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A hybrid model for the implementation of cloud-based Enterprise Resource Planning System for Nigerian Small and Medium-Scale Enterprises

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Abstract

Our society is being reshaped recently by fast advancement in Information Technology (IT), and Cloud Computing is one of such advancement in technology that brought about these changes, due to its attractive remote services rendered. It is basically service rendered for storing, managing and processing of an organizational data with the aid of a remote network of servers instead of an organizational hosted server. An SMEs face numerous challenges in identification, setting up and making use of IT as an enabler for business. With the introduction of ERP in cloud computing this could solve this problem by offering low cost of entry IT solutions. As a result, there has been a growing trend recently in SMEs considering implementing Cloud-based ERP solutions as a strategic alternative for their IT needs. Recently, there is a significant change in business process implication at an affordable cost. There is an absent of a suitable architecture, model and framework suitable for Nigerian SMEs intended to implement Cloud based ERP system. This study proposes a hybrid model for cloud-based ERP suitable for Nigerian SMEs, by combining NIST architecture and SAP model. The proposed model can be used as part of Cloud-based ERP implementation strategy for SME businesses, enabling business managers/owner to have a better understanding of their implementation process.

Keywords: Cloud-based ERP, Enterprise Resource Planning, Nigerian SMEs, Small and medium-scale enterprises.

Introduction

Information Technology (IT) has become an integral part of today modern business, this is achieved by how IT supports changes in business enterprises through the provision of modern business avenue, information sharing, storage, retrieval and reporting among others. Most business enterprises nationwide seek to integrate its IT infrastructure to enhance their development, efficiency and business goals. Small and Medium-scale Enterprises (SME) be it small with relatively low capital based are not left behind, in integrating IT infrastructural as their

core business activities [8], [10], [18]. To increase their business opportunity, production capabilities and new business initiatives, SME needs to implement a new innovative technology that brings about efficiencies to their business function model [9], [15] Globalization and new international regulation as well as partnership has been a catalyst for SME considering implementing ERP application solution in their business. With the saturation of ERP applications in large and manufacturing industries, the new emerging technology cloud-based ERP application vendors have change focus to offer affordable ERP solution as a service to SME [8], [10]. The emerging new technology that is relatively cheap and affordable like cloud-based ERP (CERP) solution is relatively more effective in SME than large and midsize businesses. CERP system services have equipped SME business to overcome the requirement needed for higher financial budget, trained IT personnel and other related problems and challenges faced. In view of finding a solution to most Nigerian SMEs and related countries SMEs problem listed, a cloud-based ERP system hybrid model is proposed. The proposed hybrid model will eliminate the need for higher startup capital, technical knowhow, environmental issue, security etc. The proposed hybrid model will enable Nigerian and related countries SME in implementing cloud-based ERP solution as their core business.

Overview of Nigerian SME

In Nigeria, the parameters such as total asset base (excluding land and building), the number of employees and the annual enterprise turnover are used to classified Nigeria SME. SME are considered to be the backbone of every economic growth and development in all countries worldwide. They play a significant role in economic growth and development. According to general statistics by SMEDAN (Small and Medium Enterprises Development Agency of Nigeria) in [13], [1] SME constitute about 83.2% of the companies operated within Nigeria. SMEs also contribute to the national development by positively influencing the general distribution of total income earn in both the functional and nominal terms. SMEs are known to be labor intensive, capital saving and capable of helping the country by creating most of the one billion jobs needed by the end of the century. [9], [17]. SME are also perceived as the major area to Nigerian economic growth & development, employment generation and poverty alleviation among others. Their unimpressive performance in generation of employment, economic growth and development in recent years has generated a lot of research interests in the field [14], [18]. SME are the significant parts that links, enhanced and strengthen the growth and development of many countries in the world. SMEs performance and growth in Agriculture, Manufacturing, Services, etc., has been considered as the drivers of economic growth and development. The sustainable growth and development in SME performance has created a competitiveness that opens numerous doors for employment opportunity and job creation [14], [15].

Overview of cloud computing

Cloud computing is an evolving computing paradigm that enables outsourcing of all organizational IT needs such as data storage, computation and application software's, through large Internet. The shift towards this service-oriented computing paradigm is driven primarily by ease of administration and management process evolving from software upgrade and fixing bugs [9], [7]. It is the service delivery nature of cloud computing that makes it such a disruptive force in every field of IT industry. The cloud computing capabilities are rented on-demand bases

and no hardware or software assets need to purchase outright by the organization. [12] opined that cloud computing is revolutionizing the way and manner in which software is built and delivered over the networks. The paradigm that shifts away the legacy model where infrastructures are bought and control, software's are built or buy to a new IT world, where organization consume everything as a service.

The concept of Cloud-based Enterprise Resource Planning

Starting in the late 80s and the beginning of 90s new application software system emerge in business enterprises known as ERP systems, this system has surfaced in the business organization mainly targeting complex large business organizations. These complex, powerful, expensive and proprietary systems are usually off the shelf solutions requiring vendors to tailor and implement it based on business organization requirements [6], [16]. ERP is a business organization system that integrates and streamline it data process across the business organization into one complete system that support the various needs of the entire enterprise system. Cloud-based ERP system also known as CERP (Cloud-based ERP) system, is basically an ERP system hosted in another location i.e. the server that is placed somewhere and accessed remotely by the client or customers. The CERP system is been accessed through a dedicated line (Internet) as such it requires only the software package that is tailored made and a good internet connection [8], [9], [6]. Cloud-based ERP has recently been an important milestone and become an agent of fast-growing technology in the field of enterprise development. These cloud-based software solutions introduced into ERP system, unlike the old traditional in-house-designed and off-line ERP system for company specific designed systems: targeting large complex organization [14], [3]. The shift towards cloud-based ERP solution brings about many fundamental changes to the ERP software industries. It eliminates the cost of hosting and managing on-premises IT infrastructure, eliminate software piracy issues and reduced the cost of acquiring and implementing ERP system as such enhanced organizational performance [9], [15].

Overview of cloud computing architecture

Cloud computing architecture becomes an active research interest area recently. As we also know the cloud architecture can ensure a crucial role in the design and development of cloud software application system. A good cloud architecture ensures certified key system requirements in different topics such as system reliability, performance, interoperability and scalability. In spite of this, the scalability, on-demand, and rapid provisioning nature of cloud computing architecture poses serious obstacles to any architectural design. So, the major architectural design task is to design and develop an effective secured architecture to support an effective, secured cloud environment. As of now there is a little or no contribution made to the systematic literature review for mapping the cloud computing system software architecture and its environments [5]. Cloud computing reference architecture aids in the design and development of cloud application software which must be scalable, automatic, ubiquitous and on-demand services. Various cloud computing reference architectures for cloud design and development have been defined by NIST, IBM and Oracle respectively [4]. However, these architectures mostly provide high level of abstraction, cloud components and definition. Also, some of the architectures provide some level of implementation details using their proprietary solutions. They mostly focus on the requirements for cloud as a complete system, but each service delivery model has its own architectural requirements that need to take into consideration in order to have a precise cloud reference architecture. [2], [5] and [12] emphasize that the

NIST cloud computing reference architecture is the most widely used and accepted cloud reference architecture. It's a high-level architecture that is not specific to any cloud computing vendor, that helps in discussing the design and development requirements, operations and structures.

The Proposed model

The proposed cloud-based ERP system for SME combines the NIST cloud computing architecture and software architecture platform (SAP) model, to propose a novel framework for SME intends to implement cloud-based ERP solution in Nigeria. The implementation of cloud-based ERP solution in Nigeria is relatively low despite its advantages. Therefore, the propose integrated model will be a solution to finding a suitable hybrid model for SME in Nigeria.

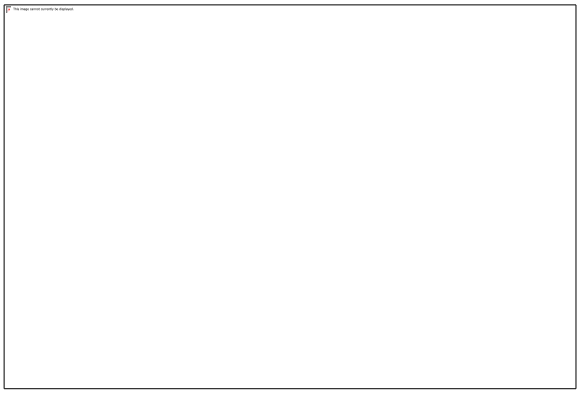

Figure 1: *Cloud-based ERP hybrid model for SME.*

The proposed cloud-based ERP hybrid model for SME was based on the hybrid model proposed by NIST cloud architecture and [11] SAP model. These models have been adapted to respond to need of Nigerian SME intent to implement cloud-based ERP solution in their core business activities. It contains an overview of the system architectural design in NIST cloud architecture, cloud service management, security and privacy in [12] and ERP modules of software architectural platform model and the database structure of [11] as shows in Figure 1.

The Propose model development approach

In order to explain and understand the CERP Hybrid model development approach effectively, reference will be made to the same concept of how a standard business enterprise with an ERP system works as compared to a cloud-based ERP hybrid model approach. A standard business enterprise ERP system is generally housed on an enterprise`s own network/server and maintained by one of its IT personnel, or an outside contractual consultant that manage and control the daily system activities. The system requires regular updates and investments in the system hardware that needed to run them. This process can be either on-premises and/or hosted, where a business enterprise purchased a license software for its selected services and deploys to its daily transactions. As such, an enterprise will absorb the cost of services and maintenance of IT infrastructures. On the other hand, the CERP hybrid model approach; does not buy, manage or host any software package on its own server but rather housed on a server owned by another person and accessed via an internet connection. With this new approach enterprise

does not need to buy any IT infrastructure and systems update are usually done automatically by the CERP system service provider.

The Propose model overview

The CERP hybrid model should consist of two main components, which are the user interface and the cloud service application user interface. The user interface mainly focusses on the user i.e. SME intent to use cloud service offered by the cloud consumer either directly or through cloud broker/agent. While the cloud service application user interface comprises of the Four managers and the cloud application interface. These managers are: The Request Manager (RM) that manage cloud request, The Composition Manager (CM) that composed user request, The Service Charging Manager/Mode (SCM) that deals with how and when the cloud service are charge and The SLA Manager (SM) that deals with conformity and maintenance of agreement made between the cloud consumer and provider. These five components should be able to provide a comprehensive guide to SMEs intent to implement cloud-based ERP services.

Contribution of the proposed CERP hybrid model

The enhanced components in the proposed CERP hybrid model are directly linked to developing a hybrid model suitable for Nigerian SME intent to implement cloud-based ERP system in Nigeria. These contributed components include the following

1. The cloud consumer: - The cloud consumer components enable SME to have direct access to various cloud provider services available to him, or through cloud service broker and choose the best services that meets its requirement. With this component its enables SME to choose cheapest as well secured services that meet its requirements.
2. The cloud Broker/Agent: As cloud computing evolves, the integration of cloud services can be too complex for SME to manage. An SME may request cloud services from a cloud broker, instead of contacting a cloud provider directly. A cloud broker is an entity that manages the use, performance and delivery of cloud services and negotiates relationships between cloud providers and cloud consumers.
3. Cloud service management: - These components provide cloud consumer/SME with the choice of appropriate service available for selection, provided by cloud service provider and ensure compliance to service rendered. These services selection includes the following;

a. The Request Manager: as the name implies is a person or a cloud computing management entity responsible for defining, managing and ensuring compliance to an SME request fulfilment process and providing central coordination roles for the management of SME service request. RM is responsible defining, documenting, implementing, maintaining and accountability of both new and old SME services request. RM responsible for maintain customers request both direct (i.e. initiated by customer) and indirect (using broker) request.

b. The Composition Manager: the CM provides a uniform cloud computing environment for sharing cloud computing media-rich applications for SME. CM provides a light weighted composited off-screen windowing system environment to enables an SME have a centralize window creation and destruction activities, thus removing applications overhead cost. These enable CM easy composition of customer`s request from RM.

c. The Service Charging Mode (SCM): SCM it's a cloud computing component responsible for managing cloud computing service charge. The cloud computing services charge are usually pay-per-use basis. The addition of this component in the hybrid model enable SME select an appropriate services available to the SME and the corresponding charge apply to it. SCM components provides SME with an appropriate cost of every service available.

d. The SLA manager: - it's a cloud computing management component of the hybrid model that is responsible for establishing agreement (SLA) between an SME and service provider. The agreement process will culminate a contractual agreement spells out the obligations and requirements of both the SME and service provider. These ensures the establishment of contractual agreement that allows the SME to retain control of data and information available in cloud.

4. Composite App: - The idea of this CERP component comes from the SAP cloud architecture. These components is a software application program that provide cloud consumer/SME with the choice of appropriate ERP module/service available for selection, provided by cloud service provider and ensure compliance to service rendered. These services selection includes the following;

a. The CRM: also known as Customer Relationship Management Modules, as the name implies is a module that manage all customer activities.

b. The SCM: also known as Supplier Chain Management Modules, as the name implies is a module that manage all supplier's activities.

c. The HR: also known as Human Resource Management Modules, as the name implies is a module that handle personnel management.

d. The Finance: as the name implies is a module that handle the financial transactions.

e. The Industrial Solution: - as the name implies is a module that provide an organization, a solution to most of its problem faced.

Conclusion

The study contributed to the research literature in developing a framework/model for cloud-based ERP system for Nigerian SMEs. Researchers in the same or similar trends can carry out extensive research with more finding. This can encourage SMEs to reduced their overall operating cost through the implementation of cloud-based ERP system solution to operate their business from anywhere and wherever there are remotely. This enhanced global interaction with the same or similar business partners across the globe. Furthermore, the study concludes that the proposed hybrid model will fit into Nigerian SMEs by providing cloud services suitable and affordable. The implementations of cloud-based ERP solution in Nigerian SMEs will not only enhance their business at a cheaper and affordable rate but are able to better serve their customers in a reduced operating cost that will increase profit margin. With cloud-based ERP system implemented, SMEs are able to focus on their core business activities without worrying about the business upgrade that will make you obsolete.

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