A Systematic Literature Review : Challenges of Cloud Computing Adoption for Small Medium Business in Malaysia

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Abstract

Cloud Computing offers variant services through the Internet that benefit Small and Medium Business (SMB). Even though cloud computing technology providers offer various cloud services, there are existing challenges in cloud computing adoption. The most crucial challenges are related to system migration and security concern subjects in cloud-based environments. Thus, this study carried out a systematic literature review since it uses a more rigorous and well-defined method to find the challenges factors of cloud computing adoption to SMB companies in Malaysia. The conclusive findings of the study suggest that cloud computing can increase business agility and values and promote a competitive business for SMBs while neutralized its challenges. This study aims to propose a cloud computing adoption based on TAM/TOE model. The results will assist Chief Information Security Officer (CISO), I.T. Manager, Chief Technology and Information Officers representing the SMBs.

Keywords: cloud computing, cloud service, security concern, small medium business, system migration.

1. Introduction

Cloud services are divided into layers, and the Internet is the medium for the connection. Therefore, the cloud computing environment provides hosting business services over Internet-based computing. The business model of cloud computing is separated into three main categories. The cloud categories are Platform-as-a-Service (PaaS), Infrastructure-as-a-Service (IaaS), and Software-as-a-Service (SaaS) [1][2]. Software-as-a-Service supports business processes and applications that allow customers to access cloud services operating on cloud domain. Concurrently, cloud service providers are accountable for controlling and governing application software, operating systems, and computing resources [3]. These services are accessed through an infinitesimal client interface, such as a Web browser. The users do not need to manage underlying infrastructure design because application providers habitually maintain all new software and hardware installations. Platform-as-a-Service, also introduced as middleware, is a medium of harbouring cloud services, such as hardware, operating systems (O.S.), and storage, over Internet-

based cloud computing to host Web applications [4]. In PaaS, a cloud service provider presents, conducts and governs both system software, particularly the operating system, programming languages and computing resources [5]. The users handle and use the application software under the operating system and on the virtual resources ministered by the service provider. PaaS allows clients to design, inspect, and establish I.T. services over a cloud platform. Thus, PaaS governs the immediate advancement of Web applications by detaching the complication of software and infrastructure.

Infrastructure-as-a-Service is a digital computing resource that includes servers, hardware, networking, bandwidth, memory, and storage services to businesses supplied by the service provider. This model rents the basic infrastructure facilities such as virtual machines and servers [6]. The computing resources are supplied in the shape of virtual machines to the SMB customer, and the consumers can employ and manage arbitrary software, as well as applications and operating systems, on these provisions [7]. SMB customer requires to manage and administer the operating system and the software applications using these digital provisions. IaaS creates prospective advantages by managing and raking in for the number of provisions required by users, also known as the pay-as-you-go scheme.

The previous paper focused on the technical problems of cloud computing technology and limited research on the challenges for cloud computing from an SMB perspective. Cloud computing adoption transforms SMB to success by providing sharing access and reducing operation cost. But at the same time, the catastrophic issues that arise among insecurities to SMB decrease Malaysia's adoption rate. Thus, this paper aims to evaluate cloud computing challenges for SMB in Malaysia and proposed a model for cloud adoption.

This paper is organized as following: Section 1 provides an overview of cloud computing services. Section 2 present the cloud computing implementation in SMEs and Section 3 discuss the systematic literature review on cloud computing among SMBs in Malaysia. Lastly, Section 4 presented the conclusion of the paper.

2. Cloud Computing Implementation in SMEs

The Internet serves as the primary platform for cloud computing utilized by any organization. The growing number of SMEs are moving their data, applications, and infrastructure to the cloud to realize financial and technological benefits. However, adopting and implementing a proper cloud service is challenging and needs the active participation from the business management and IT departments. Even though awareness of critical success factors (CSFs) for cloud implementation projects substantially promotes avoiding project failures, this topic has received limited research, particularly with an emphasis on SMEs [11].

Malaysian enterprises, particularly SMEs, have struggled to completely embrace the latest technology revolution. The alarming statement is made in light of the fact that just a few businesses in the country are capable of adopting Industry 4.0's pillars, a situation compounded by a percentage of business owners who remain hesitant to embrace technology such as cloud computing [12]. To close this substantial gap, Malaysia's government is pushing SMEs to use cloud computing services by offering facilities and a variety of programs through the Multimedia Super Corridor (MSC) and Shared Cloud Enterprise Services (SCES). The primary goals are to stimulate the adoption of cloud computing by SMEs and to increase the efficiency of business models [13].

In summary, SMEs are still developing a mandate for cloud services adoption; thus, understanding the challenges and security framework will help SMEs adopt cloud services [14]. Additionally, as cloud computing use continues to grow, the criticality of a comprehensive governance and security architecture has never been greater [15].

3. Methodology

This paper adopted the SLR method is based on [8]. SLR provides knowledge of the research problem and allows a study to collect an extensive range of sources [9]. Figure 3 shows the three phases with the steps needed in every stage of the SLR. Each stage is described in the following sub-sections.
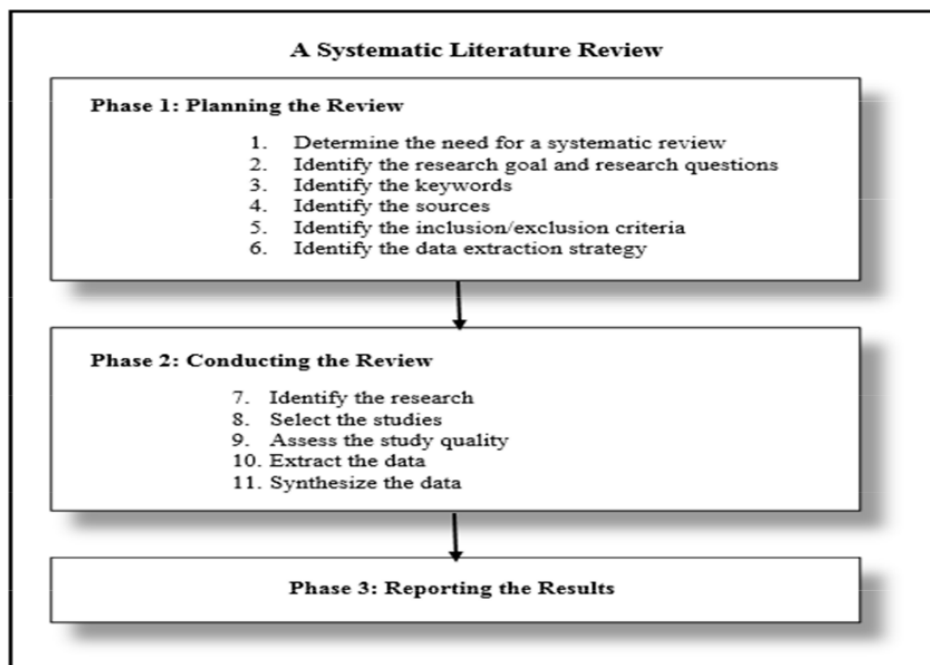
A Systematic Literature Review

Phase 1: Planning the Review

1. Determine the need for a systematic review
2. Identify the research goal and research questions
3. Identify the keywords
4. Identify the sources
5. Identify the inclusion/exclusion criteria
6. Identify the data extraction strategy

Phase 2: Conducting the Review

7. Identify the research
8. Select the studies
9. Assess the study quality
10. Extract the data
11. Synthesize the data

Phase 3: Reporting the Results

Figure 1. Summary of SLR process (Kitchenham et al., 2009)

3.1 Planning the Review

The paper pinpointed the research questions, search keywords, database provisions, and the relevance and irrelevance measures in the planning phase.

3.2 Research question

The SLR in the present study aims to determine the aspects affecting the implementation of cloud computing in small and medium business. The following research question is addressed in SLR:

What are the challenges of cloud computing adoption for small and medium business?

3.3 Research keywords

This phase involves identifying synonyms phrase based on the research question mentioned above, the key terms of challenges, small-medium business. The synonym keywords for "challenges" are problem and issue. The synonym keywords for "small-medium business" are SME and SMB.

Once the searched terms were pinpointed, they then were arranged into a search string for search process purposes. During this process, the purpose of the 'AND' operators was to join the different searched terms into a single search string. The OR operator was used to group the various forms and the end product is as shown in Figure 2.

(("Challenges" **OR** "Issue" **OR** "Problem")
AND ("Cloud Computing") **AND**
("Small Medium Business" **OR** "SME" **OR** "SMB"))

Figure 2. Research keyword used in the SLR

3.4 Resources to be searched

The following online databases were determined as the provisions to be searched: ScienceDirect Journal, SSRN, IGI Global, Inderscience Online, Wiley, and ResearchGate. In addition, the paper explores the reference list of the appropriate primary studies to make certain the accomplishment of the search.

3.5 Inclusion/exclusion criteria

The section conducted using two phases of inclusion and exclusion criteria. In the first phase, the inclusion and exclusion are based on the following criteria:

Inclusion:

- I.   Studies paper in the English language
- II.   Available in full-text papers
- III.   Review and white papers
- IV.   Any relevant studies consist of the mentioned keywords
- V.   Any relevant studies within the year 2016 to 2021

Exclusion:

- I.   Any studies paper not in the English language
- II.   Any studies that were not in full-text papers
- III.   Discussion and no reviewed papers
- IV.   Any repeated or duplication of studies
- V.   Any studies before the year 2016

In the second phase, this paper omitted all publications that are inessential to the study after full-text reading based on the motivation of study to access the challenges in cloud computing adoption.

3.6 Data extraction strategy

Data extraction strategy includes a form based on the accepted studies is shown in Table 1.

Table 1. Data extraction form

Item	Description
Study ID	An assigned ID number to each study for classification and identification
Author/s	Author/s' names
Application contents	Name of Organization or Universities or Company
Challenges factors	The challenges factors mentioned in the study

3.7 Conducting the Review

The review phase involved the following processes: research identification, study selection, quality assessment, data extraction and data synthesis.

3.7.1 Research Identification

This step involves the searching process through the online database based on section 3.3 above—the search result is shown in Table 2 below.

Table 2. Search process result through the database

Online Database	Search Result
ScienceDirect	14
SSRN	37
IGI Global	16
InderScience Online	34
Wiley	4
Research Gate	15
Total of Research Result	120

3.7.2 Study Selection

This section specifies the process of inclusion and exclusion criteria for selecting the primary studies. Figure 3 below summarized the exclusion process of the preliminary studies.
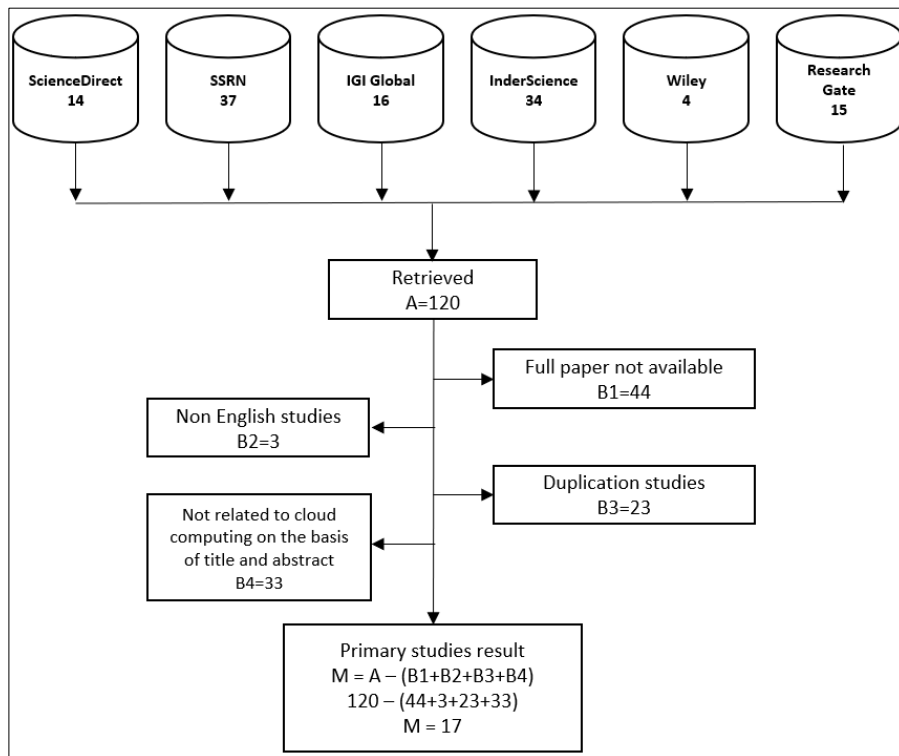
Figure 3. Exclusion process of the preliminary studies

Seventeen primary studies were found related to the challenges in cloud computing during the completion of the first level of exclusion criteria. Within these 17 studies, a secondary search was carried out, with the aim to review the references in the chosen prior studies to determine any surplus studies. The procedure and the outcome of the secondary search are as shown in Figure 4.
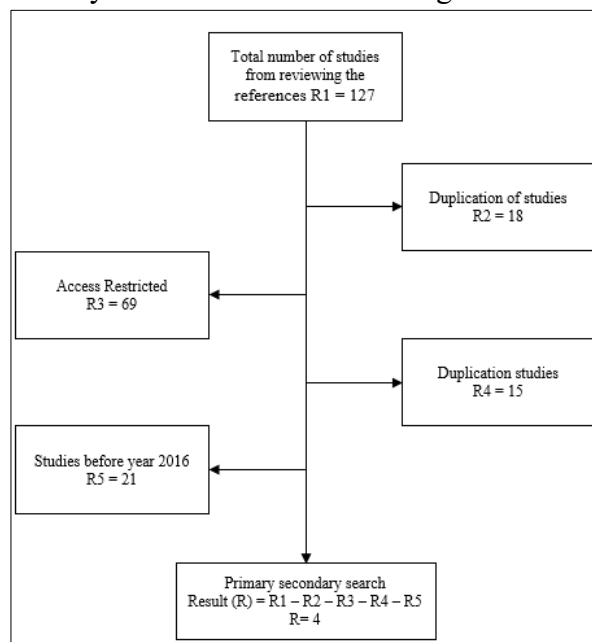
Figure 4. Result of secondary search

Upon completion of primary search in the online databases return 17 significant studies. The secondary search is based on the references from the previous search return value of four studies. Thus, the total number of selected studies was 21. The following process is to perform the second stage of inclusion/exclusion criteria. In this process, all chosen papers are read through the comprehensive text and excluded papers derived from the requirements with the aim to justify the significant material centered on challenges in cloud computing adoption. The result of second-level inclusion/exclusion criteria included nine studies and the exclusion of 12 studies. Figure 5 below displays the procedure of choosing the final studies from the primary and secondary search phrases. The conclusive series of selected studies are listed in Table 3 below.
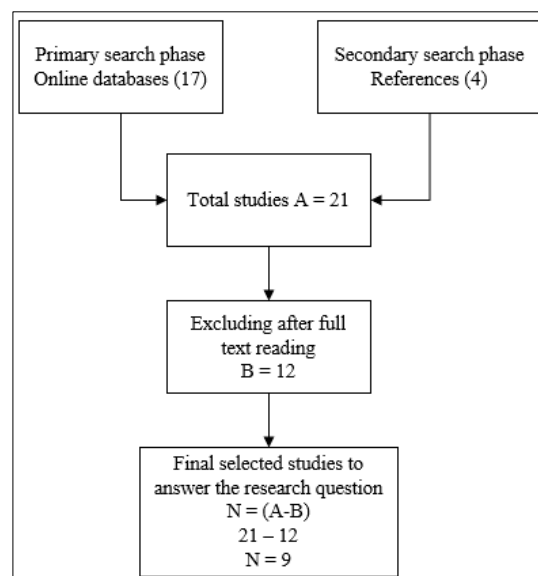

Figure 5. Process of selecting final studies for conduction the SLR

StudyID	Author/s	Source	Publication Name
RP-1	Adel Alkhalil, Reza Sahandi and David John (2017)	ScienceDirect	Faculty of Science and Technology, Bournemouth University.
RP-2	Ibrahim M. Al-Jabri, Eid Mustafa I. and M. Sadiq Sohail (2018)	SSRN	International Journal of Advanced Computer Science and Applications (IJACSA)
RP-3	Manisha Rani and Gagandeep (2019)	SSRN	Amity University Rajasthan, Jaipur, India
RP-4	Hukam Saini and Manish Khandelwal (2019)	SSRN	International Conference on Advancements in Computing & Management (ICACM)

RP-5	Aakriti Sharma, Bright Keshwani and Pankaj Dadheech (2019)	SSRN	Sustainable Computing in Science, Technology and Management (SUSCOM)
RP-6	Omar Al-Hujran, Enas M. Al-Lozi, Mutaz M. Al-Debei, and Mahmoud Maqableh (2018)	IGI Global	International Journal of E-Business Research
RP-7	Chinthagunta Mukundha and K. Vidyamadhuri (2017)	InderScience Online	Advances in Computational Sciences and Technology
RP-8	Salman Iqbal, Miss Laiha Mat Kiah, Nor Badrul Anuar, Babak Daghighi, Ainuddin Wahid Abdul Wahab and Suleman Khan (2016)	Wiley	Faculty of Computer Science and Information Technology, University of Malaya
RP-9	Michael Lang, Manuel Wiesche, and Helmut Krcmar (2018)	ScienceDirect	Technical University of Munich, Chair for Information Systems, Germany

Table 3. Selected studies details

3.7.3 Quality Assessment

A quality assessment is a process of identifying the aspect of the presented data [9] by the chosen studies above. Table 4 displays a list of questions with the aim to access the feature of the chosen studies.

Table 4. Quality Assessment Checklist

No.	Question	Answer
Q1	Are the study aims clearly stated?	Yes/ No/Partially
Q2	Is the research described adequately?	Yes/ No/Partially
Q3	Does the study explore diversity of perspectives and contexts?	Yes/ No/Partially
Q4	Do the objectives lead to conclusions clearly?	Yes/ No/Partially
Q5	Are the findings important?	Yes/ No/Partially
Q6	Are negative findings presented?	Yes/ No/Partially
Q7	Do the researchers explain the consequences of any problem	Yes/ No/Partially
Q8	Does the study add to your knowledge or understanding?	Yes/ No/Partially
Q9	Do the results add to the literature?	Yes/ No/Partially

The quality assessment score in Table 5 below indicates the capability to focus on the research question, and subsequently, the more significant values of the studies were presented. Three sets of scores contributed from the answers to the question asked.

Table 5. Quality Assessment Score

Answer	Score
Yes	1
No	0
Partially	0.5

The final percentage score is calculated based on the cumulative score from the listed question and the mathematical formula below. Table 6 below present the outcome of the quality evaluation of the detailed studies.

$$\%Max\ S = \frac{\text{Total score for each included study}}{9} \times 100$$

Table 6. Quality assessment of included studies

Study Id	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Total Score	%Max S
RP- 1	1	1	0.5	1	1	1	0	1	1	7.5	83.33
RP- 2	1	0.5	1	0.5	0.5	0	0	0.5	0	4	44.44
RP- 3	1	1	1	0.5	0.5	1	1	1	1	8	88.89
RP- 4	1	1	1	0	0.5	1	0.5	1	0	6	66.67
RP- 5	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0	5	55.56
RP- 6	1	1	0.5	1	0.5	1	1	1	1	8	88.89
RP- 7	1	0.5	0.5	0.5	1	0	0	0.5	0	4	44.44
RP- 8	1	1	1	1	1	1	1	1	0	8	88.89
RP- 9	0.5	0.5	0.5	1	0.5	0	0	0.5	0	3.5	38.89

Based on the quality assessment presented in Table 6, most of the studies scored 50%, while only three studies are getting below five points in total score and excluded in the SLR procedure. The lowest score goes to RP-9 in parallel with a scoring rate of 38.89%, and the highest points are RP-3, RP-6, and RP-8 with 88.89%. The next step is the process of a data extraction strategy involving the included studies.

3.7.4 Data Extraction

The data extraction process involves the technological factor of the challenges in cloud computing adoption based on Table 1 in section 3.6 above. As a result, 31 factors related to the technical aspect shown in Table 7.

Table 7. Summary of Technological Factor of Challenges in Cloud Adoption

StudyID	Author/s	Application Contents	Technological Factors
RP-1	Adel Alkhalil, Reza Sahandi and David John (2017)	Higher Education	• Cloud Migration & Model • Systematic Decision Process • Migration Challenges • Legal Implication • Cloud Competency • Cloud Service Quality • Security Requirements
RP-3	Manisha Rani and Gagandeep (2019)	Higher Education	• Cloud Security • Data Mining
RP-4	Hukam Saini and Manish Khandelwal (2019)	Higher Education	• Cloud Security Challenges • Sharing Services • Access Control • BCP • Confidentiality • Performance
RP-5	Aakriti Sharma, Bright Keshwani and Pankaj Dadheech (2019)	Higher Education	• Cloud Security Issue • Access Control • Authentication Techniques
RP-6	Omar Al-Hujran, Enas M. Al-Lozi, Mutaz M. Al-Debei, and Mahmoud Maqableh (2018)	Higher Education	• TOE Framework for Cloud Adoption • Physical Control • Security Concern • Privacy Issue • Policy • Performance
RP-8	Salman Iqbal, Miss Laiha Mat Kiah, Nor Badrul Anuar, Babak Daghighi, Ainuddin Wahid Abdul Wahab and Suleman Khan (2016)	Higher Education	• Security Issue • Web application security • Network security • Data security • Integration / migration • Issue in the virtualized environment • Physical security

3.7.5 Data Synthesis

The data extraction process results in the previous section were having similarities among 31 technological factors. An implicit and explicit technique procedure is needed to have a unique element to eliminate any similarities among the factors. This procedure involves data coding based on the grounded theory [10]. Although the grounded theory introduced three steps, this paper only concentrates on one element to simplify the finding.

The data coding can assist researchers in understanding the redundancy of data that carry similar meanings from the dataset; and support in determining, constructing and linking the relationships among components of the data [10]. Table 8 shows the code descriptions of the technological factor of cloud computing adoption challenges based on the previous data extraction process.

Table 8. Code description summary

Code	Description	Study ID	Similarities Remark
Cloud Adoption	Cloud adoption is a strategy used by enterprises to improve the scalability of Internet-based database capabilities while reducing cost and risk.	RP-1, RP-6,	Cloud Migration, integration, and cloud adoption
Cloud Security	Cloud security is the concern and risk of data protection stored online via cloud computing platforms from theft, leakage, and deletion.	RP-3, RP-4, RP-5, RP-6, RP-8,	Cloud Security Category: Security Concern, Security Issue, Physical Security, Data Security, network security, Access Control, and Privacy Issue.
Systematic Decision Process	A logical and systematic decision-making process that assist SMBs to address the critical elements that result in a good decision and to foresee and reduce existing risk.	RP-1, RP-6,	TOE framework is one of the systematic decisions and migration / adoption process.
Cloud Challenges	The challenges can be identify from security issue, infrastructure, cost, technical perspective, maintenance, etc.	RP-1, RP-6, RP-8	Cloud Challenges Category: Legal Implication, Competency, Service Quality, Security Requirements, Performance, Confidentiality, and virtualized environment.
Data Mining	The implementation of data mining techniques through the Cloud computing will allow the SMBs to retrieve information from virtually integrated data warehouse that reduces the costs of infrastructure and storage	RP-3	No duplication

Cloud Features	The advantage of Cloud computing that provides variety of features for SMBs operation.	RP-4, RP6,	Sharing Services, Performance, Confidentiality, and BCP.
Countermeasures	Countermeasures action/proposal benefits SMBs to handle Cloud computing challenges and security issues.	RP-5, RP-6, RP-8	Authentication Techniques, Physical Control, Policy, Web application security, Network security, and Data Security.

Following the steady distinction and data synthesis, the technological criteria were determined as the cloud migration process, the systematic decision process, cloud challenges categories, storage, and the advantages and countermeasures action. Based on the code description above, the paper categorized the challenges in cloud computing as in Figure 6 below:
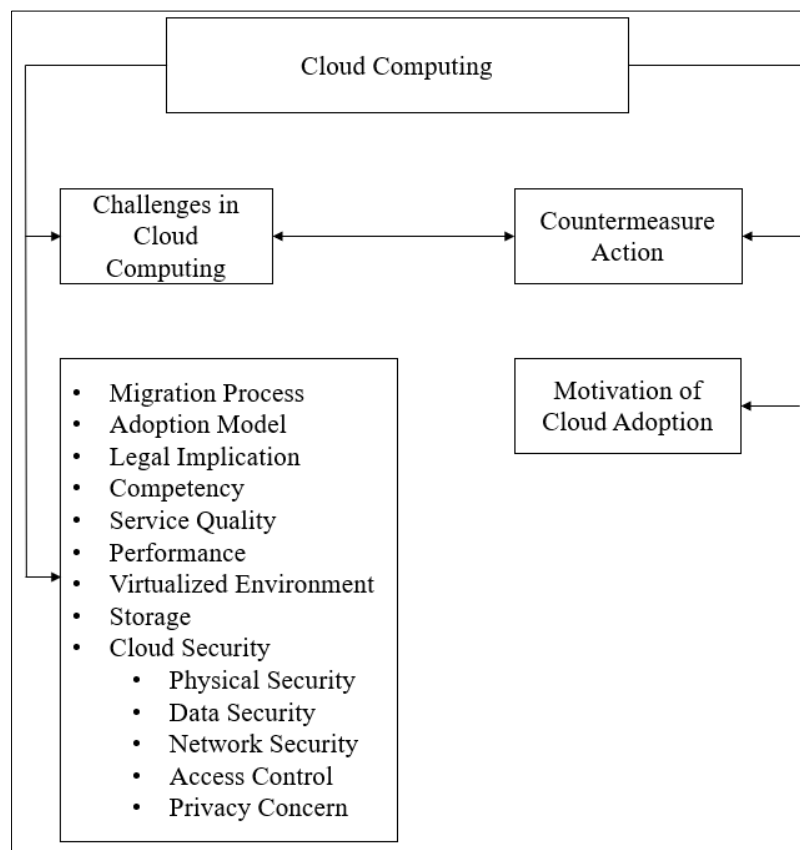

Figure 6. Summary of cloud computing based on data coding

4.0 Conclusion

Cloud computing becoming an essential service to SMB companies by uniting various services, including data storage pool, shared services, mobile application,

e-commerce, and entertainment. Despite the benefits, the SMB needs to aware of the existing challenges in cloud computing technology. The primary purpose of this paper is to present the possible challenges in the cloud computing environment faced by SMB companies in Malaysia. The service provider shall play a vital role to reduce the adoption challenge by providing a complete solution for the SMB.

Acknowledgements

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