A Novel Framework for Cloud Enterprise Resource Planning for Business Breakthroughs

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Abstract

There has been a growing need to assist Business Corporations, especially Small and Medium Scale Enterprises (SMEs) enjoy the huge benefits offered by the internet technology, cloud computing, and that of Enterprise Resource Planning (ERP). System Analysts, over the years, have sought ways of creating ERP systems that can guarantee efficient data exchange and web integration especially for sustainable growth of Small and Medium Scale Enterprises (SMEs). Undeniable benefits of such cloud-based systems are enormous, including drastic reduction in operational cost, as well as increased customer satisfaction. In this research paper, we have designed an architectural framework for a new cloud-based Enterprise Resource Planning System using the Linked Servers technology, which ensures seamless flow of information and efficient data integration between heterogeneous vendor servers within and outside the organization, and ability of a central server to address diverse data sources similarly. Being on the cloud, the system will be managed off-site by a third party provider, with its obvious business advantages. Using the system development life cycle approach, a model design was carried out that illustrates the architectural frameworks of the new system and the basic layout of application deployment, including the synchronization mechanism for data exchange. Our model answers the question of various IT-scholars and researchers who observed the need to revisit most of our existing ERP frameworks and suggested cloud ERP which will have the ability to issue distributed queries, updates, commands, and transactions on heterogeneous data sources across the enterprise.

Keywords: Internet-cloud, ERP, Vendor servers, SMEs, Data synchronization.

1 INTRODUCTION

1.1 Enterprise Resource Planning

Enterprise Resource Planning (ERP) seeks to integrate a corporation's core business processes in a single software solution. The goal is usually to enable free flow of information throughout the organization. Ordinarily, such systems focus more on internal processes, though in some cases, may include transactions with customers, busniss partners, and vendor companies.

Normally, a large business organization will have dissimilar information systems or software applications built around different functional areas, organizational levels, and business processes, which ordinarily cannot easily exchange information, especially at the point where such information is needed for quick decision making. Most times also, each of the different software application will require a fragmentation of data in hundreds of separate databases, and this can equally degrade efficiency and business performance. A good example is the

problem of a Sales Personnel who may not be able to tell (at the time a customer places an order) whether or not the ordered items exist in the inventory store. Also, the Manufacturing unit may find it difficult to carry out their duty of planning for new production due to their inability to easily access sales information at the time they need it.

A good Enterprise Resource Planning system can solve this problem of integration and seamless data exchange across various levels of the organization, and across various functional areas of the business corporation. Such a system will receive data from various key business processes in Production and Manufacturing, Finance and Accounting, Sales and Marketing, Human Resources, and so on, into a central data repository. From the central data repository, information that was previously fragmented in different systems can be shared across all parts of the firm. Undoubtedly, an efficient coordination of these parts will lower a business's operational cost, while increasing customer satisfaction.

A seemingly simple process such fulfilling a customer order as mentioned above, will require an involvement of several functional areas of the business and a free flow of data across the firm, between business partners, and vendors, as well as customers.

There are existing ERP software solutions which are mainly products of such Software Vendors like SAP, Oracle, and Microsoft. Some of these software include: SAP's Business Suite, Oracle's e-Business Suite, Microsoft's Dynamic Suite, and so on. Most of these software solutions however, target very large multinational business corporations. Over the years, not much attention has been given to Small and Medium scale Enterprises (SMEs) to find ways of helping them enjoy the huge benefits of ERP.

In a bid to solve the data exchange and web application integration problem using Enterprise Resource Planning software, software vendors have always made use of Web Services and a collection of web services popularly known as Service-Oriented Architecture (SOA) to integrate various software systems into one. Service-Oriented Architecture is a set of self-contained services that communicate with each other to create a working software application. On the other hand, a web service is a collection of open protocols and standards used for data exchange between applications or systems. Furthermore, these web services are self-contained, modular applications that can be described, published, located and invoked over a network, generally the World Wide Web [1].

Although the use of web services can provide a near flexible solution to the problem of application integration [9], the service architecture is confronted with a number of stubborn problems including the issue of data security [7], and the challenge of synchrony of web services [11]. With the use of WSDL and UDDI in web services, an attacker can access any publicly available WSDL file and tamper with it. Such attacks can be in the form of WSDL Scanning or WSDL tampering. The former scans the WSDL file and exposes some operational and even confidential information. According to [1], protection against these threats is not easy with typical methods like authentication and authorization.

There is need to design efficacious ERP solution that can enable business owners to streamline and automate tedious back office tasks. Apart from streamlining and automating back office tasks, managers can equally get real-time visibility into the inner workings of their operations and motivate employees to be more productive, focused, and successful towards performing their roles. A focus on cloud-based ERP will encourage small and medium scale enterprises to take advantage of cloud computing which delivers

computing services such as servers, storage, database, networking, software, as well as analytical and business intelligence to corporate business owners at a very low cost. With the internet cloud, a small scale company will not have to purchase the software, hardware, servers and facilities necessary to run her ERP and there will be no need to train and maintain an IT team that is responsible for the software. All that is needed are computers that can access the internet. Since the cloud host/vendor offers the maintenance of infrastructure, there will be reduced operational cost for such SMEs.

In this research paper, we seek to design an architectural framework for a new cloud-based Enterprise Resource Planning System using the Linked Servers technology, which will ensure free flow of information and efficient data integration between heterogeneous vendor servers.

1.2 Objectives of Study

In this research paper, the Linked Servers technology will be used in the design of new architectural framework for Cloud-based Enterprise Resource Planning that guarantees efficient data exchange and web integration for Small and Medium Enterprises. The following are specific objectives of this study:

i. Ascertain major weaknesses of existing ERP systems in meeting current needs of SMEs.

ii. Propose a Cloud-based ERP model using the Linked Severs technique.

iii. Create an ERP framework that ensures distributed queries, updates, and transactions on dissimilar data sources across the enterprise.

iv. Make recommendations for effective implementation of the model to ensure competitive advantage.

2 REVIEW OF RELATED LITERATURE

2.1. ERP Definition

v. According to [15], an Enterprise Resource Planning (ERP) a business process management software that enables an organization to use a system of integrated applications in managing her business. Normally, such a system will make use of tools and applications that cover all areas of the business and enables potential communication from various sources.

vi. The software will also seeks to automate many back-office functions related to technology, services and human resources. With ERP Software, all essential business functions such as estimation, finance, human resources, production, marketing, sales, purchasing, and others can be collected at a central source. From here, data can be easily accessed by the concerned persons and departments. Enterprise resource planning system can also streamline the assemblage, storage and usage of an organization's data in a most unified way. ERP system efficiently intermingles all components of business procedures and methods, which consist of development, product planning, manufacturing, sales and marketing, and others, in a single database, application and user interface. Such Enterprise Resource Planning system is reckoned to be a type of enterprise application that is created to be used by large-scale businesses and it oftentimes requires devoted teams to analyze and customize the data to handle deployment and upgrades of the software [15].

2.2. Why ERP is Indispensable for Growth of Small and Medium Scale Enterprises (SMEs)

Before now, an all-in-one solution software was not in existence which could help organizations in managing their business process, but as

technology grows, Software Developers has seen the need to introduce the ERP technology. ERP solution can be a wonderful management tool when it comes to maintaining and managing businesses in a most efficient way, and this ideology can only get better with time. A well-designed Enterprise Resource Planning, such as the one being proposed in this research project, can perfectly bring key business processes together and allow small and medium scale enterprises as well as large business organizations make data-driven decisions, improve collaboration, and strengthen business productivity. As a matter of fact, ERP can be made to covers all functional areas of a company, which include the following: finance, human resources, customer relationship management, manufacturing, and supply chain.

2.2.1. Finance

Modern Enterprise Resource Planning systems offer dashboards that give users an overview of their current financial status, and with this they can tap into real-time business data anytime, anywhere. For small businesses, ERP can assist managers track income and expenses and record transactions and account structures. It can also create financial documents like profit and loss statements and balance sheets.

2.2.2. Human Resources (HR)

Some modern ERP software can enable SMEs to manage company data and help in streamlining employee management tasks such as hiring, payroll, and other duties. Small businesses can take advantage of ERP to automate payroll processing, track employee attendance to work, and manage employee records like performance reviews, payroll benefits, and scheduling. Self-service functionalities can equally allow employees to request time off or view their attendance record. One good thing about an ERP is that it can help managers to save time, energy, and the risk-factor because they could track each

employee's performance and pinpoint HR problems before they start to happen.

2.2.3. Customer Relationship Management

A good ERP can help SMEs manage customer contact information, order histories, invoices, and quotes.

2.2.4. Manufacturing

A well designed Enterprise Resource Planning solution can optimize project and cost management as well as production planning. This feature can improve factors that play prominent part in automating daily processes and business communication. It can offer manufacturers the ability to manage resources by accessing real-time data and fulfil customer needs by providing fast and reliable services.

2.2.5. Supply chain

ERP is a good manager of the Supply Chain. It can help manage the flow of goods and services from raw material acquisition to delivery of the finished product to the customer. Most SMEs today are still in the habit of entering information by hand while striving to track down the inventory present in her warehouse. In the case of such SMEs, implementing an ERP is quite indispensable. With such a smart solution, business owners can save money and time by automating all its major business processes. Modern solutions also offer dashboards and business intelligence to help these SMEs handle most of their inventory management problems.

3   METHODOLOGY   AND REQUIREMENT ANALYSIS

3.1. Methodology Adopted

In this research, the system development methodology was adopted in conjunction with

waterfall model of the software development life cycle. Basically, the methodology comprises of Preliminary phase, and System development phase. Preliminary phase is made up of a Survey to gather via the structured questionnaire which will aid the user requirement analysis phase. Development phase, on the other hand, involves System definition, requirement analysis, system

design, coding, system testing, Evaluation and maintenance.

The figure 1 illustrates the system development methodology adopted for this research work, while the figure 2 shows the waterfall model used.
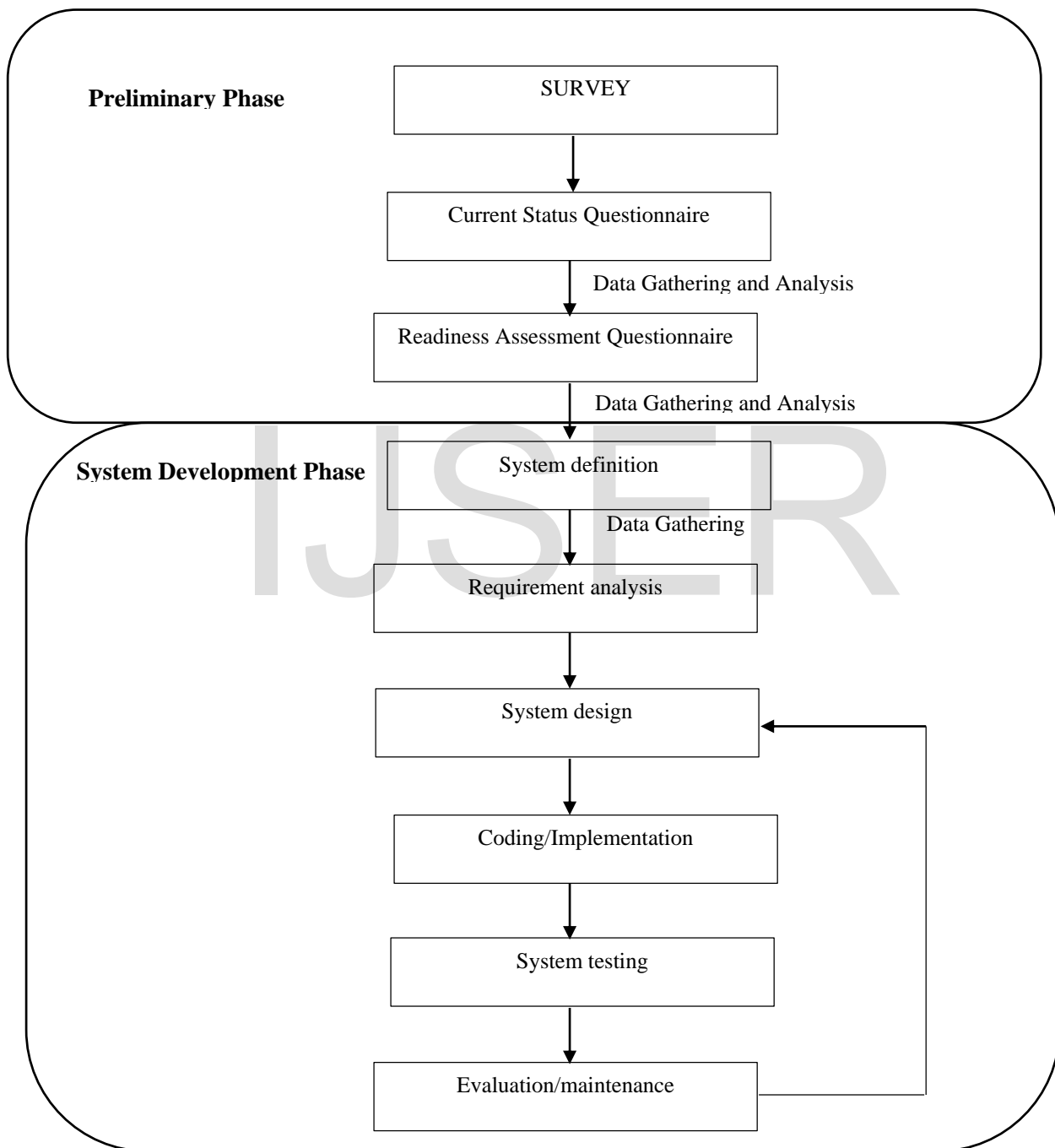

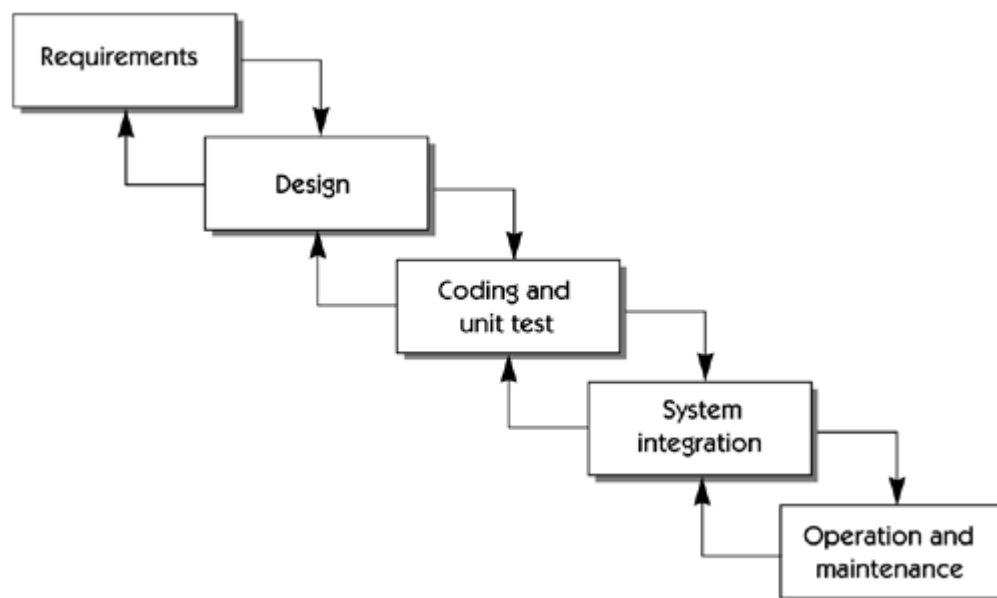Figure 1: System Development Methodology adopted

Figure 2. The waterfall model for software system development

3.2 Data Gathering and Requirement Analysis

The questionnaire method was used to gather data for our proposed system design. The purpose of the data gathering, however, is to generate user requirement for system analysis and design phase.

About 300 copies of questionnaire were administered to Business owners, as well as management staff of selected Small and Medium size Enterprises in Nigeria. Some of these SMEs include Hotels, grocery stores, large retail companies, garages, etc., that serve a hyper local target audience, and operate with less than a certain level of workforce and assets. Our goal was to ensure accurate and honest information gathering and user requirements and expectations.

In order to gather relevant data, structured questions were posed to elicit information in the following areas:

i. Need for accessibility of common company data: Most SMEs in developing countries are accustomed to spreadsheet accounting and some manual business processes using outdated data sources. Therefore, the following questions were posed:
- Do you need a system that compiles and stores company common data as well as make it readily accessible to you?
- Do you wish to gain real business insight for informed decision making?
- Would you like to view, manage, and track core business processes and resources in real-time using a single data source?

ii. Integration of core business functions: The following questions were posed:
- Do you need a system of shared database to support and connect multiple business activities?
- Do you wish to integrate business functionality for accounting, inventory management, order processing, human resources etc.?
- Do you require integration and collaboration across departments?
- Do you require improved inventory management?
- Do you think your company requires standardized business processes?

iii. Cloud-based ERP system: Business owners and top managers were asked the following question: Whom will you select as your preferred software partner or vendor, or do you prefer a cloud-based system?

      - Do you wish to leverage on global markets?

iii. ERP components and basic features: The following questions were posed:

      - Which processes of your business do you wish to incorporate into an ERP system?

      - What features do you think you will need your ERP to have as a start?

vii. Legacy systems: In order to gather user requirements in the area of legacy systems and applications, the following questions were asked:

      - Do you wish to replace your legacy systems?

      - Do you wish to reposition your company for sustainable growth and development?

      - Do you require improved customer service and operational efficiency?

viii. Operational cost and business scalability: The following question was asked in the area of operational cost and business scalability:

      - Do you want to experience reduced cost of business operations?

      - Do you require an ERP system that scales up as your business grows?

      - What are your projected performance enhancements based on your expectations and user preferences?

Ninety five percent (95%) of all questions were answered in the affirmative, showing the need for cloud based enterprise resource planning systems for sustainable growth and development of small and medium scale enterprises in third world countries.

All information and user requirements were gathered from business entrepreneurs, top management cadre of country SMEs, directors, section mangers, and supervisors, and from the information gathered during this stage, we were able to establish the following:

a. An acceptable framework for Cloud-based ERP is required for growth and development small and medium sized enterprises.

b. Existing ERP systems and businesses have major weaknesses in meeting the needs of SMEs.

c. There is need to ensure data synchronization between heterogeneous vendor database servers in order to ensure efficient information exchange.

d. There is need to design ERP framework that ensures distributed queries, updates, and transactions on dissimilar data sources across the enterprise.

e. There is need for effective implementation of cloud-based ERP models to ensure competitive advantage.

4. MODEL FORMULATION AND DISCUSSIONs

4.1. Our Proposed Cloud-based ERP Framework for SMEs

The figure 3 shows the cloud-based Enterprise Resource Planning model being proposed in his study. The model describes the architectural framework that defines layout of application deployment between vendor servers and the central server. It comprises of computers, interfaces, platforms and emerging technologies that will provide technical functionality for the new system. It also illustrates the synchronization mechanism for data exchange between vendor servers comprising of heterogeneous data sources.
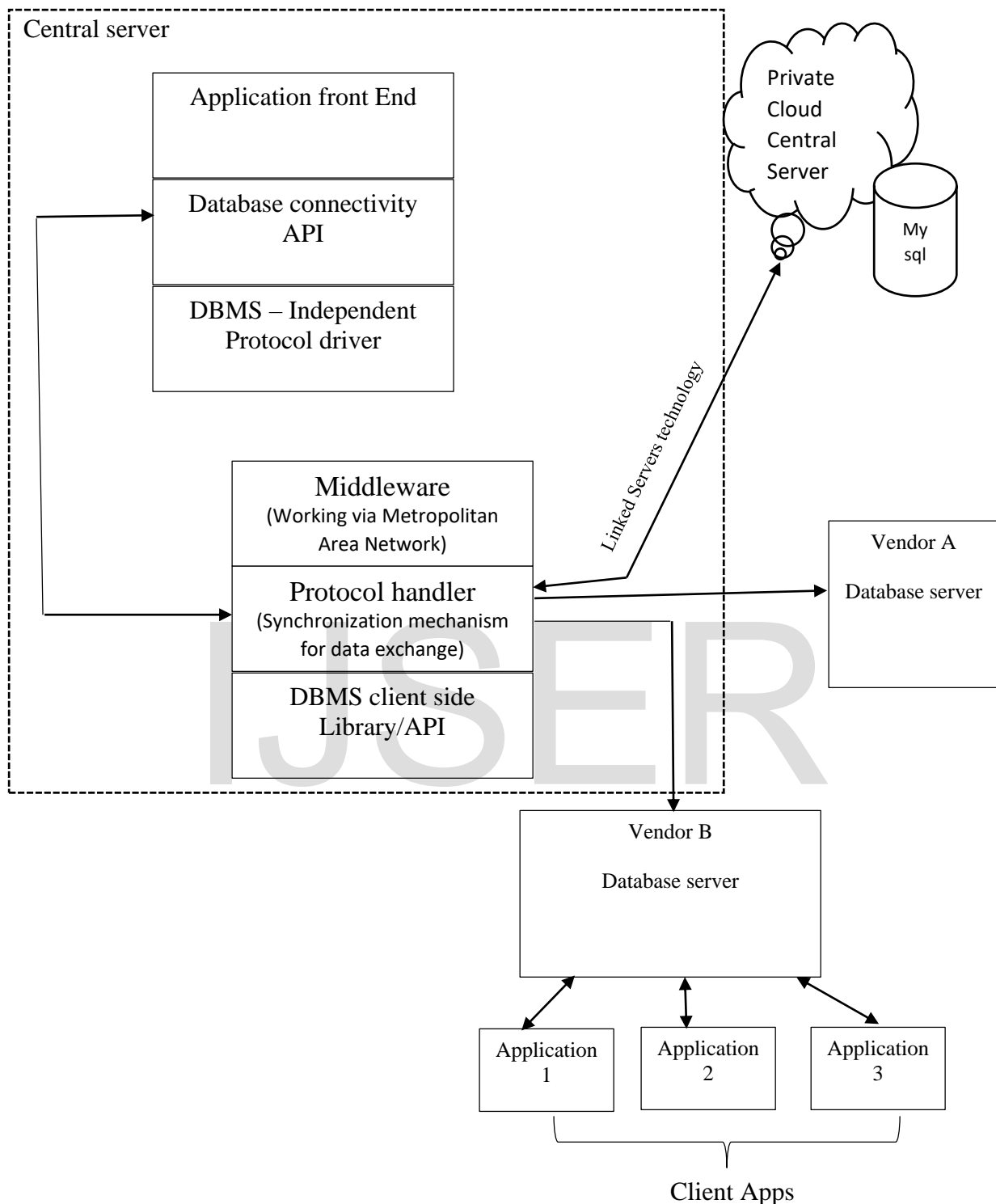
Figure 3. Architecture of the Proposed Cloud based ERP System for SMEs.

4.2. Linked Servers Technology Architecture

The figure 4 shows the Linked Servers Technology Architecture being proposed in this study.
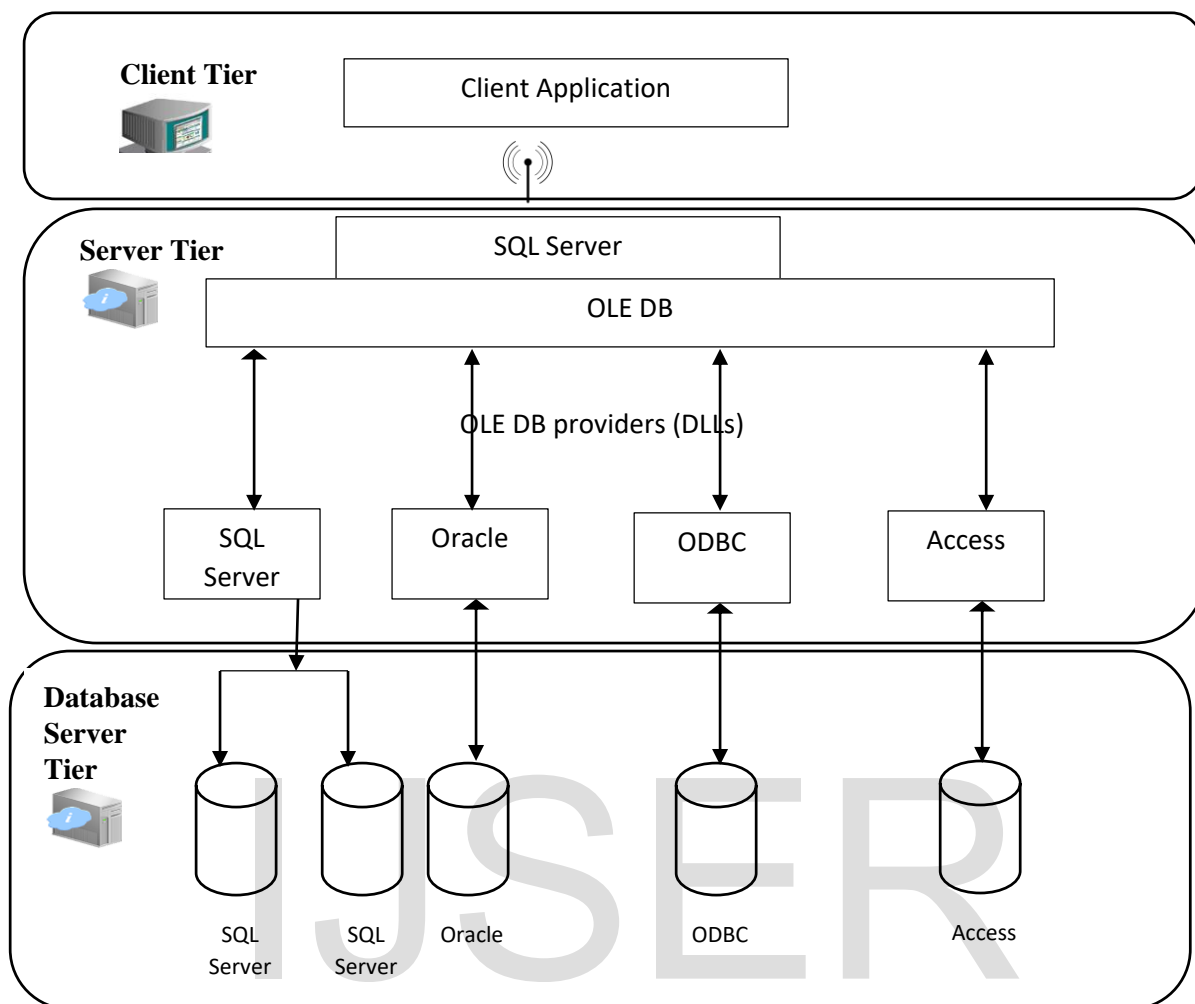
Figure 4: The Proposed Linked Servers Configuration Architecture

The figure 4 above illustrates the linked server architecture being proposed in this study. According to [5], Linked Servers technology makes it possible for an SQL Server to relate with another ODBC compliant database, such as another SQL Server instance or an Oracle database, with a direct T-SQL query. It can enable one to execute distributed queries against tables stored in a Microsoft SQL Server instance and another data store.

Research has shown that it is possible to use the Microsoft SQL Server Management Studio to link a data store to an SQL Server instance and then execute distributed queries against both data stores.

In creating Linked servers using the SQL Server Management Studio, the following steps can be followed: From the Object Explorer pane, expand the "Server Objects" section, then, right click on "Linked Servers" and choose "New Linked Server" from the menu.

SQL Server can be linked to any server so long as it has OLE-DB provider from Microsoft to allow a link. Example, Oracle has an OLE-DB provider for oracle that Microsoft provides which can facilitate its addition as a linked server to any SQL Server group.

4.3. Data Synchronization Mechanism

The figure 5 illustrates the data synchronization framework being projected in this research work,

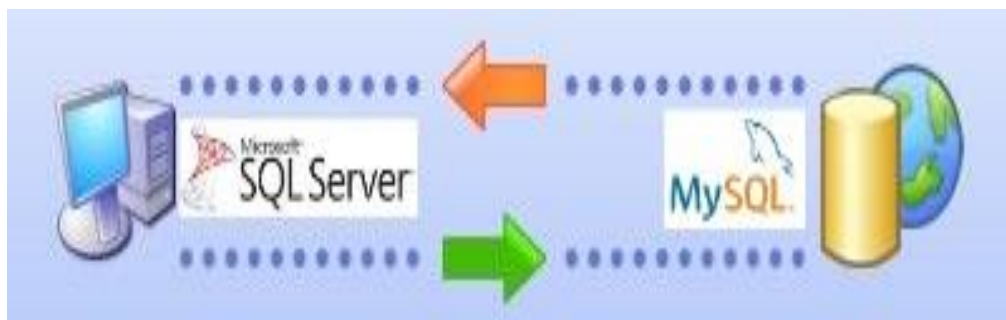which ensures seamless data exchange between vendor servers and the central server.

Figure 5. Data synchronization mechanism for the proposed system

4.4. Discussions and Recommended Implementation Strategy

In this section, we discuss some of the development tools being proposed in this study for strategic implementation of our new design to guarantee and to guarantee efficient and secure data synchronization among vendor databases from remote locations. The under-listed development and programming tool are recommended for development and implementation of the following sections of the new system:

Database Synchronization and Exchange: Linked Servers Technology is recommended as synchronization mechanism to ensure database connectivity and data exchange between vendor servers and the central server.

User Management Module: The ASP.NET is recommended for the creation of user management session for administering the central server.

Central server database: My-SQL server technology should be adopted for design of the central server database.

Vendor server A: My-SQL, an open source database management system, can be used to develop the relational database for data storage for the various web applications belonging to

various vendor servers. An example is the Inventory management subsystem.

Vendor server B: MS-SQL can be used to develop the relational database for data storage for other web applications within and outside the enterprise. Examples include the Accounting management subsystem, Human Resources, Supply chain management, and so on.

Data Migration from various platforms to the remote server: My-SQL workbench, an open source development tool would be used to export databases from other platforms to the My-SQL-based remote server. Another is the My-SQL connector for ODBE, which is a connector tool used to create an interface between the central MY-SQL server and all other database platforms that are compatible with open database connectivity technology.

Web Application: Visual Studio 2015 is recommended for implementation of suitable web applications. Some of the tools include: C# and VB.NET for the front end and application logic development, and Ado.NET for relational database connectivity.

Web Hosting: The IIS and the APACHE can be adopted as good web servers for hosting our web applications built with the .NET technology.

5   CONCLUSION   AND RECOMMENDATIONS

5.1. Conclusion

In this research paper, we have designed models of architectural framework for our proposed cloud-based Enterprise Resource Planning System for efficient data exchange and web application integration using the Linked Servers technology. The focus of our study has been on Small and Medium Scale Enterprises (SMEs) to take advantage of Enterprise Resource Planning and the internet cloud. With such an integrated system on the cloud, there will be very little operational cost on the part of the SMEs because most of the institutional and IT infrastructure will be directly managed off-site by a third party provider.

Small and medium scale enterprises will benefit from cloud computing which delivers such computing services as servers, storage, database, networking, software applications, and analytical and business intelligence to corporate business owners at a very low cost.

A skillful implementation of our new design can integrate key business processes of a firm into a single software solution, which enables seamless flow of information throughout the organization and beyond. It can solve the problem of integration and seamless data exchange across heterogeneous data sources at various levels of organization, and across all functional areas of a business corporation such as Production and Manufacturing, Finance and Accounting, Sales and Marketing, Inventory and Human Resources, and so on. From the central data repository, information can be shared among various stakeholders as the need arises.

Our study was carried out using the system development methodology in conjunction with waterfall model of the software development life cycle. The questionnaire method was used to gather all user requirements from selected SMEs in Nigeria to aid our design. A thorough Requirement Analysis was carried out to ensure good design of system architecture.

5.2. Recommendations

We recommend skillful implementation of the findings of this research work and creation of enabling environment by appropriate government authorities. The system is a new attempt to ensure rapid growth and sustainability of our Small and Medium sized Enterprises by harnessing the benefits of ERP and the internet cloud. There is need for a concerted effort by all stake holders, government agencies, corporate organizations, and business owners to take advantage of the business opportunities offered by the emerging internet and Information Technology.

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