CHAPTER THREE: MATERIAL AND METHODS
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3.0 Chapter Introduction

According to [14] an appropriate research method remains significant in whichever type of research study. The part defines research processes, methodology, objectives, design, approaches as well as sampling data required in the study, including data associated with both primary and secondary. Moreover, the study uses many methodologies whereby a simple prototype model is used in developing a proposed security model of cloud computing. The instrument, method of analyzing data used in research are simple percentage, tallies, charts and hypothesis in order to report and document the findings of the research study.

3.1 Methodology

Methodology consists of the whole phases of a particular study that remain significant towards particular research conducted efficiently [14]. This study uses descriptive, statistical methods while analyzing the data collected. This part contains numerous tasks which study overall problems, hypotheses, how the hypotheses are interpreted, data collection as well as procedures concerning designing and carrying out essential researches that guide scholar on what, why and how to collect and evaluate data, as well as procedures for drafting results towards driving conclusion in research.

3.2 Research Methods

The method of research used in this study comprises of qualitative technique that involve the use of electronic mail questionnaires (email), published questionnaire over follow ups, cellular phone, skype, whatsapp and one on one interview interactions. Organizations and user were selected based on their respective experience with cloud computing, security and privacy aspect in cloud, cloud service, deployment as well as technologies so as to comply with the main aim of the research study in finding a solution to the security issues associated to cloud computing. For the first part of the survey questionnaires were mailed to cloud users. The questionnaires were well-thought-out to enable respondents to agree whether to be communicated, whenever required for whichever additional information. Cellular phone/skype/whatsapp and one on one interview
interactions conducted with many cloud users as well. The interview interactions are semi-structured towards allowing the interviewee respondents free communication of their views.

Carefulness is followed in data investigation, while appropriate semi-structured interviews and questions are planned to ascertain additional hypothetical issues and to assist in getting free mistakes, doubt in various answers to survey questions and interview. Respondents are given assurance by the researcher on confidentiality of all that they contributed in the research study.

3.3 Research Approach

As stated earlier, a research study to be conducted in a research field of information technology and computing may be best done using qualitative approach. Due to the nature of the study that reports the current issues were researcher’s observation, critical study of relevant study, precise interview and usage of records are needed to answer lot of the research study questions. These make it easier for the study to adopt deductive/inductive and qualitative/quantitative methodologies accordingly. Therefore, the scholar uses some of the methods stated, so as to completely achieve study objectives by providing appropriate recommendations for conclusion and numerous methods of tackling cloud security problem and threats issues.

3.4 Research Objectives

The primary objectives of this research study is to offer an overview and analysis of cloud computing security issues, with regards to SPI service models, deployment models and the technologies and recommend solutions to security problems and other challenges of cloud computing by proposing a cloud security based model with little or no security risks.

The above mentioned objectives of the study were accomplished through collection of primary, secondary data, with regards to security issues, in SPI services, deployment models and technologies in cloud computing. An all-inclusive review of related literature, survey, and interview conducted to many categories of expert and users of cloud technology to ascertain the research objectives. Recommendation of the study was established on the conclusions in data analysis. The outcomes of the study resolve to help and maintain additional usage or adoption of the cloud technology in various aspects of data storage and management with regards to
probability in prospect of organization performance and achieving competitive advantage contrary to opponents who does not adopt the cloud technology.

3.5 Research Design

Research design considered being approaches, procedures as well as methods used while conducting a particular study, descriptive concepts are produced, examine in a descriptive approach. Descriptive approach which is at times discusses as explorative study are used in this study for exploring supplementary ideas and deliberate wholly on the need to categorize numerous techniques; cloud computing security issues will be drastically reduced and eradicated in order to develop organizations performance with recommendations of potential different approaches and model development at the end of research study findings.

3.6 Research Process

Even though, there exist dissimilar procedures in conducting research, all the procedures involve in a series of accomplishments that produce research processes with great reliance organized. The events in research procedure do not constantly monitor the same instruction. Consequently, the study followed certain procedures in order to effectively provide a worthy study. The process in research comprises of: describing the problem as described in introduction part, development the research design and sampling through evaluation, collecting and assembling the necessary data for the study (surveys and interviews), handling and examining the data collected from both primary, secondary sources of data collection procedures, then finally articulating inferences and discovery primarily to concluding the study. Nevertheless, the assumptions of study ordinarily produce innovative concepts for prospective study. Thus, making the entire processes in research repeated naturally, the below figure elaborate more on this.
3.7 Classification and Method of Data Collection

A good study is deliberated to be original, trustworthy, significant, realistic and well-articulated with sufficient data. The data has to be composed by means of bases which are typically categorized by way of primary/secondary confidentially. This study uses both data but emphasis are mainly on the data gathered primarily. Since, this support scholar in achieving effective, dependable and appropriate decisions which can be used in simplifying the discoveries of the study with regards to security issues in SPI service models, deployment models, the technologies and cloud computing in general.

3.8 Primary Data

The method adopted by the scholar to gather data is survey methods. Questions are designed and distributed to many respondents selected from various users and expert of cloud technology. About 200 questionnaires were distributed but 178 responses were received. Unfortunately, some were return as invalid, not filled correctly and some filled in error.

Therefore, 100 Questionnaires that are filled correctly where randomly chosen, used in the research processes to ascertain and as well find solution to the research questions and accomplished research objective.

3.8.1 Survey Questionnaires

Questionnaires: this method is frequently appeared to be reasonable and simple alternative method of collecting data and information from respondents. Questionnaires are usually disseminated in paper format or by electronic mails. It is considered not to be lengthy and comprehensive, since, been lengthy may results in abandoning questions or not to be completely responded; in order to acquire the required information desirable, the technique is reflected by the scholar as reasonable and inexpensive. Survey questions are commonly practice in leading several studies, for the reason that it didn’t involve much expenditure, it can be electronically or paper based as discussed.

3.8.2 Interview

Interview: this method allows face to face conversation and interaction with human subjects. Different methods of interviews exist. The open ended interview is accomplished in a conversational method. The investigators ask plaintiffs for particular information of the study area and also for plaintiffs’ view about certain events. While focused interview is used in confirming certain realities that previously been recognized specifically in small period, different from survey the enquiries are specifically planned. The interview may be in a method of one on one discussion or cellular phone interviews as the case may be.

3.9 Secondary Data

The secondary types of data adopted in this study were decisively the library resources like: journals, internet, text books, magazines, conferences and student papers were attended to gain more knowledge from experience scholars in cloud computing and security aspect. For that reason, the material had contributed immensely in widening possibility in the research study and the scholar’s capability in reflecting wholly on the research study area. The newspapers, published journals, seminar and conference papers are carefully studies where vigorous and significant articles on information system technology, information security extracted. Papers of diverse area used, including of statistical data, were thoroughly studied in order to collect the relevant data required for the study.
3.10 Sampling Techniques

Sampling technique create accessible range of methods that support and simplify the amount of data required to collect by taking into deliberation only data required comparatively then entirely possible cases \(^{[15],[16]}\). At the time of conducting research, it is normally impossible, difficult and even too expensive to gather data from all probable element of investigation involved in the study problem. Therefore, a lesser quantity of elements, are normally chosen to relate with the substantial elements of the whole populace. For the reason that, the samples are not entirely descriptive of the populace from which samples are extracted, researchers are not assured that conclusion’s determination shorten the whole population. The target audience of this particular study is primarily cloud end users and expert with regards to cloud computing and general computing security.

3.10.1 Reliability of the Sample

The reliability of sample is estimated frequently that determines the trustworthiness, dependability in particular study, this is disturbed with inquiry of whether the outcome of a research is repeated. The aspect that influence or disturb the trustworthiness of study is the respondent’s lack of understanding information. Therefore, it is suggested that respondent at that instant when tired, worried, or has arrogances to the survey question/interview may influence negatively on the trustworthiness of the study.

Researches that are conducted precisely with similar survey then with dissimilar randomly chosen sample of respondents may not be capable to acquire related outcome. This is generally resolute in sample size. The bigger the sample size the more trustworthy the outcome will be, however this can be categorized into many characteristic of sample reliability, that comprises of variance, confidence level and precision.

3.10.2 Sampling Techniques

The method used in the study is to create room in assuring that whole measure of the population is acknowledged in the sample. The samples are extracted from various users of cloud computing to know their opinion on security and what they think might solve the security problem or even eliminate it in totality.
3.11 Designing Survey Questions: Measurement Scales

In designing survey questions for the research discoveries; measurement are commonly practiced. Numerical information that involves of numbers are also used, the concept of measurement scale has an exact significance quality that are of interest to scholars. The primary benefit of measurement scales is that; it contains numbers that may basically be used openly as codes which can be considered with enormous numerical instruments in survey. It also focuses on circumstances which primarily diverse types of evaluations are tried. In the survey questions, three (3) measurement scales are put in place, these comprise of ordinal, interval and nominal scales. Testing the hypothesis, analysis of correlation between variables as a technique of statistical assessment used to study how strong the correlation between two statistically values are measured, as well as the remaining variables (for instance, the relationship between security in cloud service providers perspective and cloud users perspective), and other statistical techniques to analyze the data.

3.12 Methods of Data Analysis

3.12.1 Questionnaire Result Analysis

The Questionnaire Result Analysis will be used as a measure to analyzed the results of questionnaire survey collected, result of questionnaire and surveys will be analyzed using any available statistical software and will be briefly discussed so as to enable the researcher to fully explain and argue in the discussions part to enable the researcher response to research questions as well as ascertaining whether the research arguments or hypothesis are true or false before making a conclusion.

3.12.2 Hypotheses

All the hypotheses in the study are derivative after the contextual information on the effectiveness in cloud computing, acknowledged in the review of literature, the survey questionnaires and the interviews. The subsequent hypotheses require to be expressed.

1. The use of cloud computing technology in organization as a method of attaining competitive advantages by investing little capital (Low Investment Cost).
2. The use of cloud computing technology in organization improve performance of business
which results to operational excellence, by increasing/decreasing hardware based on usage (Elasticity).

3. The use of cloud computing technology in organization helps in quick decision making (Worldwide Access).

3.12.2.1 Hypothesis 1

It is strongly understood that uniqueness in effectiveness of cloud computing technology is low investment cost

The Null Hypothesis and Alternative Hypothesis:

H10: The use of cloud computing technology in organization is not best method that guarantees low investment.

H11: The use cloud computing technology in organization is best method that guarantees low investment.

3.12.2.2 Hypothesis 2

Cloud computing technology improves business effectiveness and processes for advanced profit attainment. Cloud elasticity is significant tool used by CEO in achieving advanced levels of productivity and competence in processes of business.

The Null Hypothesis and Alternative Hypothesis:

H20: The use of cloud computing technology didn’t improve business performance that results to operational excellence.

H21: The use of cloud computing technology improves business performance that results to operational excellence.

3.12.2.3 Hypothesis 3

As discussed in review of literature that cloud computing technology improves decision making, many of the company managers manage in an information circumstances, never having the precise information at the accurate time in making an up-to-date valuation and decision which upsurge costs resulting in misplacing priority customers. However cloud computing adoption
made it attainable for the managers to use actual time, data and information while making assessment and decisions where ever they are in the world (worldwide access of information to make decisions quickly).

The Null Hypothesis and Alternative Hypothesis:

H₃₀: The use of cloud computing technology didn’t improve making decision

H₃₁: The use of cloud computing technology improve making decision

3.12.2.4 Hypothesis 4 Correlation Analysis

Correlation analysis will be established on the basis of data collected in the survey questionnaire number 11 and number 12 in the survey form, in order to define the correlation among two variables X,Y.

X = Q11. (Does CSP provide Maximum Security) uses Yes and No options in the Survey form

Y = Q12. (The need for improved security in Cloud Computing) uses Yes and No options in the Survey form

3.13 Prototype Model

A part from the methodology and methods describe above, a Prototype Model will also be used after the analysis of the findings as a research design in order to develop a security model that will help in reducing the level of security risks related with cloud computing. In the prototype a single iteration of the prototyping model will be used in demonstrating functional capabilities of developed system/model. The prototype model allows for modification and amendment of a system and finally dumping the whole system and developing a newer one that fits the research study findings. This will also be represented using an UML Use Case Diagram to illustrate the functions in the model. According [⁴¹] prototyping model involves of four stage processes model. These model stages include the following: creating objectives of prototype, describe prototype functionalities, developing and evaluating prototype which is considered as main significant processes.
The prototype model implements a throw-away prototype methodology. This is as the determination of the prototype is to establish and test the well-designed abilities to stand for the problematic area identified. Furthermore, prototype was used to study the powers and fault of the well-designed abilities of the prototype model developed.

### 3.13.1 Need for Prototyping in the Research

- Enables the researcher to discover the problem with the interested party.
- As a requirements objective to initially visualize the system.
- As a design objective that allows researcher to discover the solution of the system.
- A process of communicating the possible User Interface (UI) design(s) of the system.
- A prospective basis from which to continue developing the system or model

### 3.13.2 Prototype Functionalities

The system/model is expected to be developed using and agent authentication technique or model that will provide user with strict authentication credentials from the AuthServer and the above mentioned objectives functionalities as follows:

- Generate security credentials for data storage
- Store/upload data in the cloud based model
- Retrieve/download the data stored
3.13.3 Prototype Development

A study by [41] acknowledged three (3) methodologies that can be used for user interface in prototyping; visual programming language, internet-based prototyping and script-driven prototyping. The script-driven prototyping was implemented in creating visual basics for users to interrelate with system towards performing its operations or functionalities.

Therefore the tools and language to be use in developing prototype in the study are:

Table 5: Prototype Development Requirement

<table>
<thead>
<tr>
<th>S/N</th>
<th>TOOLS/LANGUAGES</th>
<th>PURPOSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Wordpress PHP</td>
<td>Was used to design the web pages using its features such as; creating page links, forms, menus, insert images, connecting to MySQL database, etc.</td>
</tr>
<tr>
<td>B</td>
<td>Adobe Fireworks</td>
<td>Was used to design website banners, logo and background layouts.</td>
</tr>
<tr>
<td>C</td>
<td>CSS</td>
<td>Cascading Style Sheets (CSS): is a style piece language that was used to define the look and planning of our web pages inscribed in a markup language (HTML).</td>
</tr>
<tr>
<td>D</td>
<td>Ajax</td>
<td>Asynchronous JavaScript and XML (Ajax): was used in order to permit web pages to be efficient asynchronously by substituting insignificant amounts of data with the server. This means that we can update part of our web page without reloading the whole page.</td>
</tr>
<tr>
<td>E</td>
<td>PHP</td>
<td>PHP is a server-side scripting language considered in web developments, and was designed to perform all calculations, and also interact with MySQL database.</td>
</tr>
<tr>
<td>F</td>
<td>MySQL</td>
<td>MySQL: is among the world’s greatest current open source interactive database management system that was used in creating relational database and managed all the records in the database. Also MySQL is an open-source, very flexible and easy to use; it has a strong data protection.</td>
</tr>
</tbody>
</table>
3.13.4 UML: Use Case, Sequence and Class Diagrams

Unified Modeling Language abbreviated as UML it is the ability for illustrating use case diagrams [62]. Use case diagrams are mostly used throughout the analysis stage of a particular research study in order to categorize system functionalities. Therefore, the researcher uses the use case in separating the system interested in actors and use case. The actors signify characters played by users of a system. Moreover, the use case diagram is the simple technique to represent user's relationship with the system that shows the association between the user and the different use cases in which the user is involved.

Figure 36: Use Case Diagram for Prototype

![Use Case Diagram for Prototype](image)

**Source:** Adopted in survey 2018
3.14 Observation

The observation made by this study involved various stakeholders and their various roles performed in the processes of data storage. It was imperative in succeeding to know the problems that the users mostly go through in the process of data storage in cloud based models or framework.

3.15 Documentation Review

Studying documentation involved studying the organizations’ documented procedures for their operations. It involved studying the documents that have to be filled in, their contents and the approval that is required to make a data storage and accessibility easier.