers are both on the same page regarding the security expectations for the service. Three participants with experience in cloud migration also advised that firms without employee(s) dedicated to manage corporate security and audit
functions, should do so. These personnel will focus on ensuring security and confidentiality policies, procedures and processes are put in place in order to ensure organizational data are adequately protected. These personnel must be well trained and they must have requisite certifications and experience to back up their assigned responsibilities. They must facilitate the collaborative process of ensuring that agreements are detailed, thorough and does not give room for opportunistic tendencies. Contracts and service level agreements should include security and confidentiality requirements that are expected to be met by both the client and the vendor. This legal binding document makes both parties to be aware of their responsibilities in ensuring security and confidentiality of data stored in the cloud and implications of any default on this agreement.

It is also important to emphasize that confidentiality agreement is not only binding between a client and the vendor, it should also exist between the vendor and their employees. This will help guard against disgruntled personnel sabotaging the available security system in the vendor’s datacentre. It was also emphasized by majority opinion that knowledge of existing or proposed laws and regulations within the operating environment of a company will guide decision making in knowing which data need to be hosted on the cloud. The client needs to first establish whether the existing laws in their country permit data storage outside their country. This is important because most cloud-sourcing decisions in Nigeria currently are forms of offshoring, due to the very limited number of in-country cloud providers. Therefore, security measures must be applied in view of existing laws in order to ensure regulatory compliance.

Also, 5 out of 15 interviewees from oil and gas companies and 6 of 13 from cloud provider firms advocated for a private cloud model for big multinationals, because they have made huge investments over the years in building datacentres and this model will also help them in ensuring that they have control of their data. This perspective was also expressed in PWC’s (2011) research. By using the private cloud model, subsidiaries of these companies in other countries can connect to hosted services at the global datacentre. This will help companies leverage on the benefits of adopting cloud solution while having a firm control of their data. Though, participants highlighted lots of procedures needed to address security and confidentiality concerns, in the process of analysis it was discovered that procedures for tackling security cannot be exhausted. This is because security approach will be determined more by the cloud model, application, organizational environments and many other factors. But compliance with best practices, relevant certifications and audit processes, are required to ensure cloud providers and their clients achieve the much needed security. Also, because these standards and best practices are often updated, it helps keep organization on their toes in order to ensure they update their processes, in order to retain their certifications. Certification provides independent assurance from third-party audits and/or service auditors that providers are adhering to best practices and standards (Becker and Bailey, 2014). Therefore, when planning to engage a cloud solution and provider, the provider needs to provide evidence of these certifications which shows their compliance with best practices in their service delivery, while the client also need to showcase their internal control processes and governance frameworks that governs their operations. This synergy in achieving best
practices between the client and the vendor will definitely ensure all security risks are minimized to the barest minimum.

“Security concerns can be best minimized by ensuring that cloud providers provide evidence that they comply with best practices, quality standards, ISO security compliance policies, and other frameworks. For example, there are rules governing data offshoring in the UK, This include data protection act, which ensures encryption is put in place during data transfer”.

– Systems Integration Consultant (Cloud provider)

Lastly, it is worth knowing that technological adoption can best be maximized when it aligns with business objectives and directly translates to enhanced productivity and profitability. This helps erase the fears associated with technological adoption, especially when stakeholders know that the decision was taken in order to achieve organizational effectiveness and profitability.

4.1.3 Challenges specific to Nigeria

Ten out of 15 interviewees from oil & gas industry, 8 out of 13 cloud suppliers and 1 out of 2 interviewees working with regulatory agencies within the industry confirms that the cloud service providers currently being engaged are located outside the country. This doesn’t imply that there are no indigenous cloud service providers within the country, but there is more preference for foreign cloud solution providers. One of the major factors responsible for high offshoring of cloud services and low cloud adoption which was unanimously expressed by 13 out of 15 interviewees from oil & gas industry, 13 out of 13 cloud suppliers and 2 out of 2 interviewees working with regulatory agencies is the poor state of infrastructure in the country. The benefits to be derived from cloud solutions are largely dependent on infrastructure capability, reliability and availability in business environment. As evident in the research findings these participants emphasized the need for robust infrastructure in Nigeria before cloud benefits can be effectively harnessed. Infrastructure in this context can be classified as hard or soft (Oyedele, 2012). Hard infrastructure implies the physical networks of technologies and services that are crucial for the effective functioning of a country; while soft infrastructure entails institutions that are necessary to ensure the sustainability of the economic, health and social life of an environment. These institutions include financial system, health, governance, educational and many others (Oyedele, 2012). The infrastructure concerns expressed in this research is majorly hard infrastructure challenges which range from epileptic power supply, insufficient internet backbone, minimal or non-existent disaster recovery plan and the lack of capacity to accommodate massive transition to cloud.

A. Cloud Providers Feedback

“The power challenge in Nigeria affects cost. Also, the two digit interest rate is hindering investment in infrastructure in the country. Indigenous providers need to collaborate to minimize these disadvantages”. - Senior Systems engineer
“Technology is still evolving in Africa, hence lack of confidence in indigenous providers. This is also coupled with infrastructure issues in the country.”

- Systems Support Engineer

“Cloud providers in Nigeria offer limited services mostly for SMEs due to infrastructure challenges and their lack of capacity to accommodate lots of companies. Lack of tools to manage billing, cataloguing, automated provisioning and portfolio management”.

- Senior systems Engineer-Pre-sales

B. Oil and Gas professional feedback

“Foreign providers have more infrastructure and experts and this makes indigenous providers not to be able to meet up with availability requirements. Although indigenous providers are making remarkable improvements, but power, infrastructure, network issues are major concerns with indigenous providers”.

- Network and Communication Expert

“Prevailing infrastructure situation results in high cost. The cost of ensuring availability coupled with the power challenge. Also, since, the awareness level of cloud is still low, the extent of subscription is low, making indigenous providers not to be productive”.

- Server and storage administrator

“There is a lack of trust in the competence and service delivery of indigenous cloud providers, especially based on the concern about their service availability”.

- Information Management Analyst

“Poor infrastructure in Nigeria affects availability of service, especially because of poor power supply. These results in intermittent outages and this problem is a peculiar challenge that is affecting cloud services in Nigeria. These challenges are minimal in developed nations, but they will ease out as infrastructure improves in the country”.

– Manager, Project control

C. Regulatory/Government Feedback

“Infrastructure problem, government policies, lack of trust, high cost and poor reliability are reasons why indigeneous providers are underperforming”.

- Cloud Researcher

“Providers in the country cannot guarantee availability”

– Network Engineer/System Administrator

Even though Nigeria is blessed with human and natural resources, the issue of corruption has over the years crippled infrastructural development in the country. For example, the country generates 2687.2MW of power, while the power demand as at 6th June 2016 for the country is 12800MW (www.power.gov.ng). Therefore, making private sector companies playing a
critical role in building the infrastructure that they require to ensure 99.999% availability for their system. Most indigenous cloud service providers in the country are faced with the challenge of building their own infrastructure from scratch. This is further complicated by the two digit interest rate facility that is available for loan meant to finance the setup of these datacentres. Also, the capacity of internet backbone in Nigeria is not yet robust and the minimal terrestrial internet link are also part of the infrastructure challenges.

Another challenge with cloud-sourcing in Nigeria, which also makes it synonymous to offshoring, is based on the view expressed by 3 participants from oil and gas companies that decisions to engage foreign providers were based on the fact that the need to migrate some functions or processes so that they can be managed at the corporate level. Since, the implementation of this cloud solution is enterprise wide (cuts across all the locations of the company worldwide); hence the preference for foreign cloud service providers. As said earlier, the biggest oil companies in the country are multinationals; therefore, strategic decisions are taking from their home office. But in other to ensure regulatory compliance, some of these companies ensure that the backup of these data are domiciled in their datacentres within the country.

There is also a culture within the country that gives preference for foreign brands and their products, based on their capability, reliability and service delivery. This was expressed by 7 out of 15 interviewees from oil & gas industry, 7 out of 13 cloud suppliers and 1 out of 2 interviewees working with regulatory agencies. This culture is believed to be another hindrance for indigenous providers because they need to double up effort in convincing clients that they have all the competencies and infrastructure that are required to ensure effective and quality service delivery. Also, there is a perception that foreign providers have attained some form of maturity based on their years of experience offering cloud services; hence they are more structured to ensure security and confidentiality of data. This is not to castigate indigenous cloud providers, but this is the perception expressed during the data gathering process and which need to be documented. For example, a staff of an outsourcing firm to the largest telecom provider in the country was compromised to install an antennae for a separatist movement in the country (Adepetun, 2015). Examples, like this causes fear within the oil sector in outsourcing functions with indigenous providers because of the erroneous believe that any individual can be compromised due to the prevailing corruption in the country.

The fact cannot also be denied that foreign providers have proved over the years to be more competent in their service delivery, through the deployment of relevant tools. For example, to provision or subscribe to a hosting service (storage, platforms etc.) in Nigeria will require either a visit or a call to the cloud providers, instead of having tools for automated provisioning, billing and portfolio management. Indigenous cloud providers with these automated facilities actually have their datacentre domiciled in a foreign country. Therefore, the trend of offshoring service in the cloud will continue until there is more advancement and development in the way indigenous providers render their services.

In order to improve indigenous participation in cloud service delivery, relevant competencies need to be developed. As earlier stated, cloud adoption will result in a paradigm shift and this
implies that new competencies will be required for IT professionals in the oil and gas sector to be relevant. Based on the feedback gathered from majority of participants during data gathering, the need for employees to be more robust in their skills and knowledge base cannot be over emphasized.

A. Cloud Providers Feedback

“The same skills currently being used will still be relevant because in-house personnel will still need to manage the cloud. Required competencies are subject to the strategic direction of the organization. Skills required for private cloud include hypervisor, cloud management and client/vendor management”. – Senior Systems Engineer Sales

“IT professionals should not limit themselves, but they should have cross skills in all aspects of IT. Professionals within the oil sector needs to be versed and brush up their skills through training in order to be relevant”. – Head, Engineering

B. Oil and Gas professional feedback

“I think analytics and business intelligence will be more relevant as cloud is continually being bought into. Therefore, IT personnel will need to perform less technical role and they will need to have business orientation”. – Server and Storage administrator

“Current IT skills will still be relevant, but they’ll be more applied at the cloud service provider firms. Cloud programming and networking competencies will be more needed with the oil and gas sector”. – Head, Information System Infrastructure

“The skill set required will involve monitoring and managing cloud services. SLAs management will be very relevant. IT function will shift towards technology for finding oil. It will be seen more from the business perspective than technical”. – Manager, Information Systems

“IT professionals should follow technology trend and continue to upgrade their knowledge. Second level support and administration will be relevant”. – Head, Information Technology

This implies that IT professionals should get out of their cocoon and expand their scope to be more relevant in other oil and gas functions. Hence, IT professionals that will be relevant as cloud computing continues to emerge within the sector, must have a combination of both technical and business orientation skills. Relevant skills identified in the cause of data gathering are Business analysis, IT Governance, Analytics, Service level management, Database management, Network management, Virtualization, Business automation and intelligence. Furthermore, the focus of IT departments in the Oil and Gas industry will be more on technology for finding Oil. This implies that IT units will focus more on applying technology to help automate Oil and gas operations and projects. Based on this, the role of IT professionals will transform to Petro-technical Engineers. Petro-technical engineers are professionals with competence in IT skills, automation, production, instrumentation and other
relevant core skills in the oil and gas sector. Also, IT professionals within the oil sector will be more saddled with the responsibility of managing different cloud vendors in order to ensure their service aligns with stipulated SLA. This implies that IT professionals must be highly skilled and abreast of the activities of the vendors in order to ensure gathered knowledge is retained in-house. This can be achieved through effective knowledge sharing. From data gathered most cloud decisions within the Oil sector do not have detailed knowledge sharing plan. Exchange of knowledge takes place during planning and migration process, but after migration to the cloud has been completed, knowledge transfer is at the mercy of whatever knowledge the service provider feels to share with their clients. The approach to implementing knowledge sharing plan differs from one organization to another and it will be defined based on their expectations and needs for going to the cloud. The current practice involves ensuring detailed documentation of support, upgrade and all technical tasks that are carried out. Also, occasional webinars training and technical sessions are often organized for cloud administrators in some few companies.

Also, concerns relating to clarity of regulations were also expressed by 10 out of 15 interviewees from oil & gas industry, 11 out of 13 cloud suppliers and 2 out of 2 interviewees working with regulatory agencies. The absence of explicit regulation is a major hindrance in determining the regulatory position of Government on cloud computing. None of the interviewed participant is conversant about regulations and policies enacted for cloud computing in Nigeria. However, there is a perceived assumption by these participants that there are regulatory restrictions which hinder storage of industry data outside the shores of the country. This is responsible for the low-level of cloud adoption currently being experienced in Nigeria and which is creating lack of clear direction as to policies and laws that are meant to be complied with when making a cloud-sourcing decision. When there is clear regulatory commitment, clients will be confident in adopting the technology within the country, knowing full well that any decision taking has government support and backing. Also, regulations are vital in organizational operations because it help ensure that organization’s operate within stipulated laws of their operating environment. The influence of regulations in cloud sourcing decision is important because most cloud providers render services to customers outside their borders and this often entails data transmission outside geographical boundaries. As earlier buttressed, most cloud providers are based in the United States (Berry and Reisman, 2012) and this implies that cross-border transfer of data will occur when the clients are located outside United States. Therefore, regulations are necessary in determining how cloud sourcing decisions are taking, especially based on its impact on employments, security of data, infrastructural development, stakeholder investments and lot more.

A. Cloud Providers Feedback

“Regulators can enforce restrictions, but the stricter the laws it may hinder advancements. Regulations must be geared towards giving loans, concession, tax rebates, access to forex etc. in order to encourage indigenous participation of providers and developers in cloud computing”. – Telecoms Engineer/Management Consultant
“Regulators need to provide robust regulation because there is current lack of oversight function as regards cloud adoption. Regulations should address transfer of data and data security.” - Technical Pre-Sales

“Regulators need to support indigenous cloud providers. For example, priority must be given to indigenous providers. Policies can be enacted that will ensure companies and multinationals localize some of their data (e.g. backup) in indigenous companies.” - Engineer

B. Oil and Gas professional feedback

“Regulatory influence is required in ironing out the grey areas associated with data sharing requirements in JV and PSC agreements”. – Application Developer

“Regulators have a serious role to play. There is a need for a national cloud policy. Regulators need to first be aware and train themselves in order to be versed with cloud technology, so that they can develop proper and effective framework that will help govern cloud adoption, but the bureaucracy in regulatory process in Nigeria is a major bottle neck in achieving this”. - Head, Information Technology

“Before regulators can be effective, there is need to create awareness among these policy makers”. - Manager, Project Control

C. Regulator/government Feedback

“Local content and DPR must ensure that cloud providers have local representation and they must ensure that they are in tune with local content act”.
- Network Engineer/System Analyst

In the same vein, corporate cloud strategies of organizations are meant to be derived from the existing regulations in the country. No wonder, only 2 out of 30 interviewees have a corporate cloud strategy within their organizations; although 1 participant working for an oil and gas company confirmed that their corporate cloud strategy is currently being drafted. The two organizations with a strategy, developed it with the aim of achieving central administration of some functions (e.g. Human resource) across the enterprise and also the need for unifying, standardizing and providing needed flexibility that is required for operational effectiveness. Based on this, cloud solutions are gradually being deployed in these organizations to achieve this strategic objective. The need for developing a clear enterprise or corporate strategy will be discussed in the discussion chapter of this thesis.

Despite the fact that there are no clear corporate strategies, most oil companies have governance framework in place that governs their IT service delivery. The most used governance framework currently being used in managing IT service delivery within the oil and gas sector are Information Technology Infrastructure Library (ITILv3), Control Objectives for Information and Related Technology (COBIT) and ISO 9001:2001. Out of these frameworks, 11, 5 and 2 out of 30 interviewees confirmed that ITIL, ISO and COBIT are respectively the mostly used framework by firms in the sector; while other interviewees
don’t have any clear governance framework in their organization. This confirm Becker and Bailey (2014) view that ITIL is the most used IT Governance framework. The relevance of this framework is hinged on the fact that it helps in defining IT service strategy, design, transition, operation and continual service improvement. Despite the fact that cloud computing is applicable in all ITIL lifecycle, some of the processes in the framework needs to be customized for environments with cloud solutions. The key areas that needs to be updated when applying ITIL are aligning Service Level Management to this Corporate strategy, Demand and Capacity Management because cloud is typically a metered service, Change Control (because changes, upgrades etc., are carried out by the provider), Service Validation and Testing (in order to ensure cloud provider meets up with agreed SLAs) and Incident Resolution (how to resolve issues in a widely distributed network) (Gohil et al., 2011).
Chapter 5 Discussion

Based on the outcome of the data gathering, this discussion section analysed these data from relational view perspective on how organizations can leverage on the relationship opportunities involved in cloud transactions in order to develop a robust cloud strategy that will deliver maximum value for Oil and gas companies and their vendors.

The effective adoption and implementation of cloud computing require extensive collaboration among the parties involved. Therefore, it is essential for technological change strategy and plan to be a product of both top-down and bottom-up engagement approach. This will help in ensuring the buy-in by all stakeholders within the organization and this will also improve the process because bottom-up engagement can help inform management of some salient facts that can help achieving successful change when implementing new technologies. But beyond insider stakeholder management in developing cloud strategy, there is a need for this strategy to be developed with collaboration with external stakeholders (Vendors and Regulators). Therefore, this section will focus on how these stakeholder relationships can be harnessed in the development of a robust corporate or enterprise cloud strategy.

5.1 Analysis using the Relational View

The effective collaboration among cloud actors (client, vendors and regulatory agencies) is very crucial in ensuring smooth deployment and usage of cloud solutions in Oil and gas companies. As mentioned in chapter two, the essence of applying relational view is based on the fact that it is the only approach that is relevant in all the phases of an outsourcing process. Relational view approach is very vital in ensuring collaborative synergy among these stakeholders in order to generate relational gains and competitive advantage for all parties. The importance of relational view in cloud sourcing is that it helps to shift cloud sourcing deals from being a mere transaction to a relationship based on alliance, where each party sees themselves as partners in order to achieve set objectives (Turkem, 2013). The relational gains in this perspective are achieved through four major methods which are inter-firm specific assets, knowledge sharing routines, complementary resource endowments and effective governance (Dyer and Singh, 1998). These four key factors are relevant in addressing the categories expressed in these research findings and in strategizing towards a more effective cloud adoption in the oil and gas sector.

Cloud adoption helps to achieve inter-firm specific assets because the resources of both the client (customer) and vendor (provider) are leveraged to achieve the much-needed competitive gains (Aviles, 2015b). These assets can relate to a specific site, physical assets or human assets. The vendor in this case, as it relates to cloud based solutions has competitive advantage based on their technologies, tools, core expertise and highly skilled personnel, while the client can leverage on their in-house infrastructure, knowledge about their
exploration and production operations, highly skilled staff in order to create the much-needed synergy that will help achieve competitive gains. As emphasized in chapter two, strategic alliances like this, already exist within the oil sector and this is majorly between the OEMs, technology providers and the oil companies, involved in oil and gas operation (Ernst and Steinhubl, 1997). The success of this approach over the years has been responsible for the very high rate of outsourcing arrangement in oil and gas operations because the expertise of these OEMs and service providers needs to be leveraged on. These OEMs deploy their technologies and personnel on client sites and these personnel work seamlessly in client locations in order to achieve the strategic goals of the client. In the current client-vendor outsourcing relationships in the oil sector, the client has firm control because most vendor assets are deployed within the client’s office or field locations, but this will be different in cloud adoption. As identified in the findings, cloud adoption tends to transfer the outright control of these assets, processes and functions from the client to the cloud provider. This is what is resulting in the concerns associated with security, confidentiality and offshoring, which is translating into the low adoption of cloud solutions.

Therefore, in order to effectively achieve sharing of inter-firm specific assets, the issue of lack of total control by the client needs to be tackled (Merrill, 2014), so that it will not create avenue for opportunism. This was why participants feedback emphasized the need for deploying relevant policies towards adherence to global best practices, and for deploying tools and technologies that will ensure maximum security and confidentiality of data on the cloud. Also, there is a need to only achieve inter-firm asset relationships with cloud vendors with proven track records, experience and expertise. This is necessary to help boost the confidence of the client when trying to generate relational rents by partnering with vendors when adopting cloud solutions.

Also, the second factor that helps achieve relational gains is inter-firm knowledge sharing routines. Inter-firm knowledge sharing routines is defined by Grant (1996) as “regular pattern of inter-firm interactions that permit the transfer, recombination, or creation of specialized knowledge”. Most cloud adoption within the oil and gas sector is deficient of clear knowledge sharing strategy and this is hindering the full maximization of the benefits which cloud adoption portends. Effective knowledge sharing to the relational view, helps in achieving inter-organizational learning, and this is very relevant in the Nigerian Oil and gas sector in bridging the competency gaps in the country in the field of cloud computing. Also, current cloud-sourcing decisions in the country are offshored to other locations. An effective Client and cloud provider (vice-versa) knowledge sharing strategy will help in addressing the knowledge gap and improve the proficiency of indigenous professionals on cloud technologies. Such a strategy would help to create room for effective localization, more adoption and address service delivery issues, which are associated with indigenous providers. Also, successful transition to a cloud based environment can only be achieved through effective knowledge transfer because the provider needs to have clear understanding of some knowledge assets of their clients before they can effectively deploy the technology. Cloud providers need to ensure that the solution is fit for purpose and that the client derives maximum value from the technology.
Also, the knowledge derived from this inter-organizational learning is a major source of innovation and performance enhancement in organizational activities (Dyer and Singh, 1998). There are two types of knowledge which are explicit and tacit knowledge. Explicit knowledge is readily available in the form of facts and symbols that will help facilitate the alliance partnership when adopting cloud solutions. Except for trade secrets and documents that are classified as confidential in line with regulatory policies, both oil and gas companies and the cloud providers needs to release the needed information that will help in ensuring smooth decision making during all phases of the cloud adoption process. Tacit knowledge is difficult to verbalise, code or document, but can help organizations to be competitive. Expert know–how is tacit knowledge that is very difficult to transfer, but when clients and vendors can devise means of extracting this tacit knowledge, it helps both of them to be competitive. Therefore, in applying the relational view in strategizing for more cloud adoption within the Oil and gas sector in Nigeria, both client and vendor needs to institutionalize processes within their systems, which help to achieve and facilitate purposeful exchange of relevant data when in an alliance relationship.

Another source of relational rent in outsourcing relationship is complementary resource endowments (Dyer and Singh, 1998). A cloud-sourcing relationship is hinged on the synergy of complementary resources because both clients and providers are contributors of their resources in order to increase the productivity of the company. In most cloud-sourcing arrangements the client contribute resources in subscribing to the service, which if harnessed properly, can lead to greater efficiency and benefits that help in improving the company’s productivity. The cloud provider contributes their tools, technologies and competencies, to help improve the productivity of their client, something which translates in increased gains for the vendor. Hence, cloud sourcing helps to achieve a symbiotic relationship with opportunities for profitability for both parties.

Lastly, effective governance strategies are crucial in achieving relational rents in an outsourcing relationship. This is necessary to ensure value creation initiatives are generated and sustained, ensure reduction in transaction costs and safe-guarding against opportunism. The governance approach can either be by third party enforcements or self-enforcing agreements (Dyer and Singh, 1998). Per the relational view, a self-enforcing approach is more suitable, as compared to third party enforcements which increase transaction costs through cost associated with developing, administering and monitoring contracts. But this perspective is contrary to oil and gas sector because the sector is highly regulated because of the complexities and high risks associated with the nature of Oil and gas operations. These regulations, agreements and contracts are aimed at protecting the interests of client, vendors and governments. Based on the assumption that this sector commands huge financial resources, the need for third party enforcement (in this case by regulators) will help ensure opportunism is reduced to the barest minimum. Also, self-enforcing agreements may not be sufficient in tackling risks associated with data offshoring, security and confidentiality, and the need for adherence to global best practices, regulations and standards.
5.1.1 Challenges of the Relational view

It is important to emphasize that the expected relation rents that are required in an alliance relationship are based on some assumptions. These are learning effects, resource heterogeneity, imperfect mobility and voluntary governance structure (Turkem, 2013) and these needs to be understood within the context of cloud-sourcing. The success of knowledge transfer in the relational view is premised on the learning effect assumption (as discussed in chapter two), which assumes that organizations are willing to learn, in order to increase their capabilities. This implies that a company with an organizational learning culture will be easier to engage in knowledge sharing. The research outcome did not discover the willingness of oil companies to learn, but due to lack of knowledge sharing strategy from feedbacks provided, the need for effective knowledge sharing when adopting cloud computing is obvious.

Also, the extent of heterogeneity in the resources and competence of the client and provider are major criteria for the success of relational view in cloud computing. This is because the main aim of cloud adoption is to fill competencies and resource gaps, but sometimes some organizations may opt to replicate their core resources by having more than one provider for similar functions. Furthermore, voluntary governance, which is another assumption that determines the applicability of relational view (Turkem, 2013) may not be realistic (as earlier explained) because most client-vendor relationship is not limited to one transaction, companies will have different alliances with several cloud providers, based on the processes or functions they are outsourcing. Therefore, the need for a central authority managing these alliances is very important, in order to ensure that all these transactions complies with relevant laws and that they deliver maximum value for all stakeholders. This tends to limit the applicability of self-enforcing approach in cloud adoption within the Oil and gas sector in Nigeria.

5.2 From Theory to Practice: Applying Insights from the Findings Towards Actionable Practices

The essence of action research is to take action based on knowledge gathered, in order to transit an organization from their current state to a desired future state (Coghlan and Brannick, 2010). In view of this, a framework (as shown in figure 17) was developed based on insights gathered and my reflection during this research and it shows the factors influencing the status of cloud adoption in Nigeria and the strategies that are required to stimulate further cloud adoption in the sector. Subsequent sections will focus on discussing these strategies.
5.2.1 Regulatory Framework

As discussed in section 4.1.3, it was evident from the findings that there are no clear laws governing cloud adoption in Nigeria, hence, the need for a clear regulatory framework to be developed that will help guide the adoption of cloud-sourcing. This can be a standalone policy or an update of the current national information technology policy, so that it can capture cloud adoption. Countries like United States, Australia, United Kingdom, Switzerland etc., have all developed cloud policies for their countries. This policy is also required to update relevant local content laws to ensure cloud adoption is properly managed and to develop policies that will help guide local and offshore participation in cloud adoption. According to Dahunsi and Owoseni (2015), “the Government has to be the major driver of cloud computing in Nigeria for it to have an established and lasting footing and for clients to take optimal advantage of cloud services”. In view of knowledge gathered in the research, a national regulation is necessary to address localization, data offshoring/onshoring, cloud infrastructure development, encourage indigenous provider participation, data sharing requirements and incentives for cloud providers. Other factors to be considered in this policy which was emphasized by Organization for Economic Cooperation and Development includes the need for standardisation, awareness and competency development, cloud for development, research and development and many other (OECD, 2014).
Having a policy governing cloud adoption in a country like Nigeria which has a lot of agencies providing regulatory functions within and outside the Oil sector, will help Oil companies to understand the roles and influence of each of these agencies (NITDA, Local content Board, DPR, NCC, etc.) when deciding on using the technology. This is very crucial to avoid a situation when companies that had already migrated some of their systems or functions to the cloud, will be informed that they have violated relevant laws and need to revert to their traditional systems. This policy can be best achieved through national collaboration between Industry professionals, Government agencies, academic community and other stakeholders in order to ensure that the national cloud policy is drafted as a matter of urgency. To develop a robust policy will require in-depth knowledge sharing among these stakeholders and this aligns with relational views as an effective means of tapping into the benefits of the technology.

![Figure 18: Overview of main features of national cloud policy (OECD, 2014)](image)

Figure 18: Overview of main features of national cloud policy (OECD, 2014)

As inferred from figure 18 having a national policy can help in increasing awareness, skills and education, which is currently at the moderate level as shown in the data gathered. Therefore, the need for government to create more awareness through promotional and educational programmes. These promotional activities can be in the form of encouraging publications on cloud technologies, adoption by public and private firms and organizing events that promotes cloud computing. An example, of the essence of this strategy, is an overall action initiative by the German government that encourages the use of cloud computing in the whole country. Also, in order to improve skilled development in cloud computing Japan developed ubiquitous town and concept and Ireland’s has a skill enhancement programme for cloud technologies (OECD, 2014). Initiatives like these can only be achieved, when there is a national programme that is geared towards cloud adoption, hence the Nigerian Government needs to take clue from this.
Furthermore, this policy should include strategies that will help increase research and development initiatives ranging from public-private partnership approach, encourage academic researchers through grants and scholarships, and many other approach as deemed necessary. Another issue that a national cloud policy should address is the need for standardisation. This will help in helping to curb provider lock-in concerns which are associated with the use of diverse proprietary solutions. A clearly defined standard will clarify the requirements for interoperability. In the same vein, national policy will help develop a clear roadmap of how the country wants to maximize cloud adoption for development. This is very crucial because as this research as shown there is an infrastructure deficit in the country, hence this policy should develop strategy of improving broadband internet, improve infrastructure, encourage indigenous participation through incentives and capacity building for indigenous professionals.

A very crucial issue that this policy must address as shown in figure 18 is security and privacy in cloud-sourcing; and the achievement of this will be based on a detailed risk management highlight for the country. This is important to provide a detailed guideline that will ensure security and confidentiality of data generated within the country that are being moved to the cloud. Specific requirements for data offshoring, encryption requirements, risk assessments and management should be addressed, certification requirements for providers and professionals managing cloud solutions and other relevant requirements will be necessary as deemed fit. This policy should be periodically reviewed as the technology continues to advance in order to ensure that it is updated to be at per with current status of the technology. Lastly, government needs to spear head this change by ensuring that cloud computing is entrenched in the service delivery being rendered by Government ministries. Some agencies of government regulating the Oil sector are using cloud solutions, but there is a need for synergy towards cloud adoption in Government sector so that it can help build the confidence of corporate firms (especially in the Oil sector) to follow this trend.

5.2.2 Corporate Cloud Strategy

Apart from having regulatory clarity, there is a need for oil companies to develop clear corporate strategy that guides their cloud adoption process and the responsibility to achieving this rests on the cloud consumer (oil companies), being the main stakeholder in this process. The current practice of adopting cloud solutions based on business needs is not sufficient in ensuring that maximum value is derived from this technology deployment. As emphasized by Siepmann (2014) a clear strategy should be the first step in the six-phase outsourcing cycle; and with the dwindling crude price of oil, oil and gas companies cannot afford to deploy technologies without detailed business case and this justification must be in line with organizational policy. This corporate cloud strategy can be a standalone policy or it can be a subset of the existing IT policies in organizations. Also, this strategy is very relevant even if the oil and gas company does not currently have a cloud solution because it can also serve as a proactive measure that will ensure that the organization is properly guided in the decision making of whether to go to the cloud. This strategy must clearly communicate policies and business driven expectations for the use of cloud solutions within the oil company; and it
must determine who, why, what and where cloud resources will be deployed and for which functions.

Also, drawing from key cloud adoption success factors as identified by Gartner group (Linthicum, 2015) the following needs to be defined in a cloud strategy (1) Multi-tenancy (2) Cloud model (3) roles and responsibilities (4) Globalization (5) workload policies (6) Integration (7) Governance (8) Standards (9) leveraging on existing systems (10) virtual image repository. Multi-tenancy implies that cloud solutions must be able to ensure simultaneous access or connection of multiple users to the same resources over the public or private cloud model. Therefore, a cloud strategy must define details of the minimum multi-tenancy requirements of the organization. After defining the multi-tenancy requirements, it is important to also determine which cloud architecture (public, private, hybrid etc.) the organization will be adopting because the choice of model will influence the choice of vendors, cloud technologies and applications that will be deployed within the organization. It is also important to define the impact of globalization on cloud solutions, knowing full well that cloud adoption implies that adopted cloud solution is being used in different countries. This implies that consideration of different cultures, standards, regulations and policies is very important. Therefore, CIOs and IT managers in the Oil and Gas sector need to specify their specific localized policies and regulations, to ensure that cloud adoption do not violate any existing law or beliefs.

Furthermore, there is a need for effective cloud integration and deployment strategy, so that migration from in-house legacy system to a cloud-based option is seamless and successful. Integration is a complex process which needs to be implemented with a clear plan, knowing full well that data, systems and processes between the client and the vendor will be integrated. This strategy must also define deployment strategy and this can be handled by adopting a project management framework (PMI, PRINCE2 etc.) suitable in achieving organizational objectives. Lastly, there is a need to ensure virtual image repository are shared and archived with ease. It is also important to determine the new software requirements for the organization and the decision on these software requirements will be influenced by the cloud service model (IaaS, PaaS and SaaS) that will be applied. Some of the required software for cloud environments are cloud infrastructure and application management software. As explained by (Linthicum, 2015), infrastructure management software for the cloud will help in ensuring effective management of shared pool of physical resources and which provides just a single point of access for management. It should also be compatible with different hypervisor types, so that it can be used for different cloud providers (vendor lock in). This management software also makes provisioning and de-provisioning by clients to be managed easily. This software will help ensure workload reduction through the ease it offers in the management of cloud infrastructure.

A very crucial aspect of cloud strategy within the Nigerian Oil and gas industry is the need for proper and thorough change management plan. This is because implementing a cloud solution will result in minor or major changes, depending on the scope of the cloud solution. This change in most cases will affect job function and roles, responsibilities and workflow within the organization, therefore human resources should be engaged in development
planning and role reassignment (where necessary). The development plans must align with the corporate strategy of the organization, to ensure that training, mentoring and coaching plans align with corporate goals. Also, taking cognizance of the impact of trade unions on employee welfare, appropriate HR strategies will also need to be applied in order to effectively engage these relevant trade unions, especially when there may be the possibility of the impact of the technology negatively affecting some employees. A clue can be taken from a situation that occurred during the conduct of this research, which was the shutdown of the state oil company (which also doubles as the regulator) by trade unions based on the restructuring of the organization (Soniyi et al., 2016). This confirms the sensitivity of Oil and gas operations in Nigeria and that any action that will impact on the work force must be managed with all level of sensitivity.

The concepts highlighted in this section are just a guide to what is expected to be included, but each CIO or IT manager within the oil and gas sector will need to collaborate with their stakeholders and determine details of what they want to be included in their corporate cloud strategy. It is also important for this strategy to be reviewed and updated as the technology continues to advance.

5.2.3 Collaboration among cloud actors

The process of drafting and implementing a corporate cloud strategy is a collaborative process which requires inputs from all cloud actors, even though the client (cloud consumer) is the main user of the solution. Also, the process of deploying a cloud service requires active involvement of all cloud actors because the process is premised on ensuring inter-firms capabilities. Therefore, the need for these actors to be engaged at various phases of the cloud adoption process that is relevant to them. The process goes beyond transaction, but the transaction must be built on a robust relationship between these cloud actors. Aviles (2015b) buttressed the fact that inter-firm relationships that are premised on effective collaboration, will help derive maximum value for the organization. Figure 19 shows the expected interaction that is required among all cloud actors (stakeholders), in order to achieve a successful deployment.
As soon as the decision has been reached by oil companies as to which cloud service will be deployed, they need to initiate the process of engaging the most suitable cloud provider directly or through a cloud broker. The selection criteria and procedure for selecting the most suitable provider will be determined by the governance framework governing the process and the kind of cloud services being subscribed to. But this must be a product of very detailed assessment by the customer (Oil company) of the cloud provider's competencies, experience, resources, reputation and culture that can help in achieving inter-firm relationship between the two organizations. After a decision, has been reached on which provider will be used, there is a need to devise a strategy that will be used in ensuring that robust relationship is sustained between the parties involved in the transaction. To effectively establish a relationship that will ensure that both the client and the provider effectively share their assets and resources when adopting cloud solutions, will require very detailed contract, clear and detailed performance targets, proper definition of rules and behaviours, governance structure, knowledge sharing and effective communication strategy (Hansson and Jansson, 2013). These factors are important to build trust and commitment that are foundational to ensure effective relationship is sustained.

**Contracts** – The commitment to align in sharing assets and resources can only be binding when there is a legal document in form of contract, which contains the scope of the service, resources (human, technical and financial) to be deployed, service level requirements, roles and responsibilities, performance clauses, stakeholder requirements, regulatory requirements and compliance (considering all branch locations) and other relevant details which will be included. When this is clearly specified all actors involved need to be clear on their responsibilities in the implementation plan. For example, as the data has shown, some companies in the oil and gas sector currently use legal binding agreements in the form of contracts (which includes service level agreement) as a strategy to ensure security and confidentiality of data, ensure performance target are met and to build confidence in the relationship between them and the cloud providers. The data also shows that they expect the
use of contracts in cloud adoption to be taking more seriously because the technology is still emerging in the sector. Legal and contract department in oil companies have a crucial role in driving this process and seeking inputs from all actors. The customer, provider and broker (if needed) will need to make contribution by presenting their detailed service level requirements and collaboratively, all parties will make inputs before a final contract is drafted. It is important to emphasize that flexibility should be the key word when drafting any cloud computing contract. But a major input into this contractual process is compliance with regulatory framework (Yigitbasioglu, 2013) and since there are no clear regulations on cloud adoption in the country, legal departments of each oil company may need to make company specific interpretations of existing policies as it suits their cloud computing strategy.

Effective Communication - The heart of successful interaction is a robust communication strategy that helps ensure that relevant stakeholders are informed and allowed to provide feedback on relevant processes within the entire process. The three aspects of effective communication as emphasized by (Mohr and Spekman, 1994) are quality of communication, knowledge sharing and collaborative goal settings. For example, data gathered shows a common view that successful cloud adoption is directly related to collaboration between the oil companies and the cloud providers and this collaboration can only be achieved through right communication. Effective communication is premised on making right information available to all parties on time and in the right format. As shown in figure 19 no actor should be left out in the flow of communication, since their role can either make or mar the success of the cloud system. The customer needs to also engage their internal stakeholders, so that internal resistance won’t hinder the deployment of the technology. But it is important to note that, to build the much-needed relationship that will stimulate effective communication and ensure harmony among parties, is the need to have common norms (Ivens, 2006). Common norm is premised on clear communication of the organization’s vision for adopting cloud solutions, so that all actors can have a clear focus of what the customer/client wants to achieve. Common norm can also be achieved when the relationship between the customer and other actors is carried out based on mutual respect, trust and cooperation.

Knowledge Sharing - A key feature of effective communication is knowledge sharing, which help ensure relevant information and knowledge are made available to all actors. As reflected in the research findings, majority of Oil companies in Nigeria that have adopted cloud solutions, do not have a clear knowledge sharing plan. As emphasized by Kotlarsky et al., (2008) knowledge transfer is vital for knowledge integration among project stakeholders which is crucial for successful coordination and management of complex projects. For example, a provider cannot deploy cloud solution for Oil and gas operation, if the customer refuses to pass across relevant knowledge about the company’s relevant operational systems, current technology being used, workflow, policies and other vital information to the provider. Also, the provider needs to make available detailed documentation of how the solution was implemented, train in-house personnel on how to use the system, conduct refresher courses as soon as new updates are available, just to mention a few. Therefore, the focus of knowledge collaborative learning among parties is to ensure that the tacit and explicit knowledge within these organizations are shared, interpreted and documented (Sudolska and Lis, 2014). Also, the focus of knowledge sharing should be a synergy aimed at achieving a win-win situation.
for both parties. To stimulate effective knowledge sharing relationship openness, trust and opening diverse channels of interaction among both parties are required. Furthermore, for knowledge transfer to be effective, both the customer/client and cloud provider needs to develop a framework for the knowledge sharing process. This is important to help control the kind of information being shared and to avoid parties hiding under knowledge sharing to engage in knowledge leak (Sudolska and Lis, 2014). This framework should also include plans to leverage on opportunities created for knowledge sharing and collaboration when social ties are established among all stakeholders (Kotlarsky et al., 2008). These social ties can be maximized by leveraging on available collaborative technological tools. Another means Oil and gas companies can ensure effective knowledge sharing is by ensuring that relevant personnel attends technical sessions organized by providers for all their clients, industry conferences, membership of relevant professional associations (British Computer Society, IEEE etc.) so that professionals can have access to relevant publications which shows advancement in cloud computing and helping them to learn how to adopt it in the Oil and gas sector.

**Governance** – The governance approach to be used in cloud deployment must be clear and precise, so that it can be suitable in managing the risks, adaptability and effective communication that is required for effective inter-firm relationship that will deliver maximum benefits for both parties. IT cloud governance framework is still at the infant stage in Nigeria oil and gas sector; but the current IT governance frameworks (COSO, COBIT, ITIL, and ISO) being used across the oil industry for managing service delivery are still relevant in cloud implementation and does not need any major alteration (Becker and Bailey, 2014). As data gathered shows, Oil and gas companies in Nigeria have not clearly aligned their governance framework for cloud adoption and this need to be addressed by decision makers in these organizations as a matter of urgency.

It is important to emphasize that the choice of cloud model(s) to be used in cloud deployment should be influenced by the specific organizational peculiarities, personnel and the maturity and suitability of the current IT governance model being used in the organization. Therefore, Oil and gas companies should continue using the framework that is most suitable for them; however, some aspects that needs to be modified to suit cloud deployment needs to be reviewed. To customize existing IT governance framework being used in an organization to the cloud, IT governance dial (See figure 20) was developed by Becker and Bailey (2014) so as to make sure that the process generates required deliverables needed in cloud adoption. This cloud governance dial are:

1. **Process** – This dial should define the process, system or function to be moved to the cloud.
2. **Delivery** – How will the cloud system be delivered (SaaS, PaaS or IaaS)?
3. **Deployment** – What deployment approach (Public, Private or Hybrid) will be used?
4. **Cloud Formation** – Internal/External, Proprietary/Open, Parameterized/Deparameterized, Insourced/Outsourced
5. **Enterprise Risk Management** – What are the risk associated with the cloud deployment.
6. Control – This dial should specify the modifications that should be made to the control measure in the framework that will be suitable for the cloud deployment.

Figure 20: Cloud Governance dial (Becker and Bailey, 2014)

Lastly, since cloud governance is still at an infancy stage, it is subject to changes by factors like technology, regulations and government laws, etc. Hence, the need for constant monitoring and evaluation in order to and ensure that cloud governance initiatives are properly updated.

5.2.4 Addressing infrastructure concerns

The quality of infrastructure in any environment has direct impact on the growth and productivity of companies located in such environment (Nedozi et al., 2014). The issue of poor infrastructure as emphasized by participants is peculiar to the research environment (Nigeria). As expressed by Onodiege et al., (2013), the high transaction cost of services in Africa is largely a result of infrastructure problems. A clear evidence of the infrastructure deficit in the country reflects in the Uptime Institute Tier Certification Map (2016). Nigeria has just 4 data centers out of which 3 has Tier III Certification of design documents and one data center with Tier II certification of design documents. South Africa has 10 data centers with range of certification from Tier IV certification of their constructed facilities to Tier III certification of their design documents. But United States has 82 data centres with ranges of certification up to Tier IV Gold certification of operational sustainability and 45 of such data centres have Tier III certification on their constructed facility (Uptime Institute, 2016). The more data centers will determine the economies of scale available for service providers, hence these makes the costs of services provided by indigenous providers in Nigeria not to be competitive when compared to their foreign counterparts. Also, this infrastructure deficit is making most datacenters in the country not to be scalable, since their capacity seems to be
insufficient for the estimated demands assuming the level of awareness and acceptability is high.

This challenge is very critical for effective cloud adoption and no matter the policy or strategies in place, the suitability of this technology in managing the complexities associated with oil and gas operations is dependent on the robustness of the infrastructure available in the operating location and environments. Based on the analysis of the data gathered in the research process, the infrastructure concerns peculiar with Nigeria is power supply and internet access (backbone bandwidth and terrestrial access). These are the major concerns that affect the management of datacenters in the country and this is responsible for the high cost, availability and reliability issues associated with cloud service provision within the country. The responsibility to develop and create a conducive environment that supports investments in infrastructure lies on the government, and without their commitment cloud adoption within the country will be hindered; and the continuous trend of offshoring services through cloud implementation may continue.

Even though infrastructures are not developed overnight, it is important for Nigerian government to tackle this issue. Until these infrastructure issues are addressed, cloud services cannot be fully maximized and the trend of offshoring will continue. If Organizations (especially cloud service providers etc.) in Nigeria continue to generate their own power to manage their datacenters and backbone network, then they will not be able to compete with their Global peers. Similarly, quality broadband internet is relatively efficient within urban areas in the country, and this is a major bottleneck for Oil and gas operations, knowing full well that most oil field installations (apart from offices) are situated in remote areas. Since some of these infrastructure related challenges are beyond the control of organizations, there is a need for organizations to continually strategize on how to maximize and make the best use of available (limited) infrastructure resources.

The Nigerian Government in 2014 launched the National Integrated Infrastructure Master Plan (NIMP) which is aimed at spending $3 trillion on the development of infrastructure over the next 30 years. But because private sector businesses (including Oil companies), cannot afford a delay in technology adoption, Nigerian Government need to implement this long-term goal, by prioritizing sectors that are critical to the economic buoyancy of the country, especially power, internet backbone and terrestrial access. Based on the fact that we are in the information age, power supply and good ICT infrastructure will position the country properly for economic development. Oil and Gas companies in Nigeria have historically contributed to building infrastructures in their operating environment, but these CSR efforts need to be properly coordinated by Government, so that the developmental efforts by these oil and gas companies can tie into NIMP. Furthermore, private sector firms (including cloud carriers and cloud providers) can also bridge this infrastructure gap by collaborating with their foreign peers to minimize the implications of poor infrastructure and to build the much-needed capabilities required to manage cloud services. For example, the leading cloud provider in Nigeria is currently partnering with Microsoft (http://www.mainone.net/mainones-tier-iii-data-center-mdx-i-partners-microsoft-on-cloud-computing/), in order to provide IaaS solution to their clients.
Also, one of the factors affecting cloud services which were emphasized by almost all participants is the issue of poor service delivery from cloud providers and cloud carriers in the country. Therefore, for effective cloud deployment there is a need for detailed service level management approach that helps monitor the implementation of agreed SLAs and contracts, as part of client control process. Cloud standards customer council (2015) developed a process (as shown in appendix VIII) through which this can be achieved. This process is suitable and relevant in SLM approach for cloud adoption in Oil and gas companies. I am currently adopting this process in my SLM coordination with cloud carriers in my workplace and the outcome has been impressive. This is resulting in increased service availability from these firms, because of a more thorough SLM process that I have adopted.

5.3 Recommendations and Actions Taken

A). Formulation of a policy or guideline governing cloud adoption in Nigeria.

To stimulate the needed change in resolving the issue of lack of clarity about regulations governing cloud adoption, I studied all available regulations on information technology adoption and based on my findings there are no policies or guideline governing the adoption of the technology in Nigeria. In view of this I made recommendations (as shown in appendix IV) on the development of a National cloud policy to a relevant government agency that is saddled with this responsibility. The initial feedback from a senior official was based on the need to present a more detailed justification that can help the agency in seeing the real need for this. This detailed justification was sent as contained in appendix IV and this was forwarded to the Director General of the National Agency. Based on the request from the agency, sample regulations that can be used as a guide in developing this policy/guideline were also forwarded. To further push this action by creating more awareness and support, I decided to leverage on my membership of various professional association (Nigerian Society of Engineers and Nigerian Institute of Electrical and Electronic Engineers) to advocate for the need to have this regulation in place. This is being achieved by making presentations and creating awareness on this issue at various forum organized by these associations. I gave a presentation at the July 2016 technical session/meeting of NIEEE (as evidenced in appendix IV). The presentation was focused on discussing the impact of this technology on process automation and how it relates to electrical engineering practice. This forum served as an opportunity to discuss the essence of clear regulations and to seek collaboration towards driving the formulation of this policy. But pending the adoption of this policy, the recommendation I proposed to decision makers which is evident in (appendix V and VI) is for decision makers to always seek legal/regulatory clarification on case by case basis (based on the peculiarities of the technology and the type of data involved) for any cloud solutions they intend adopting and which involves offshoring.

B) Corporate strategy for governing cloud-sourcing

Furthermore, I also provided areas of improvement within my workplace (appendix V) by engaging a key stakeholder (who also participated in the research) on areas of improvements
on how Information systems unit in my work place manage the process of cloud adoption. One of the important feedbacks from the stakeholder engaged is the need to act towards creating more awareness about the relevance of this technology among other decision makers within my work environment, so that when proposals and recommendations are being made it will be much easier to get their buy-in. In view of this, I jointly authored an article (as documented in appendix V) that is focussed on the general (overview) benefits (personal and organizational) of cloud solution in the organization’s quarterly magazine. This publication helped in creating awareness about the benefits of cloud technologies and this has greatly improved the rate of awareness about the technology. Also, I made recommendations to another cloud provider where I was granted access to conduct interview on areas of improvement in their cloud deployment strategy for Oil companies. I have received positive feedback from this request as shown in appendix VI) and I will continue to provide inputs into this process so that the effectiveness of the recommendations made can be monitored and further analysed in future research work.

C). Suitable governance framework is required for successful cloud-sourcing: As seen in appendix V –VI, action has been initiated within my work environment and another organization, so that these companies can implement a more robust governance framework that inculcates cloud solutions. Feedback regarding this has been impressive and the recommendations are in the process of being implemented.

These recommendations which include developing a corporate cloud strategy, data security and transfer, adoption of suitable governance framework (e.g ISO/IEC 27017:2015) and requirements for accessing and monitoring cloud providers will require sometime for it to be implemented, based on the low-level of activity in the oil and gas sector. It is important to emphasize that the implementation of these recommendations proposed in this research are at the discretion of the stakeholders engaged. Furthermore, to effectively champion this needed change in the sector and in my workplace about cloud adoption, the need for effective change management approach is very crucial. This is because adopting new technology in organizations is a sensitive matter which needs to be carefully tackled. This is evident in the research findings with participants expressing fears of role reassignments and even redundancy. This concern buttresses the need for effective change management plan that is premised on understanding the sensemaking and reflective process of stakeholders. This is because stakeholder decisions and actions are influenced on their cognitive, conceptual, emotional and intentional behaviours which can either support or hinder changes (Piderit, 2000). Vince and Broussine (1996) also emphasized the fact that change is conducted with identified stakeholders and it is not imposed on them, so that all people related issues that may arise as a result of cloud adoption can be effectively managed. In view of this, the importance of strategic collaboration with key stakeholders within the oil and gas sector is vital in ensuring cloud-sourcing is embraced.

5.4 Reflections and Lessons Learnt

As buttressed in chapter 3, at the center of this research is the application of critical reflection, in order to ensure that the research process is rigorous and that proper meaning and
inferences are drawn from the gathered data. The reflective approach throughout this research can be classified as both reflection in action and reflection on action in line with Schon’s (1987) reflection concepts. By reflecting in action, I was constantly reviewing the research process while the research was on going (as shown in reflection diary 1 in appendix VIII), to ensure that all aspects of the research was rigorous and to ensure that the outcome and conclusions made are valid and reliable. Also, the ladder of inference concept developed by Chris Argyris (Coghlan and Brannick, 2010) as shown in figure 21 was also useful in influencing my reflective process. The reflective process was iterative which involves observing all data gathered, make meaning out of the data by reasoning, draw conclusions and take action by making recommendations in order to test the validity of the inferences drawn from the data. The reflective process involve self-inquiry, double loop thinking, questioning and inquisitiveness; and in doing this my experiences, judgements and understanding and that of other participants were taken into consideration during the reflective process. As earlier emphasized, journaling technique was applied in order to ensure that all observations are properly documented in an approach that is suitable for thinking through them and to make necessary interventions. Reflection diary 2 and 3 in appendix VIII contains summaries of some reflective processes and how they influenced decisions (actions) in the cause of the research process.

![The Ladder of Inference](https://pivotalthinking.wordpress.com/tag/ladder-of-inference/)

**Figure 21: The ladder of inference** (Source: https://pivotalthinking.wordpress.com/tag/ladder-of-inference/)

Furthermore, I also reflected on action by thinking through the research process (see reflection diary 4 in appendix VIII) and developing lessons learnt and evaluating the impact of this research on my development as a scholar practitioner. Based on careful reflection and experience during this research, I inferred that conducting action research is a very complex process because of the need for intense collaborative effort that is required, understanding of
change agency and political dynamics in organizations and complexities associated with change implementation. According to Bradbury (2015), the political forces within or outside an organization can undermine any research endeavour and planned changes.

Therefore, as I continue to develop as a scholar practitioner and as I continue to follow up on recommendations made in this research, I have been adopting Buchanan and Badham perspective of being a ‘political entrepreneur’ (Coghlan and Brannick, 2010). This is being achieved by understanding the influence of key stakeholders, securing their buy-in, collaborate with them and building necessary support, which is required to ensure recommendations are implemented. But in doing this, I ensured that the process of managing the political dynamics within the work place and industry does not create opportunity for unethical practices. This I achieved by ensuring that my preunderstanding of the organization and the oil sector and role duality (being an employee and a researcher) are effectively managed, in the research process in order to ensure that the outcome of my research endeavour are valid. As buttressed by Coghlan and Brannick (2012), access to research setting, role duality and preunderstanding must be effectively tackled in order to ensure that the research is valid and reliable. Despite having primary access within the industry as a result of being a practitioner in the sector, secondary access was quite challenging. I therefore learnt that the status of a scholar practitioner within their organization is very crucial to the extent of access they can be given, especially in organizations with hierarchical structure (Coghlan and Brydon-Miller, 2014). I was able to gain the relevant secondary access to other key participants by using snowballing approach in order to ensure that the key participants required are engaged. Also, despite the challenge posed by role duality, this research further developed my ability to merge both by functional responsibilities within the organization and that of a scholar practitioner. This was achieved through effective time management, planning and journaling.

Furthermore, the participant’s engagement effort involved in this research has helped in improving my collaborative skills, which is a vital requirement for action research. I learnt that collaboration will only be effective when participants are engaged on the benefits they tend to gain from participating in the research. No wonder, Stephen Waters-Adams (1994) emphasized that scholarly development can be best strengthened through collaboration in action research process. The participants I engaged were made to realise that the engagement process in the research will help awaken them to emerging realities in cloud adoption and how the research findings will inform their decision making in their functional roles or in their career decisions.

The positive influence of the knowledge gathered in the taught module of this DBA programme cannot be overemphasized; because it provided the foundational knowledge and experience required for effective scholarly practice that is needed in planning and carrying out this research work. Most especially the interaction within my learning set provided enough experience required by me in engaging participants in addressing organizational issue. This research also serves as an opportunity to apply the knowledge gathered in the taught phase of the programme. The relevance of the knowledge gathered in the taught phase of this programme was evident in how the research problem was identified, knowing the right
philosophical assumption to be applied in the knowledge creation process, understanding assumptions and biases which influences qualitative data, adopting suitable research methodology, change management resulting from actions, ensuring right decisions are made in the engagement process and in taking actions and to ensure that the entire research is conducted ethically. I will continue to apply the theoretical knowledge gathered in the taught modules and practical knowledge from the research work in my future scholarly practice.

Lastly, this research has greatly improved my practice because it has imbibed in me the culture of critical reflection in decision making, effective stakeholder collaboration and how to strategically and continuously be a positive change agent within my work place. Also, this research has improved my performance on one of my job responsibilities which entails “Advising Information Systems Management of IT Systems requirements, as well as technology changes and advancements that could benefit the company. Based on this research and experience in the programme, I have been able to further influence decisions relating to how technology is being adopted. It is worth emphasizing that one of the senior executives engaged as a participant in this research and who has been instrumental in helping to driving positive changes on this subject within my work place, has been referred for this DBA programme and he is expected to commence his taught module soonest. This is a positive development for me because when there are more scholar practitioners in an organization’s leadership, it eases the implementation of critical decisions and recommendations.
Chapter 6 Conclusion

6.1 Recapitulation of purpose and findings

In view of the immense benefit, technological adoption poses to organizational growth and advancement, this research identified one of the technologies that is fast shaping the IT service delivery landscape and how it can be properly adopted for Oil and gas operations and projects. In recent years, the oil and gas industry has been faced with the challenge of instability in the price of crude and one of the ways in which productivity can be achieved is through effectiveness in their processes. Based on this the technology that was studied in this research was cloud computing and the focus was majorly on understanding how Oil and gas companies can outsource their systems, processes and functions into the cloud and how to manage the implications. In approaching this research the following issues were studied which are to examine the status of cloud computing in the oil and gas sector and how oil companies are embracing this technology. Also, the research examined the strategies that are required by decision makers to ensure that the adoption of this technology within the oil and gas industry is seamless. In approaching this research, the focus of data gathering was on the Nigerian Oil and gas sector and based on the fact that the big Oil and gas companies in Nigeria are multinationals (with their corporate offices in their home countries) and the participants interviewed cuts across these companies, the knowledge gathered is reliable. Meaning that, its applicability is not limited to the Nigerian oil industry alone. In analysing this data, relational view approach was applied, and the selection of this theory was because it is the only outsourcing theory that is applicable in all the phases (Preparation, Vendor Selection, Transition, Managing relationship and Reconsideration) involved in an outsourcing decision. Also, relational view approach is important to ensure that maximum value is derived from the inter-firm relationships that are entrenched in cloud adoption.

Based on the outcome of the data gathering and analysis process, coupled with the relevant background knowledge acquired through numerous literatures, some findings emerged from this research. Firstly, it was established that this technology is very relevant within Oil and Gas operations, and it can be used to drive business efficiency in the areas of cost optimization, suitability for core and non-core operations, improved decision making through automation and analytic feature of the technology, enhance the achievement of an agile and lean Oil and gas sector. However, despite these benefits, the level of adoption of cloud technology within the Oil and gas sector is adjudged to be low. Some of the reasons for this include conservative culture within the industry, huge investments in data center infrastructure, security and confidentiality concerns, lack of national policy (peculiar to Nigeria), infrastructure deficit in Nigeria, lack of skilled personnel are some of the reasons that emerged from the data gathered. Also, for the companies that have adopted this technology, it was discovered that there is no clear strategy governing their adoption of cloud. The decision to adopt the technology was just based on need or recommendations by the
service provider. The need for a clear strategy was identified as a fundamental reason for harnessing the technology effectively, based on the fact that technology deployment must be aligned with the strategic goals of an organization, so that a holistic deployment can be achieved. The current lack of strategy is resulting in lack of knowledge sharing programme, ineffective governance strategy, and detailed plan for addressing security and confidentiality concerns. Of major importance in cloud deployment is adopting a suitable governance framework. This is necessary because this framework will ensure that a strong foundation which helps both the client and the provider build a strong relationship that will translate the cloud sourcing relationship from a mere transaction to an alliance is achieved. Also, the framework helps to guide this process so that cloud sourcing transactions is built on strong agreements, clear performance monitoring and measurement, knowledge sharing and security and privacy strategies.

6.2 Limitations of the research
The limitation of this research is that the inclusion criteria for participation are oil and gas professionals with basic knowledge about cloud computing. Based on the fact that the level of technological awareness in developed nations cannot be compared to a developing one like Nigeria, the selected participants that met this requirement were majorly professionals with IT background. Since, these participants are technologically savvy; they all tend to have a bias which supports rapid technological adoption.

Another limitation of this research is that it was conducted when the Oil sector was facing a major downturn; hence it makes selection of participant to be tedious because of the fear and anxiety that permeates the industry during this period. More than 30 participants would have been interviewed if the responses and feedback from the information sheets and consent form (Appendix I and II) circulated were impressive. Furthermore, this affected open communication because, despite the assurances of confidentiality and anonymity, more free flow of information would have been achieved if the mood within the industry is exciting.

6.3 Implications and recommendations
The findings from the research can be adjudged to be very reliable based on the fact that the participants engaged in this process cuts across all sectors of the Oil industry and they were engaged using best practice procedures used in conducting qualitative research. Based on this, the findings from this research are highly applicable and relevant within the Oil and gas sector. The recommendations that emerged from this research are:

1. The need for a national cloud policy (specific to Nigeria).
2. Corporate cloud strategy should precede cloud development.
3. Security and confidentiality issues can be addressed through adherence to best practices and standards, continuous certification programs and deploying relevant tools and technologies.
4. Successful cloud deployment is hinged on suitable governance framework.
5. Nigerian Federal government has responsibility of addressing infrastructure challenges in the country, so that investors can be attracted in investing in cloud services infrastructure. To speed up this process Government should collaborate with companies (especially Oil and gas companies) in order to increase public-private
sector partnership. Furthermore, they should encourage oil and gas companies to key into the NIMP strategy, by selecting infrastructure projects that aligns with this plan, when embarking on their corporate social responsibility projects.

6.4 Contribution to research
The main contribution of this research is that it has identified the necessary strategies to ensure seamless cloud adoption in the oil and gas sector. These factors which are captured in the corporate strategies (has identified in figure 17) are suitable governance framework, effective communication and stakeholder engagement, suitable service and deployment models and Legal and Service level agreements. These factors are also relevant in changing the low adoption trend that characteristics cloud deployment in the sector. If oil and gas companies implement these strategies, seamless cloud adoption will be achieved, although the challenge that is peculiar with Nigeria needs to be addressed.

Therefore, a major contribution of this research to existing knowledge is the fact that having a clear corporate cloud strategy is a prerequisite to successful cloud deployment, because the strategy helps to ensure that the business derives required value from the technology. Furthermore, this research confirms existing literatures that inter-firm assets sharing, inter-firm knowledge sharing, harnessing complementary resources and implementing a robust governance strategy can help achieve relational rents (gains) in a cloud–sourcing arrangements. However, the findings in this research contradict voluntary governance assumption of relational view because this assumption is not applicable within the oil and gas sector. This is based on the fact that the industry is a highly regulated one; hence external governance (in the form of regulatory controls) cannot be avoided. The need for close regulatory oversight is based on the complexities involved in oil operations, the need to ensure that operational activities complies with HSE best practices and to ensure that opportunism doesn’t arise in the transactions among all stakeholders. Also, this research discovered that cloud adoption in environments (countries) with inadequate infrastructure and minimal advancement in cloud service delivery will translate in offshoring. In view of security and confidentiality concerns associated with offshoring, governance framework and adherence to regulations is mandatory.

Lastly, as shown in this research, cloud computing is disruptive, meaning that it can shrink responsibilities and functions in the oil sector, whereas creating more roles within the service industry. In view of the fact that employee mobility is low within the Oil sector because of the perceived good salary structure, there is a need for IT professionals to expand their scope of competency development in other to be more relevant within other core and non-core operations within the sector.

6.5 Future research areas
As earlier emphasized, technology development is constantly emerging and the need for improvements and innovation cannot be overemphasized. The areas of future research that needs to be delved into is how cloud computing can be used to manage Big Data. Some core functions such as reservoir simulations, asset management, seismic interpretations etc; which involves data gathering from multiple sources, generate Big Data. Suitability of cloud system
for managing this Big Data needs to be researched, so as to come up with innovative ideas that will help oil companies effectively manage these big data using a cloud system. Another aspect of future research interest is security concerns associated with cloud solutions. More research efforts need to be geared towards how third parties can process and manage sensitive data and maintain much needed confidentiality. Despite the security strategies discussed, the need for robust security strategies cannot be exhausted. If more technologies and methods, especially on how organizations can speedily detect faults, threats and attacks can be more researched into, confidence in deploying cloud solutions will experience great improvements. As explained by Schubert and Jeffery (2012), security strategies must be accompanied with relevant policies and it must be done in a way that ensures that these policies are dynamic enough to align with the emerging threats of cloud adoption.
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APPENDIX I: PARTICIPANT INFORMATION SHEET

1. Title of Study

Exploring strategies for outsourcing oil and gas functions in the cloud, and analysing the implications for the Oil & Gas industry

2. Version Number and Date

Version 2.2 12/10/2015

3. Invitation Paragraph

You are being invited to participate in a research study titled “Exploring strategies for outsourcing oil and gas functions in the cloud, and analysing the implications for the Oil & Gas industry”. Before you decide whether to participate, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and feel free to ask us if you would like more information or if there is anything that you do not understand. Please also feel free to discuss this with your supervisor and peers if you wish. I would like to stress that you do not have to accept this invitation and should only agree to take part if you want to.

Thank you for reading this.

4. What is the purpose of the study?

In many sectors, such as the oil and gas, banking and manufacturing, IT units are only assumed to play support roles. The general perception of IT departments and their functions as support service does not imply that they are perceived to be irrelevant, but rather they are seen as strategic non-core which is vital to the achievement of the core function of the organization. But this perception that the unit supports the core business has implications in regards to the level and types of IT investments Chief Information Officers can propose to improve the efficiency of organizational operations within those sectors.

Recent technological developments such as cloud computing have created a paradigm shift in terms of how organizations render technology services in order to achieve their organizational goals. The emergence of this technology is shaping the way traditional IT units are being managed and which is creating a shift from how organizations render technology services in other to achieve their organizational goals.

Cloud computing can be considered as a type of outsourcing because infrastructure, applications and services being hosted in the ‘cloud’ are still domiciled in data centers that are being managed by other companies. Therefore, a decision to adopt cloud computing is an outsourcing decision because the organization would need to
externalize and purchase some IT functions, resources and capabilities as a service
from a cloud service provider. Thus, through cloud computing, organizations are
forced to make outsourcing decisions aimed at achieving cost reduction and
optimization, while enabling those organizations to focus on their primary (core)
activities.

The current practice being used in managing IT units is the ‘traditional’ approach,
which entails in-house management and control of systems and processes required in
IT operations and projects. However, when organizations make a decision to
implement cloud computing, control of IT services would be migrated to the cloud,
shifting management of IT services from in-house to another company entirely. This
transition creates challenges which include loss of control of the IT unit by the
organization, threat to current jobs within IT units, resistance by trade unions,
compliance with relevant local content laws, security concerns and many others.

In order to address the research question the following key areas needs to be
addressed:

I. Examine the current status of ITO in the oil and gas sector and how oil companies
are embracing cloud technologies.

II. Examine IT Governance, Operational and HR strategies required by managers and
other key decision makers to manage the adoption of cloud based systems.

5. Why have I been chosen to take part?

Your knowledge of cloud solutions in Oil and gas functions is very vital for this
research. Therefore, your selection to be part of this research is based on the fact that
your feedback and data gathered from you will be of immense benefit, in addressing
the research topic.

6. Do I have to take part?

Your participation in this research is voluntary and you are free to withdraw your
participation anytime without explanation or incurring any disadvantage. You have a
month to review this information sheet, ask questions or raise objections, in order to
make informed decisions.

7. What will happen if I take part?

a. Research Methods – You will be interviewed (using face to face, audio tape or
phone recordings) and asked questions on the research topic and the data
gathered from you and other participants will be analysed qualitatively.

b. Researcher – Tomi Toluwase is the main researcher and this research is a
requirement for his DBA program. He will be carrying out all the analysis for
this research.
c. Participant responsibilities – The participants main responsibilities entails providing data through interviews.

d. Duration – The Interview is estimated to be for an hour.

8. Expenses and / or payments

None

9. Are there any risks in taking part?

The potential risk involved in this research is relationship risk. The research will be conducted in order to ensure that engagement of participants in data gathering does not alter the existing working and professional interaction dynamics between researcher, co-workers and professional colleagues. To mitigate this risk, be rest assured that you are free to only share experiences and views that you are comfortable about and you are free to withdraw your participation at anytime, while also guaranteeing the confidentiality and anonymity of all views expressed in the conduct of the research.

10. Are there any benefits in taking part?

The benefit involved in this research is that it will further expose and broaden participant’s industry wide knowledge on the influence of cloud solutions on operational functions, which may be useful in future endeavours.

11. What if I am unhappy or if there is a problem?

If you are unhappy, or if there is a problem, please feel free to contact me [Tomi Toluwase and Tel: +2348087183331] and I will try to help. If you remain unhappy or have a complaint which you feel you cannot come to me with, then you should contact the Research Governance Officer at ethics@liv.ac.uk. When contacting the Research Governance Officer, please provide details of the name or description of the study (so that it can be identified), the researcher(s) involved, and the details of the complaint you wish to make.

12. Will my participation be kept confidential?

Confidentiality of your participation is key and would be held in high esteem. All electronic data will be password protected with complex passwords. In general, data files, transcriptions, and audio recordings will not be stored on a personal or work network but only on external hard disks in locked cabinets at my professional workplace (office). For the short periods when the data will need to be stored on my personal computer, for example during analysis and processing, I will ensure that the files are stored on the local hard disks and NOT on shared drives. This will prevent accidental or unwanted external access as my personal computer is password protected.
Electronic handling of magnetic and optical media will be conducted according to strict procedures to protect the privacy of participants. Should the publication of direct quotations from respondents become necessary, I will ensure that the content does not lead to the potential identification of the source and obtain consent from the participants when appropriate. Specific consent for audio recording is included in the consent forms. All processing of personal data will comply with the terms and principles of the Data Protection Act 1998, with the terms and conditions stipulated by the University of Liverpool Data Protection Guidelines. **All interviews will be anonymized during transcription and pseudonyms will be used to prevent the identification of places and people in the study.** No other person outside me and my supervisor will have access to the data.

13. **What will happen to the results of the study?**

The results of this research will be domiciled with the University of Liverpool and it would be kept in line with the university policies. Also, the research outcome would be presented in a manner that will ensure that your participation and input is anonymous.

14. **What will happen if I want to stop taking part?**

Your decision to participate and withdraw from this research is voluntary. You can withdraw your participation at any time without explanation. If you are comfortable, we can use your results up to the point of your withdrawal, but if not happy with this, the results would be destroyed. Please note, research results before anonymisation are the once eligible to be destroyed.

15. **Conflict of interests?**

The research will be conducted in other to avoid any form of conflict of interests. Objectivity in data gathering, analysis and the outcome will be upheld and the research will not be done in other to achieve any self-serving agenda.

16. **Who can I contact if I have further questions?**

**Student Researcher:** Tomi Toluwas
C/o IS department, Addax Petroleum,
Plot 46, Trans Amadi Industrial Layout,
Portharcourt, Nigeria.
Email: tominiyi.toluwas@online.liverpool.ac.uk
Tel: +234 8087183331

**Research Participant Advocate:**
USA number 001-612-312-1210 or email address liverpoolethics@ohecampus.com
Title of Research Project:
Exploring strategies for outsourcing oil and gas functions in the cloud, and analysing the implications for the Oil & Gas industry.

Researcher(s): Tomi Toluwas

1. I confirm that I have read and have understood the information sheet dated [12/10/2015] for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my rights being affected. In addition, should I not wish to answer any particular question or questions, I am free to decline.

3. I understand that, under the Data Protection Act, I can at any time ask for access to the information I provide and I can also request the destruction of that information if I wish.

4. The information you have submitted will be published as a thesis report; please indicate whether you would like to receive a copy.

5. I understand that confidentiality and anonymity will be maintained and it will not be possible to identify me in any publications.
6. I agree the data collected from me to be used in future research and understand that any such use of identifiable data would be reviewed and approved by a research ethics committee.

7. I understand that my responses will be kept strictly confidential. I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research.

8. I understand and agree that once I submit my data it will become anonymised and I will therefore no longer be able to withdraw my data.

9. I understand and agree that my participation will be audio or phone recorded and I am aware of consent to your use of these recordings for the following purpose of gathering data for this research.

10. I agree to take part in the above study.

________________________________________________________________________
Participant (Pseudonym)

________________________________________________________________________
Name of Person taking consent

________________________________________________________________________
Researcher

________________________________________________________________________
Student Researcher:
Tomi Toluwose
IS Department, Addax Petroleum, Plot 46 Trans Amadi, Industrial Layout, Portharcourt, Rivers State, Nigeria. Tel: +234 1 2795531, +2348087183331 Email: tomi.toluwose@addaxpetroleum.com

[Version 2.2 & 12/10/15]
APPENDIX III: RESEARCH INSTRUMENTS

Interview Questions

What is your job description? (Information Technology Specialists, Supervisors/Team Leaders, Managers, CIO)

Which sectors of the oil and gas industry are currently employed (or offering services)?

What is your experience like (Service level management, Relationship Management, Workflow etc.) with cloud based systems?

Section 1 – Organizations that are already adopting cloud computing

1. Is there any cloud computing strategy in the organization?

2. Which cloud computing model do you use?
   
   (a) Public (b) Private (c) Hybrid (d) Community

   Please outline some of the benefits and challenges of your chosen model.

3. What are some of the implications of outsourcing functions to the cloud in regards to local content laws? Can you give some examples

4. What strategy do you use in addressing the security and confidentiality of organizational data stored in the cloud?

5. Are there implications for IT and other departments in the Oil sector if more applications are migrated to the cloud?

6. Do you use any cloud service provider outside the shores of your country? If yes, please specify the country the cloud provider is located. Why was this location chosen? Which factors influenced your decision? (cost optimization, technical and support reasons, innovations etc)

7. What do you think is the major challenge affecting cloud service providers in the country?
8. Which competencies can be developed by IT professionals in order to be relevant despite threats posed by further adoption of cloud computing?

9. What strategy is being used to ensure knowledge sharing between your organization and your service providers?

10. Which Governance framework is being used to manage this process.

Section 2 – Organizations where cloud computing is yet to be adopted

1. What is the level of awareness about the relevance of cloud computing in Oil and Gas Operations? Can you identify some potential drivers for choosing cloud computing? Alternatively, what are some potential challenges?

2. What factor(s) could influence decisions for migrating existing systems to a cloud based system in your organization? Some factors could include:

   a) Cost Optimization
   b) Technical and support reasons
   c) Need to improve system performance
   d) Innovative trend
   e) Focus on core objectives

   Have you given some thought on how these factors can influence existing operations?

3. What are some possible risks associated with outsourcing functions to the cloud?

4. Have you considered the possible benefits currently being derived from cloud based systems as compared to legacy systems in operational activities.

5. What could be some of the implications of outsourcing functions to the cloud in regards to local content laws? Can you give some examples

6. What strategy should be used in addressing security and confidentiality of organizational data stored in the cloud?

7. Are there implications for IT and other departments in the Oil sector if more applications are migrated to the cloud?
8. What do you think is the major challenge affecting cloud service providers in the country?

9. To what extent can cloud systems be further applied in drilling, production and support related functions?

10. Which competencies can be developed by IT professionals in order to be relevant despite threats posed by further adoption of cloud computing?

11. Going forward which cloud computing model do you suggest for the Oil and gas sector?
   (b) Public (b) Private (c) Hybrid (d) Community
   
   Please outline some of the benefits and challenges of each model.

12. Which IT governance framework is being used to manage IT service delivery in your organization?

13. What are the roles of regulators in cloud adoption process?
APPENDIX IV: ACTIONS TAKEN TOWARDS HAVING CLEAR REGULATION

Copy of email sent to government agency on 12th February 2016

Dear Sir,

My name is Tomi Toluwise and I am an Engineer within the Nigerian Oil and Gas sector and also concluding my Doctoral Program at the University of Liverpool. I saw your email contact on website and I want to congratulate you on the just concluded stakeholders’ forum on the promotion of ‘ICT Local Content’.

Sir, my doctoral research is focused on ‘Exploring strategies for outsourcing oil and gas functions in the cloud, and analysing the implications for the Oil & Gas industry’. In the course of my research work I discovered that Nigeria does not have a national cloud adoption policy. This policy is needed to guide cloud investors, corporate organizations, IT professionals, entrepreneurs etc. on government’s policy direction on cloud computing. This is my finding is hindering the adoption of cloud in corporate organizations, due to lack of clarity on the policy direction of government. Also, this policy will help in providing guidelines on data offshoring, localization and engagement of indigenous service providers, cloud competence development for Nigerian IT professionals and many others. Other countries like United States, Switzerland, United Kingdom, and Australia already have this policy in place and we can even use theirs as a leverage.

This policy can be a standalone policy or integrated in any of the existing NITDA regulations (National IT policy, National Information Systems and Network Security Standards & Guidelines and Guidelines on data collection etc.).

Kindly use your good office to influence this change, and I am also available to offer my service to be part of this process, if you deem it necessary.

Yours Sincerely,

Engr. Tomi Toluwise
10, Olive close, New airport Road,
Eliensa, Port Harcourt
Tel: 08087358331
Copy of justification letter sent on 11th July 2016 based on request from a senior official

10 Olive Close, GU Ake Road,
Elizu, Port Harcourt,
Nigeria
11 July 2016

National Information Technology Development Agency,
No 28, Port Harcourt Crescent,
Off Gimbiya Street,
P.M.B 564, Area 11, Garki,
Abuja, Nigeria.

Dear Sir,

Sequel to my earlier mail on the subject of having a clear regulation that governs the adoption of cloud based solutions in Nigeria, I hereby present my justification for this policy.

I humbly request that you use your good office to discuss these suggestions with key stakeholders within your organization.

Thanks as I await your feedback.

Yours Sincerely,

\[Signature\]

Tomi Toluwase
JUSTIFICATION FOR NATIONAL CLOUD GUIDELINE/ POLICY

Background

Technological advancement is rapidly evolving and this has great impact on how individuals and organizations (private, Public, NGOs etc.) function. One of such technology is cloud computing, hence the need for Nigeria to leverage on this technology and explore it for National development. This is in line with the vision of NITDA, and the agency has immense responsibility to providing necessary policy and guidelines that will ensure that the adoption of this technology helps to improve productivity in public and private sectors. Also, it is important to ensure that this policy or guideline is in place to ensure that the impact of this technology in Nigeria which include offshoring of data and services, clarification on localization, manage security and confidentiality implications, competency development for indigenous IT professionals are properly managed. The basis for this is based on the fact that organizations with on-premise datacenters and infrastructure are finding cloud based solutions to be attractive; hence the next few years will witness a huge migration of data and services to the public cloud. Furthermore, based on the fact that most notable cloud providers are based outside the shores of the country, it is need to come up with clear government position, so that organizations can be properly guided in line with government’s expectations.

It is worth emphasizing that some countries had already developed similar policy in their respective countries. Example are:

1. United States – Federal cloud computing strategy
2. United Kingdom- Government Cloud strategy (A sub strategy of the Government ICT strategy)
3. Australia – Australian Government cloud computing policy

In view of this, the time is ripe for Nigeria to develop this policy or update relevant section of existing National IT policy, Guidelines on data protection 3.5 and National information systems and network security.

Aim

In view of the background above, there is need for NITDA to plan towards developing relevant guideline (or update existing ones) that will help govern the adoption of cloud in the country. NITDA need to chair the discussion, engagement and collaborative process with all relevant stakeholders in order to ensure that a robust policy is produced or existing policies updated.

Suggested key areas of focus

1. Cross border data transfer and Security – Section 2.1 of existing Guideline on data protection 3.5 discusses expectations on transfer of personal data, but it is important for the scope for this to include other types of data (financial, regulatory, industry etc). This is important because government and private sector data (because of Government’s stake in some companies) need to be properly covered in the scope of NITDA’s trans-border data transfer. This is important because as organizations continue to embrace cloud based solutions, the next few years will witness transfer of these data outside the country. This is because most cloud providers are outside Nigeria, hence the cross border transfer of data on
the large scale is imminent. Therefore, there is a need for clarity on the policy governing data
migration offshore. Also, the existing National information systems and network security was
developed based on review of some standards as contained in the Section 1.1 - preamble of
the guideline. It is important for this guideline to be updated in line with the fact that
International standards Organization (ISO) has released a guideline that is focussed on cloud
security (ISO 27017:2015). This guideline is built on existing security measures in ISO 27002,
but with clear focus on cloud security.

2. Service Offshoring and Competency development – Cloud adoption will result in lots of IT
services, functions and processes being moved to other countries where cloud providers house
their data centers. This has potential impact on availability of IT jobs in the country. Also, this
will also impact competency development for indigenous professionals. Offshoring is a global
trend, but this policy can help make provision for some form of localization strategies, which will
help to ensure job creation and capacity development for IT professionals in the country.
Example may include:
➢ Ensure that cloud providers mirror government data in the cloud to existing Tier III
certified data centers in the country.
➢ Create conducive incentives for partnership between renowned cloud providers and
indigenous service providers.
➢ Facilitate and encourage skill and competency development programme on this
technology.

3. Awareness – This guideline should contain plans for creating awareness (in partnership with
other stakeholders) among students, professionals, MDAs, academia, private sector etc. More
effort is required in Nigeria to creating awareness about the benefits of this technology for rapid
economic development.

4. Cloud for national development – Cloud based solutions will definitely play a pivotal role in
the National Smart City initiative of Nigeria, hence the need for this guideline to be developed
so that it can help advance the development of the country. It is expected that this policy will
contain initiatives that will help indigenous and foreign participation of cloud service providers in
the country and this will help achieve the vision of the agency.

5. Infrastructure – This policy should also be developed with focus on providing solutions to the
infrastructure challenge. This is majorly responsible for the low participation of indigenous
providers in building cloud infrastructure. For example Nigeria has just two TIER III certified
data centers and this is not sufficient to achieve the needed economy of scale to compete with
their global peers. Therefore, there is a need to spearhead the discussion around incentives
that can help increase investment by indigenous cloud providers.

Conclusion
These recommendations are advisory, but it will be of immense benefit to our country if these
suggestions are considered and included in the short-term programme of your reputable agency. Also,
this recommendation requires further deliberation among experts in IT, A and other stakeholders, so as to ensure that the discussion around this subject is robust and to ensure that more perspectives on this issue are gathered.

**Copy of recent mail stating that the justification for a cloud policy is presently with the Director General of the Government agency**

![Email Image]

Hello Tominiyi,

Your mail was forwarded to the DG the same day your last mail was sent.

Thank you.

Head, Service Unit

**Copy of response to request for sample policies for other countries that can be used as a guide.**

![Email Image]

Dear ...,

As requested, attached are two sample policy that can be used as a guide in developing this cloud policy. This policy should consider factors and situations peculiar with Nigeria.

I am always available to make input into this process.

Regards,

Tomi

3 Attachments

![Attachment Images]
Evidence of presentation made to electrical engineers, where challenges relating to cloud technology adoption in the country were discussed.

CLOUD TECHNOLOGIES AND PROCESS AUTOMATION: BENEFITS AND CHALLENGES.

Technical Presentation at Nigerian Institution of Electrical and Electronics Engineers, NIEEE, Port Harcourt Chapter Meeting.

TOMITOLUWASE

13 July 2016
APPENDIX V: ACTIONS TAKEN AS A SCHOLAR PRACTITIONER WITHIN THE WORK PLACE

Copy of recommendations made within my work environment

Sir,

Thanks for your participation in this research. Below are some of the feedbacks/recommendations which are applicable to your organizational environment. These recommendations are merely advisory which you can apply if you deem necessary.

1. **Corporate Enterprise cloud Strategy**: It is important to develop a corporate cloud strategy policy that will help in guiding and standardizing cloud adoption in the organization. This strategy can be a standalone policy or can be a subset of the existing IT policies in the organizations. The cloud policy should include (but not limited to): (1) Main tenants (2) Cloud model (3) Roles and responsibilities (4) Impact of Globalization on cloud (5) Cloud Integration strategy (6) Governance and standards. Kindly collaborate with corporate IT in order ensure this strategy is developed.

2. **Indigenous providers**: Nigeria has four certified data centers offering IaaS, PaaS, and other services. Out of which, I have Tier III Certification on their design documents and the other with Tier II certification on their design documents (https://vhsites.com/TierCertification/). It is important to emphasize that none of the certifications by these indigenous companies are based on their constructed facilities and operational sustainability. This is largely as a result of the information deficit in the country, hence the need for effective and result service level management effort when engaging indigenous cloud providers.

3. **Regulations and cloud adoption**: In view of the fact that most cloud sourcing offenses in the country are forms of offshoring, data transfer outside the shores of the country will be a common feature of cloud adoption. Nigeria being a member of Organization for Economic Cooperation and Development (OCED) is obliged to align with "Guidelines on the Protection of Privacy and Cross-border Flows of Personal Data". Also, having reviewed National IT policy, National Information System and Network Security Standards & Guidelines and Guidelines on data collection, there is no clear regulatory direction for cloud adoption in Nigeria. Therefore, there are no major constraints for data offshoring, except if any localization or cloud-specific policy emerges in the near future. But there is a need to continue to seek legal interpretation of agreements before cloud sourcing decisions are taken.

Best Regards,

Tosi
Re: Request for participation in postgraduate research

Toni Tolwase

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Nice suggestion, will review.

Thanks,

Toni Tolwase

Sir, As I continue to adopt cloud solutions, I suggest that we adopt ISO/IEC 27017:2016. This standard was released December 2016 and it provides guidelines for information security controls applicable to the provision and use of cloud services. This standard provides additional implementation guidance for relevant controls specified in ISO/IEC 27002 and additional controls for implementation of cloud services.

This will help to further strengthen our governance strategy for cloud computing, especially when it relates to security concerns.

Kindly engage relevant personnel so that this process can be kicked started and an update to current version of IS handbook will be required.

Best Regards,

Toni Tolwase

Student Engineer II
Evidence to show that scope for cloud strategy has been clearly defined

Absolutely and in practical terms as regards decision to migrate to DF365.

We estimate a 42% reduction on MS License cost alone.
We also envisage a 60% cost reduction on infrastructure and support fees once we decommission all on-premise messaging servers.

Regards.

Tomi Toluwaso

Sir, Based on your presentation/briefing on the... 08/07/2018 06:10:05

From: Tomi Toluwaso@PortacountNGAPE
To: 08/07/2018 06:10
Subject: Re: Request for participation in postgraduate research

Sir,

Based on your presentation/briefing on the planned transition to a cloud-based messaging system, can we conclude that the main scope of the strategy governing cloud adoption has been defined to achieve the following: (1) Reduction in global cost of IT, (2) Increase business efficiency and (3) Strengthen IT security?

Regards.

Tomi Toluwaso

Sedem, Freedom
Copy of article jointly authored to create further awareness about cloud technology within the work place.
APPENDIX VI: ACTIONS TAKEN TO IMPROVE CLOUD-SOURCING STRATEGY IN ANOTHER CLOUD PROVIDER FIRM

C/o Plot 46 Trans Amadi industrial Layout, Port Harcourt, River State, Nigeria
1st March 2016

The Executive Director (Operations),
Ordinance road, Trans Amadi,
Port Harcourt, River state

Dear Sir,

RECOMMENDATIONS AND OUTCOMES FROM RESEARCH WITHIN YOUR ORGANIZATION

In view of your authorization [REF: 11/15/APP/001] to gather data for my Doctoral research within your organization, I am pleased to propose some recommendations suitable for the continuous advancement of your organization and which will help enhance your strong presence in technology service provisioning for Oil and Gas operations.

Your organization is a major Technology solution provider in the country, with keen interest in playing major role in Oil and gas service delivery. But due to the current dwindling price of crude, most oil companies are embarking on cost reduction initiatives which will help them survive this challenge. This challenge is an opportunity your organization can leverage on by deploying innovative solutions that can help these companies to achieve their aim of cost effectiveness. In order to achieve this, the following recommendations (relevant to your organization), being outcome of my data analysis and reflections in the course of the research are being proposed for your necessary action.

First and foremost, Cloud computing is at the heart of IoT services (SCADA, Tracking etc.) which your organization renders to clients (as shown in figure 1), hence the relevance of this research.

1. Research findings indicate that the level of adoption of cloud based solution is low in the Nigerian Oil sector and this serves as an opportunity to be leveraged on. One of the causes of this low adoption is the lack of in-depth awareness about the capabilities, benefits and opportunities these technologies offer in driving oil and gas operations. In view of this, you need to develop a business development strategy that show cases the immense benefits (especially cost optimization benefits) of cloud based IoT solutions for your existing and potential clients.
Regulatory clarity – There is currently lack of clarity on regulations governing cloud solutions in Nigeria, hence your organization needs to always seek legal clarification on case by case basis, especially when data offshoring is required.

Security and confidentiality concerns is the major implication of cloud based solutions and this concern will be expressed by most of your potential clients, when trying to introduce innovative cloud based solutions to them. My recommendation in mitigating this risk (apart from product specific security measures) is to always show case evidence of aligning with global best practices in meeting up with high security standards. Certifications like ISO/IEC 27017 cloud security etc. can be pursued by your organization and this can always be show cased in order to build confidence when exploring business opportunities.

Finally, these recommendations are advisory and I am hopeful you will review them with your team and adopt them. I am willing to continue to continue to make observations as to see how these recommendations will yield required expectations of continuous business opportunities for your organization, despite these challenging times in the Oil sector.

Best Regards,

Tomi Toluwase
Mr. Tomi Toluwasie
Plot 46 Ordinance Road
Off Trans Amadi Industrial Layout
Port Harcourt
Rivers State
Nigeria.

RE-RECOMMENDATION AND OUTCOMES FROM RESEARCH WITHIN YOUR ORGANIZATION

This is to acknowledge receipt of your letter dated 1st March 2016 and to provide update on how your feedback is being considered within our system.

We have further enlightened our business development personnel on Strategies they should apply in showcasing the benefit of our IoT (Cloud-Based) solutions and measures we are adopting to address and mitigate assumed risks associated with cloud-based solutions. Based on this, we have been getting positive commitments from potential clients on the value and benefits of our solution. The only challenge is that the state of the oil sector especially in Nigeria is affecting decision making in the sector.

Furthermore, I have directed my team to holistically review our governance process and come up with areas of improvement and also take cognizance of your recommendations.

Yours Sincerely

Executive Director (Operations)
APPENDIX VII: SERVICE LEVEL MANAGEMENT PROCESS (Source: Cloud Standards Customer Council, 2015)

<table>
<thead>
<tr>
<th>Action</th>
<th>Service Level Management processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Periodic measurement of cloud service levels achieved against agreed SLA</td>
</tr>
<tr>
<td></td>
<td>(1) Receive service level reports generated by the cloud provider</td>
</tr>
<tr>
<td></td>
<td>(2) Client should monitor service level and generate their own service level reports</td>
</tr>
<tr>
<td></td>
<td>(3) Compare both client and provider generated service level reports</td>
</tr>
<tr>
<td>2</td>
<td>Periodic assessment of compliance of cloud service</td>
</tr>
<tr>
<td></td>
<td>In a situation when regulatory compliance or adherence to standards is very important, for the customer; then it is important for the customer to implement relevant governance process that constantly monitors the valid proof of compliance of the cloud provider.</td>
</tr>
<tr>
<td>3</td>
<td>Service failure reports</td>
</tr>
<tr>
<td></td>
<td>Reports must be generated for any service failures or incidents which affects, availability of service, security breaches and protection of personal data.</td>
</tr>
<tr>
<td>4</td>
<td>Notification of changes from the cloud service provider</td>
</tr>
<tr>
<td></td>
<td>Four key indicators must be monitored in order to ensure that SLA requirements are being met; and that users (internal or external users) of the cloud service are experiencing the agreed service. These factors are the number of open problems and their impacts, total number of problems not resolved within stipulated timeline, problem trends and their resolutions.</td>
</tr>
<tr>
<td>5</td>
<td>Problem reports</td>
</tr>
<tr>
<td></td>
<td>Reports needs to be produced on current reporting period and this report should address the following. All problems that were reported, how they closed out and duration used for the issue to be resolved.</td>
</tr>
<tr>
<td>6</td>
<td>Request reports</td>
</tr>
<tr>
<td></td>
<td>Reports on (non-problem) requests made by the cloud service customer to the cloud service provider should include (1) All the requests made (2) Number of open requests and (3) Time to action the requests.</td>
</tr>
<tr>
<td>7</td>
<td>User satisfaction reports</td>
</tr>
<tr>
<td></td>
<td>Reports on user satisfaction with the cloud service(s)</td>
</tr>
</tbody>
</table>
Reflective diary 1

7. How will I measure and know that I've succeeded in this?
1 Feb 2016: By 1st week of March 2016, I should have been able to complete analysing all the data gathered, categorise them, follow up on proposed actions.

6. What do I need to do or learn to achieve this?
1 Feb 2016: As I proceed on time off, I will use this opportunity to step back and review the entire research process, continue with analysis and identify areas of intervention to my practice and in the oil sector.

5. What improvement do I want to make or assist?
30 Jan 2016: I need to be more reflective on the data gathered, conceptualization, linking of codes and re-evaluation. I think I need to be out of office, so that I can fully concentrate. Also, I will need to engage some participants again (informally) for further clarification on some views expressed.

4. What can I take from this?
25 Jan 2016: I need to read the entire transcripts again after completion of remaining 3 interviews, so as to make sure that all data are captured. 30 Jan 2016: Themes and patterns are emerging from the coding process. The relevance of cloud in oil and gas operation is obvious, but concerns about security and confidentiality risks are very huge. Although, the industry seems to be more conservative towards technological adoption (I need to reflect more on this). Another theme is the concern about offshoring because of poor infrastructure in Nigeria.

3. What is my honest objective assessment of what happened and the causes?
26 Jan 2016: The interviews have been thought provoking based on the diverse perspectives expressed by participants. The depth of engagement and quality of data gathered so far was largely influenced by the industry experience, competence and judgement of the participants. The coding process is hectic but Atlas ti software has been very useful. 28 Jan 2016: Knowledge from management research module has been very helpful.

8. What are my next steps?
1 March 2016: Schedule another meeting with Dr. Panos to discuss my findings, key areas of discussion and intervention. Talking with him will help me to reflect again, based on his vast experience.

2a. Whose fault (if relevant)? Now move on

2. How did I feel/do I now feel?
24 Jan 2016: I think I am making good progress in my development as a scholar researcher, especially being the first time conducting interviews. But I need to double up effort in order to ensure that pending interviews are completed in record time, so that I can adequately focus on reflective analysis.
Reflective diary 2

Date: __________________

1. What happened/what did I do?
   Based on the need for the formulation of a national policy for cloud, I sent a mail on 12 February 2016 to the director general of a relevant agency. A reminder mail was also sent on 15th February and followed up with a phone call to the agencies head office. (22 February 2016)

2. How did I feel/did I now feel?
   I felt excited that I am initiating action as I continue to develop as a scholar practitioner. But the delay in getting feedback is demoralizing. (20 February 2016)

2a. Whose fault (if relevant)? Now move on

3. What is my honest objective assessment of what happened and the causes?
   I think the recent restructuring of government agencies and their leadership is the root cause. But despite, minimal feedback should have been provided. (20 February 2016)

4. What can I take from this?
   I need to continue to devise alternate approach to ensure this policy is drafted. I will need to explore my network within my professional affiliations to engage stakeholders on this. Also, I need to provide feedback on the need to seek legal/regulatory clarity for each cloud project, pending the time a national policy is formulated. (20 February 2016)

5. What improvement do I want to make or assist?
   I need to attend professional meetings more often in order to network and collaborate in driving necessary regulatory changes.

Driving changes like this require lots of political efforts and stakeholder collaboration. (22 February 2016)

6. What do I need to do or learn to achieve this?
   I need to write more articles and make presentations in National technological and Oil and gas events in order to create awareness and stimulate regulatory action. (22 February 2016)

7. How will I measure and know that I’ve succeeded in this?
   When a national cloud policy or guideline is formulated in Nigeria (22 February 2016)

8. What are my next steps?
   Communicate the need for regulatory clarity to Executive Director Operations.
   Attend NIEE meetings and make presentations. I will be using this opportunity to create more awareness about cloud adoption and also using it as a platform to rallying stakeholders to influencing the drafting of this national cloud regulation. (1 March 2016)
Reflective diary 3

7. How will I measure and know that I've succeeded in this?
When a clear framework for managing cloud security (e.g. ISO 27017) has been implemented in order to ensure that cloud adoption process aligns with global best practice (22 February 2016).

6. What do I need to do or learn to achieve this?
I need to ensure that my work place and service providers show evidence of their security readiness and compliance with best practice prior to cloud adoption. I will also have to communicate to a stakeholder in the workplace on the need for review of existing governance framework. Also, the ED of the service firm engaged should drive the need to also provide this evidence when engaging clients in his organization (20 February 2016).

5. What improvement do I want to make or assist?
I need to ensure that clear plan is in place to address security concerns when adopting cloud solution within work environment and which can be applied in other organizations (20 February 2016).

4. What can I take from this?
Practical steps need to be taken to convince decision makers on technical, policy and strategies that have been taken to guarantee security. Before they can be comfortable with public cloud (18 February 2016).

8. What are my next steps?
Continue to follow up with identified stakeholder and ED operations in order to ensure that the ongoing governance framework review process is concluded in record time. (22 February 2016)

2a. Whose fault (if relevant)? Now move on.

1. What happened/what did I do?
Majority of participants interviewed so far expressed security and confidentiality as a major challenge which tends to slow adoption of cloud in the tel sector. This fact was also gathered in the course of my literature review and based on my observation in my professional practice (30th December 2015).

2. How did I feel/do I now feel?
The concern on security is genuine and decision makers need to see practical steps in tackling it before they can adopt cloud or they may prefer to have a private cloud. But I need to wait until other interviews are conducted and further observations made before I can conclude on this view (7th January 2016).

3. What is my honest objective assessment of what happened and the causes?
With my conclusion of all interviews, I have been able to deduce that, the security concern is based on the assumption that IT departments will no longer have total control of their data, infrastructure etc; hence their fear that their data may be compromised. Most especially when these companies have government stake and trade secrets to protect (18 February 2016).
Reflective diary 4

7. How will I measure and know that I've succeeded in this?
20 May 2016: My success in this research will not be measured solely by being able to complete the DBA successfully, but by seeing how the recommendations in this research (in few years) help oil companies to be more effective, efficient and profitable through the adoption of cloud based solutions.

8. What are my next steps?
28 May 2016: I will continue to practice as a scholar practitioner even after completing this DBA program by following up on ongoing actions and recommendations made.

2a. Whose fault (if relevant)? Now move on

6. What do I need to do or learn to achieve this?
4 May 2016: I started a comprehensive review of the research work.
11 May 2016: The feedback received was documented in my thesis as additional evidence of my impact in practice.

1. What happened/what did I do?
3 May 2016: Review of the entire data analysis, findings and discussion process with Dr. Panos created the need for further review of the research and impact on practice.
29 April 2016: I received feedback from Dr. David and the need for more review was evident.

2. How did I feel/do I now feel?
29 April 2016: Though, I have made immense progress in my scholarly practice, I feel the need to be more thorough in show casing interventions to practice and contribution to knowledge.

5. What improvement do I want to make or assist?
3 May 2016: I need to ensure a thorough review of the entire research process so that I can ensure that the research is thorough.
10 May 2016: I need to continue to follow up with relevant stakeholders within my workplace, oil industry and professional network to ensure that my proposed actions are implemented and also reflect on their impact.

4. What can I take from this?
3 May 2016: Feedback is an important process in my development as a scholar practitioner. This helps in ensuring double loop thinking and challenging my assumptions.
10 May 2016: I received additional feedback on progress made in implementing the research recommendations and the impact to practice in the organization.

3. What is my honest objective assessment of what happened and the causes?
3 May 2016: The feedback from both supervisors were genuine and it shows that I need to reflect further on my thesis structure, documenting actions and impact on my practice in the Oil and gas sector. Although, some areas of reservations were also discussed and turned out.
APPENDIX IX: DEFINITION OF KEYWORDS

I. Cloud computing – This is a technology which allows on demand access to computing resources (infrastructure, Applications, Softwares etc.) over the internet or a private network.

II. Outsourcing – Outsourcing is process whereby specific function (s) within an organization is delegated to another firm.

III. Cloud actors – These are individuals or organizations that are involved in a cloud computing transaction. These actors include the client (customer), cloud provider, cloud broker, cloud auditor and cloud carrier.
APPENDIX X – ACRONYMS

CIO - Chief Information Officer
CAQDAS – Computer Aided Qualitative Data analysis Software
E & P - Exploration and production
HSE – Health safety and Environment
IaaS - Infrastructure as a service
IOC - International Oil companies
ISO - International Standards Organization
IT - Information Technology
ITIL - Information Technology Infrastructure Library
ITO - Information Technology Outsourcing
NIEEE – Nigerian Institution of Electrical and Electronics Engineers
NIMP – National Integrated Infrastructure Master Plan
NOC- Network Operation Center
NUPENG - Nigerian Union of Petroleum and natural gas workers
OEM - Original Equipment Manufacturers
OLA - Operational Level Agreement
OPEX - Operating Expenditure
PaaS - Platform as a service
PENGASSAN - Petroleum and Natural Gas Senior staff association
SaaS - Software as a service
SLA - Service Level Agreement
SLM - Service Level Management
STATEMENT OF ACADEMIC INTEGRITY

School: Management
Full Name: Tominiyi Oluwaleke Toluwase
Student ID: 200610743
Date: 1st February 2017

Title: Exploring strategies for outsourcing oil and gas functions in the cloud, and analysing the implications for the Oil & Gas industry.

I confirm that the attached thesis is my own work that I have not presented anyone else’s work as my own and that full and appropriate acknowledgement has been given where reference has been made to the work of others.

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Print Name: Tominiyi Oluwaleke Toluwase
Date: 1 February 2017