CHAPTER FOUR:
RESULTS
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RESULTS

4.0 Chapter Introduction

In this chapter, details of results, evaluation, hypothesis and the data analysis were discussed using descriptive form analysis from various primary and secondary data collected. The results chapter are subdivided into three parts; the Data Analysis, Research Findings (Questionnaire), Numerical Results of the Hypotheses, Correlation Analysis and Interview Interpretation.

4.1 Data Analysis and Research Findings (Survey Questions)

The survey conducted with the aid of questionnaire instrument been disseminated for discoveries to several respondents with knowledge of cloud computing, data are composed to allow the scholar come up with realistic analysis and answers to the study questions. The problems are typically concerning the privacy and security issues with regards to adoption, services, deployment and technologies of cloud computing. The investigation of the study outcomes had been analyzed by means of a simple descriptive analysis from question 1 to question 18. The data gathered are systematized in a raw data sheet to provide significant information on a specific event in the study. The statistical results of number one and two in the survey form specifies the percentage of respondents who are familiar with cloud computing as well as those respondents who make use of the technology in one way or the other. As shown in the figure below. Figure 37: Cloud Computing Familiarity and Usage (Q1 and Q2)

Source: Primary Survey, 2018
4.1.1 Usefulness of Cloud Computing

There is always a reason behind any move or migration from a state of ignorance about a given technology to the full adoption. Cloud computing is not an exception users and organization having a tendency to move or migrate to cloud computing because of its effectiveness. The most frequent among the usefulness or the effectiveness are Remove economic/expertise barriers, Avoiding Capital Expenditure (Low Investment Cost), Elasticity and scalability in Information Technology properties, Aggregating computing capability and business presentation, Broadening Information Technology system, Local as well as universal optimization in Information Technology organization, Business Continuity and Disaster recovery capabilities (Easy Recovery of Data), Access to services and Data 24/7 globally, Adding idleness to intensify availability and flexibility, Monitoring minimal profit and minimal costs and many other as shown in the figure below from the answered questionnaire form.

Figure 38: Usefulness of Cloud Computing (Q3)

Q3. Usefulness of Cloud Computing

Source: Primary Survey, 2018
4.1.2 Deployment Models

Question 4 of the survey questionnaire talked about various types of cloud computing in which users can have one of access to cloud computing technology through any of the models.

Figure 39: Cloud Deployment Models (Q4)

Source: Primary Survey, 2018

4.1.3 Services Model of Cloud Computing

Question 5 of the Questionnaire Survey talked about the various services adopted by users who implement cloud computing technology. These services include SaaS, PaaS, IaaS which are most commonly used. The result from the questionnaire survey filled by respondents shows that 39% of the respondents preferred or uses SaaS, 29% of the respondents preferred or uses PaaS, 23% preferred or uses IaaS and only about 9% uses other models. All these models allowed user to run application of their own choices based on the Service Level Agreement (SLA) and various responsibilities attached to the usage of the models. As shown in the figure below:
4.1.4 Main Concerns in Approach to Cloud Computing

Just like any other innovative technology in the area of Information and Communication Technology (ICT). A lot of issues or concern prevented users from fully approaching or implementing this technology based on the responses Privacy/Security are the major concerns with 29%, services/data availability 13%, transformation of business enterprises 4%, Denial of Services 9%, loss of services/data control 15%, providers lack of responsibility of in circumstance of incident 5%, irregularity between intercontinental laws and regulations 8%, difficulty while migration to cloud 6%, Intra-cloud (Vendor Lock-in Migration) 8%, and Others 3%. So, these and many other issues and concerns resulted in technically low adoption of the cloud technology.

Source: Primary Survey, 2018
4.1.5 Cloud Computing as a Method of Attaining Competitive Advantage by Investing Little Capital (Low Investment Cost)

Result as shown in the figure 42 shows 35% of the respondents who agreed Cloud Computing as a method in attaining competitive advantage through investing little capital (Low Investment Cost) and 27% strongly agreed. The result similarly shows 31% respondents are Neutral, strongly disagree 1% whereas disagree has 5% only.
4.1.6 Effectiveness of Cloud Computing in context of Data Storage and Management

Effectiveness of cloud computing in perspective of Data Storage and Management is one of the research questions, after discussing the effectiveness in data storage and management in the Literature section. Most respondents are also of the opinion that cloud computing is very effective in the context of Data Storage and Management based on the responses given from the Questionnaire survey form as Question 8, were 83% of the respondents said Yes only 17% are contrary to the research questions. Therefore, with this result from the survey the Research Question is answered.

Source: Primary Survey, 2018
Figure 43: Effectiveness of Cloud Computing in Context of Big Data Storage Management (Q8)

Q8. Is Cloud Computing Effective in the context of Big Data Storage and Management

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series2</td>
<td>83%</td>
<td>17%</td>
</tr>
<tr>
<td>Series1</td>
<td>83</td>
<td>17</td>
</tr>
</tbody>
</table>

Source: Primary Survey, 2018
4.1.7 Cloud Computing Improves Business Performance

Result in the below figure displayed that 43% agreed Cloud Computing improve performance in business, strongly agreed had 21% as those with the declaration in accordance with outcome, Neutral had 31%, strongly disagreed had 2%, whereas disagree had 3%.

Figure 44: Cloud Computing Usage Improves Business Performance (Q9)

Source: Primary Survey, 2018
4.1.8 Cloud Computing Improves Decision Making

According to result below those who agreed had 46% that Cloud Computing improves Decision Making through (Worldwide Access) and strongly agreed had 17%, Neutral had 20%, strongly disagree had 17% whereas disagree had 12% respectively.

Figure 45: Chart for Improve Decision Making (Q10)

Source: Primary Survey, 2018
4.1.9 Whether Cloud Service Provider (CSP) Provide Maximum Security to Clients/Users

The responsibility of ensuring security and privacy of data belongs to both the CSPs and the different users, this question is directed to users on whether those cloud providers provided them with maximum security or not. The respondents responses is that 47% believed the providers provided maximum security in securing the data and ensuring privacy and confidentiality of data stored while 53% of the respondents said No due to the issues concerns as shown in the figure below.

Figure 46: CSP security to Clients (Q11)

Source: Primary Survey, 2018
4.1.10 The Need for Improvement in Cloud Security

There is a need for improvement in cloud security based on the responses below, were 72% of respondents said Yes and only 28% say No who are of the belief that no need of improvement.

Figure 47: Improvement in Cloud Security (Q12)

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series2</td>
<td>72%</td>
<td>28%</td>
</tr>
<tr>
<td>Series1</td>
<td>72</td>
<td>28</td>
</tr>
</tbody>
</table>

Source: Primary Survey, 2018
4.1.11 Cloud Service Providers Issues based on Responses from the Survey

There was lots of responses from the various respondents with regards to CSPs in particular, among which are letting users to choice an isolated precise location for data backup, letting users to select a specific location for the use and or storage of data and obeying to any established law governing basis involvement in Data Security Control as agree in Service Level Agreement (SLA). Users had responded and opinions were given as shown in the analysis of Questions 13, 14 and 15 from the Survey Questionnaire Analysis below.

Figure 48: CSP (Q13 and Q14)

Source: Primary Survey, 2018
4.1.12 The Issue of Adherence to Data Security Control

On the Issue of Adherence to Data Security Control as agreed in Services Level Agreements (SLA) the responses from respondents is that 16% said Yes, 49% said No and 35% of the respondent answered Maybe, that’s to say they are not sure on whether the Cloud Service Provider obey to such agreement strictly or not.

Figure 49: CSP adherence to Data Security Control as agreed in SLA (Q15)

Source: Primary Survey, 2018

4.1.13 Cloud Service Providers (CSP) Perspective and Users Perspective

On the security concerns with regards to relationship from Cloud Service Providers (CSP) Perspective and Users Perspective, both the providers and users are having related concerns in terms of Data and Information Storage. Most especial the privacy and security issues, so responses are presented after analysis of the Question from the Survey form which shows 62% of the responded consider there is strong direct relationship from both parties and 38% are of the opinion of indirectly related as shown in the figure below.

Figure 50: Relationship between Security from CSP and Users Perspective (Q16)

Source: Primary Survey, 2018
4.1.14 Safeness of Cloud Computing

Moreover, as discussed in the previous chapter, on the authenticity of data that is stored in the cloud computing environment is safer or not safer and weather there is a need for improved security in the cloud computing security generally so as to encourage users in adopting the technology and even complete migration in order to achieve some of the usage and benefit derived from the cloud technology. Responses are given as 28% believe whatever that is stored in cloud is safer, 20% think the data is not safe and about 52% are neutral due to the sensitivity and nature of the entire Cloud Architecture.

Figure 51: Safeness of Cloud Computing (Q17)

Source: Primary Survey, 2018
4.1.15 The need for Improvement in General Security of Cloud Computing

On the need for cloud computing general security to be improved based on the questionnaire survey 73% of the respondent said there is a need to improve the security in order to encourage user’s adoption and implementation of cloud computing technology, only 27% of the respondents consider the security is normal. Which based on the researchers opinion are the little users who are already using the cloud computing technology for data storage.

Figure 52: The need for improvement in General Security of Cloud Computing (Q18)

![Q18. Need for Improvement in General Security for Cloud Computing](image)

**Source:** Primary Survey, 2018

4.2 Statistical Result of the Hypothesis and Correlation Analysis

**Question 7, 9 and 10** were used in describing the hypotheses 1, 2 and 3 respectively.

The hypotheses testing is used in the study as the greatest corporate category of statistical interpretation, in order to examine and make assumption about degree of a population established based on the sample data gathered. Statistical analysis of data that permits the scholar in using statistical philosophies in determining the likelihood of the sample results equal with the hypothesis around a population and examine statistical data in briefing the important features and relations of data so as to make simpler investigation and control pattern of actions in certain outcome or future trends. The hypotheses testing by means of confidence interval and correlation analysis are correspondingly used.
4.2.1 Hypotheses Testing

The hypotheses testing are normally used in research as a well-established instrument for study outcomes and findings; this similarly comprise of the evaluation of populations. Hypotheses analysis are sometimes refers to as significance testing, hypotheses had been articulated in the study on the basis of literature research questions, objectives to determine study problems as well as answers. Therefore, the step-by-step analyses are shown according to results findings.

4.2.1.1 Hypothesis 1: Survey Question 7

Results from below figure shows 35% agreed Cloud Computing as methods of attaining advantages competitively by investing little capital (Low Investment Cost) and strongly agreed had 27%. Neutral had 31%, strongly disagree had only 1%, the remaining percentage disagreed which are only 5% based on the data collected in survey. These outcomes, can’t be able to determine the final outcome with regard to hypothesis 1.

Figure 53: Question 7 for Hypothesis 1

![Bar graph showing survey results for Hypothesis 1](Image)

*Source: Primary Survey, 2018*

**Hypothesis:** Cloud computing is method of attaining advantages competitively (Low Investment Cost)

**Used Statistic:** \( X = \text{Reply of survey question 7} \) (5 = Strongly Agree and 1=Strongly Disagree)

**Ho = Null Hypothesis:** where \( \mu_X \) as 3.5
**H₁: Alternative Hypothesis:** - where $\mu_X$ as greater than 3.5

T-Test method is used to examine the hypothesis

**First Step** = Sample size ($n$) = 100; Degree of Freedom = $n-1=99$; Significant Value ($\alpha$) = 5% (0.05).

**Second Step** = The CR = Critical Region

**Third Step** = The Statistics test

t stand for statistics

\[
t = \frac{\bar{X} - \mu}{S} = \frac{3.81 - 3.5}{0.939} = \frac{0.939}{\sqrt{100}}
\]

therefore $t = 3.301384452$

**Fourth Step** = in conclusion: Accept $H₁$ and Reject $H₀$. There is strong evidence.

Table 6: Hypothesis 1 Result

| Source: Primary Survey, 2018 - The 99% confidence interval = 3.81± 0.247 = 0.563 ...... 4.057 |
4.2.1.2 Hypothesis 2: Survey Question 9

Result in the below figure shows 43% had agree that Cloud Computing improves performance of business, strongly agreed had 21%, 31% are Neutral, strongly disagree had 2% whereas only disagree had only 3%. With the outcomes, conclusion cannot be reached until the hypothesis is examine.

Figure 54: Question 9 for Hypothesis 2

Source: Primary Survey, 2018

Hypothesis: Cloud Computing Improves Performance of Business, that results to excellence in operations.

Used Statistic: \( X = \text{Reply of Survey Question 9} \) \((5 = \text{Strongly Agree} \text{ and } 1=\text{Strongly Disagree})\)

\[ H_0 = \text{Null Hypothesis:- where } \mu_X \text{ as } 3 \]

\[ H_1 = \text{Alternative Hypothesis:- where } \mu_X \text{ is greater than } 3 \]

T-Test method is used to examine the hypothesis.
First Step = Sample size (n) = 100; Degree of Freedom = n-1=99; Significant value (α) = 5% (0.05).

Second Step = The Critical Region

Third Step = The Statistics Test

T stands for Statistics

\[ t = \frac{\bar{X} - \mu}{\frac{S}{\sqrt{n}}} = \frac{3.77 - 3}{0.874} = \frac{0.874}{\sqrt{100}} \]

Therefore \( t = 8.81006865 \)

Fourth Step = Conclusions: Accepts \( H_1 \) and Reject \( H_0 \). The evidence is strong enough.

Table 7: Hypothesis 2 Result

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.77</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.0874498413</td>
</tr>
<tr>
<td>Median</td>
<td>4</td>
</tr>
<tr>
<td>Mode</td>
<td>4</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.874498413</td>
</tr>
<tr>
<td>Sample Variance</td>
<td>0.764747475</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>0.650264757</td>
</tr>
<tr>
<td>Skewness</td>
<td>-0.547798226</td>
</tr>
<tr>
<td>Range</td>
<td>4</td>
</tr>
<tr>
<td>Minimum</td>
<td>1</td>
</tr>
<tr>
<td>Maximum</td>
<td>5</td>
</tr>
<tr>
<td>Sum</td>
<td>377</td>
</tr>
<tr>
<td>Count</td>
<td>100</td>
</tr>
<tr>
<td>Confidence Level(99.0%)</td>
<td>0.22967874</td>
</tr>
</tbody>
</table>

Source: Primary Survey, 2018

The 99% confidence interval = \( 3.77 \pm 0.229 = 0.541 \) …… 3.999
4.2.1.3 Hypothesis 3: Survey Question 10

Result below displayed 46% agreed Cloud Computing improves Decision Making by (Worldwide Access) and 17% had strongly agreed, Neutral had 20%, strongly disagree had 17% also whereas disagree had 12% respectively. With the above outcomes, the study will not be concluded until the hypothesis is examined.

Figure 55: Question 10 for Hypothesis 3

Source: Primary Survey, 2018

Hypothesis: Cloud Computing Improves Decision Making by (Worldwide Access)

Used Statistics: X = Reply of Survey Question 10 (5 = Strongly Agree and 1=Strongly Disagree)

H₀ = Null Hypothesis: - where \( \mu_X \) as 3

H₁ = Alternative Hypothesis: - where \( \mu_X \) is greater 3

T-Test is used to examine the hypothesis.

First Step = Sample size (n) = 100; Degree of Freedom = n-1=99; Significant value (α) = 5% (0.05)
**Second Step** = The Critical Region

![Critical Region Diagram]

**Third Step** = The Statistics Test

T stands for Statistics

\[
t = \frac{\bar{X} - \mu}{S} = \frac{3.58 - 3.0}{\frac{1.065}{\sqrt{n}}} = \frac{0.58}{\frac{1.065}{\sqrt{100}}}
\]

Therefore \( t = 5.446 \)

**Fourth Step** = Conclusions: Accept \( H_1 \) and Reject \( H_0 \). Evidence is strong.

Table 8 Hypothesis 3 Result

<table>
<thead>
<tr>
<th>Source: Primary Survey, 2018</th>
</tr>
</thead>
</table>

| Mean                       | 3.58 |
| Standard Error             | 0.106534008 |
| Median                     | 4    |
| Mode                       | 4    |
| Standard Deviation         | 1.065340084 |
| Sample Variance            | 1.134949495 |
| Kurtosis                   | -0.017549235 |
| Skewness                   | -0.724740893 |
| Range                      | 4    |
| Minimum                    | 1    |
| Maximum                    | 5    |
| Sum                        | 358  |
| Count                      | 100  |
| Confidence Level(99.0%)    | 0.2798015 |

The **99% confidence interval** = \(3.58 \pm 0.279 = 0.301 \ldots 3.859\)
4.2.1.4 Hypothesis 4: Correlation Analysis of Survey Q11 and Q12

The below analysis is established from the survey data collected for Q11 and Q12 in the survey form respectively.

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

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

**Used Statistics =**

\[ X = \text{Response to Q11 (2=Yes and 1 = No)} \]

\[ Y = \text{Response to Q12 (2=Yes and 1 = No)} \]

The below table in specify the r-value for the relationship of the two variables.

Table 9: Hypothesis 4 Result

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>0.639575254</td>
<td>1</td>
</tr>
</tbody>
</table>

*Source: Primary Survey, 2018*

\[ r = 0.639575254 \]

The r-value specifies the two (2) variables are clearly related. However, the correlation between the two X and Y is strong.

Moreover, Using Correlation Coefficient and Coefficient of determinant format the results is as shown below: Correlation Analysis makes use of Correlation transformer in order to determine the level to which variations in the value of an attribute takes place, for instance (Level of security provided by CSPs in Cloud Computing) are related with changes in another attribute (The need for improved Security in Cloud Computing). The data for a correlation analysis
calculation consists of two input columns mentioned above (Security Provided by CSPs and the need for improved security in Cloud), this uses X and Y values for security provided by CSPs and the need for improved security. Below is the calculation for the correlation and detailed calculation in spreadsheet attached in this research study, using the sample size pattern.

Table 10: Data Analysis- Correlation Analysis

Source: Primary Survey, 2018
Table 11: Data Analysis - Determination

Source: Primary Survey, 2018
Therefore, with the above correlation analysis it can be stated that those respondents who are having doubts with the level of security given by the CSPs and those respondent who are of the opinion of the need to advance the security in the cloud computing are correlated because of the fact that the Correlation Coefficient $r = 0.165735$ is positive and 3% level of Coefficient of Determination arrived in the calculation and the null hypothesis asserts the two attributes are correlated. Therefore, there is need from the CSPs to provide maximum security and improve in the general security of cloud computing.

**Source:** Primary Survey, 2018
4.3 Interview Interpretation

The research design methodology was implemented in the research thesis where both questionnaire surveys and interviews are used as discussed in the previous chapters. An interview was conducted to the Cloud end users and those with knowledge on cloud computing in order to ascertain or share their experiences with regards to this technology (CC) and find out some of the solutions to the privacy and security issues as well as proffer a solution to the stated problems in the research study. After introducing the researcher and the Idea behind the research study aim and objectives to be achieved at the end of the study, The Interview is in two forms face to face and cellular phone, in order to ascertain correct facts for reacting to the research questions. The interview questions are basically about cloud computing security with regards to adoption, services, deployment models and technologies. All questions enquired are considered personal, most specifically if the person interviewed wouldn’t want his contact details to be stated in the research thesis and is only meant for this research study. The interview response is been translated and used in the main study in order to help the researcher in finding solutions and or answers to the research question that will help in providing solutions and recommendations that will at the end encourage users in adopting cloud computing. Some of the questions asked in the process of the interview are listed in the table below

Table 13: Interview Questions

<table>
<thead>
<tr>
<th>S/No</th>
<th>Interview Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Do you have an idea of what cloud computing is all about?</td>
</tr>
<tr>
<td>2.</td>
<td>Does your organization have a cloud system?</td>
</tr>
<tr>
<td>3.</td>
<td>What do you realized as the benefit of adopting this particular technology?</td>
</tr>
<tr>
<td>4.</td>
<td>What are the challenges you encountered in cloud computing.</td>
</tr>
<tr>
<td>5.</td>
<td>Have you ever thought of the security concerns in the Cloud Computing services models (PaaS, IaaS, Saas), deployment Models (Public, Private Community and Hybird) as well as the technologies.</td>
</tr>
<tr>
<td>6.</td>
<td>Do you have an Idea about the security from the providers perspective.</td>
</tr>
<tr>
<td>7.</td>
<td>How can you describe the level of adoption of cloud computing by most users</td>
</tr>
<tr>
<td>8.</td>
<td>Is Cloud Computing effective in the perspective of Big Data Storage and</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>9.</strong></td>
<td>Do you think the general security in cloud computing framework (Services, Deployment and Technologies) needs to be further improved by developing a Model that will guarantee little or no security risk so as to encourage adoption.</td>
</tr>
<tr>
<td><strong>10.</strong></td>
<td>Thank you very much for given us this useful information.</td>
</tr>
</tbody>
</table>

*Source: Primary Survey, 2018*

### 4.4 The Proposed Model

The Cloud Agent-based Encryption Mechanism (CAEM) Model Architecture:

![Proposed Model Diagram](image)

<<< End of Model >>>

Figure 56: Proposed Model
4.4.1 The Cloud Agent-based Encryption Mechanism (CAEM) Model Processes:

In a simple linear sequence the model follows the processes below;

1. USER1 tries to access specific data on the cloud, assuming either SaaS, PaaS or IaaS (Connection Request: CR)
2. The agent receives the HTTPS transaction request
3. Relay the identity credentials (e.g. Username and Password) to the client/customer AuthServer, located, monitored, managed and controlled by the user/client/customer organization (Key Request: KR)
4. The AuthServer use three-way handshake synchronization with the agent’s message token to authenticate and grant, reject or revoke data access to USER1 (Grant/Reject/Revoke: GRR)
5. Agent reply the user with the result from the AuthServer (Reply: RP)
6. The agent goes back to idle state (again to the cloud and wait for another request).

The above model and processes were propose based on the responses from the research survey for the need to develop a model that will strengthen or eliminate the security and privacy in cloud computing, this will be further discussed in the discussion chapter.

4.5 Comparing Previous Researches with Current Study

Cloud computing had currently become a very demanded facility owing to the numerous benefits of low-priced services and facilities, extraordinary performance, scalability, convenience as well as availability. But due to been in a period of early stages, most especially by the users in developing countries it still has some weaknesses or issues (Privacy and Security) which need to be given an appropriate consideration to make cloud computing services more reliable and user friendly. For that reason lots of researchers are proposing different models in order to reduce the security and privacy issues, for instance a research conducted by Komeil Raisan and Jamaiah Yahaya on Security Issues Model on Cloud Computing: A case of Malaysia they proposed a model as shown
Also, a study on Data Storage Security Issues in Cloud Computing conducted by Naresh Vurukonda and B. Thirumala Roa proposes this as shown.

Moreover, another one was proposed as shown.

**Fig. 4** Proposed data security model in cloud computing.
Therefore, in order to fill the research gap in combining SPI, Deployments and Technologies with regards to general security and privacy issues and proffer a lasting solution a CAEM model was proposed and Developed in this study. Since, other researches focuses on theoretical aspect and sketchy models alone, while few who develops model is just for security not minding other privacy issues and incorporating SPI respectively. The CAEM models will help in eliminating the security concerns to its minimal levels if adopted and implemented.