A Literature Review – Firm Investment on Cloud as Efficient & Effective Technology

Gede Indra Raditya Martha¹ and Apol Pribadi Subriadi²
Magister Sistem Informasi, Fakultas Teknologi Informasi, Institut Teknologi Sepuluh Nopember
Jl. Raya ITS - Kampus ITS Sukolilo, Surabaya, 60111 Indonesia
Telp: (031) 5999944, Fax: (031) 5964965 E-mail: raddityaindra@gmail.com,
apolpribadi@gmail.com

Abstract. The improvement of cloud computing is progressing very quickly can be measured by the elements that can already be handled by this technology trends. Cloud improvement makes the working capability of everyone who uses it increases because the cloud negates the hardware requirements that a user must have to perform a certain task. Tasks that have high hardware requirements for high processing activity that consume large investment cost can be minimized significantly from infrastructure, maintenance, upgradeability, and electricity cost. It shows that cloud computing has excellent investment relevance for companies and work elements that require high processing capabilities, in addition to cloud computing are also eco-friendly/green computing environment-friendly technology that can add value from cloud technology itself, for users/companies and the environment. However, the flow of cloud-focused research lacks a clear roadmap or agenda due to the rapid development of cloud technology. Therefore, this article analyzes and synthesizes existing studies on cloud-computing. The results of this study/paper are to provide an opportunity for development and further research in the field of use of cloud computing as an efficient & effective technology investment in a firm.

Keyword: Investment, Energy Efficient, Green Computing, High Performance, Cloud Computing.

1. Introduction

The improvement of cloud computing is progressing very quickly can be measured by the elements that can already be handled by this technology trends. Cloud computing presents fundamental changes to how IT services are created, developed, launched and maintenance [1]. In general, cloud computing has three forms: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) but the innovation and development of cloud computing makes new forms of cloud services such as Render as a Service (RaaS) [2], Communication as a Service (CaaS), Entertainment as a Service (EaaS), Design as Service (DaaS) [3] etc., and make this technology increasingly dependable on any technological elements required today.

Cloud improvement makes the working capability of everyone who uses it increases because cloud negates the hardware requirements that a user must have to perform a task. Some evidence to substantiate the statement is Cloud Rendering such as Google Cloud Rendering, Autodesk Cloud Rendering and Render Rocket, which is used to 3D renderings for 3D designers such as Architects, Digital Artists, Animators, Designers so those users do not need a PC Workstation with high specification to be able to produce excellent output. Cloud computing is now able to do virtual cloud rendering with large data input and output and it is proven by the presence of cloud gaming like PlayStation Now [4] so users do not need to have PlayStation Console to play exclusive PlayStation games on PC that proves the capability of cloud processing power this day.

With using the cloud as in the previous example, tasks that have high hardware requirements for high processing requirements that consume large investment cost can be minimized significantly from infrastructure, maintenance, upgradeability, and electricity cost. It shows that cloud computing has excellent investment relevance for companies and work elements that require high processing capabilities, in addition to cloud computing are also eco-friendly/green...
computing [5] environment-friendly technology that can add value from cloud technology itself for users/companies and the environment. However, with many advantages in terms of cost, performance and eco-friendly itself, there are still very few companies and work elements that require the high computing capabilities as previously mentioned use cloud computing as their active working infrastructure. Based on the background above this study aims to know and bring up the things that cause cloud computing is a good investment for users and corporate actors.

2. Background

2.1 Cloud Computing and Technology Investment

Cloud computing is reliable, dynamic, cost-effective technology with guaranteed quality of service and usage form, which comes from 3 type of forms (IaaS, PaaS, SaaS) but now the form has been very diverse with various service tasks. Cloud computing technology enables efficient computing by centralizing hardware for storage, memory, processing, bandwidth, etc on the cloud [3]. Cloud computing service are generally a virtual-based application that runs on cloud server both hardware-based or software-based and SOA (Service-oriented architecture) that are mean to sufficient and handle the computing, software, and hardware needs of enterprises more effectively and efficiently because resources can be more configurable to achieve maximum cost-benefit [6]. Cloud computing not only provides substantial savings on IT equipment spending but also in empowering more efficient and effective technical staff. The cost of the IT workforce alone represents as much as 70% of the IT operating budget [7].

Technology has a very substantial influence on the advancement and progression of the company today. IT investments contribute to the achievement of business objectives so that investments in information technology are important. [8] The main objective of the company planning technology investments is to prevent unnecessary investment and reduce waste from scarce resources [9]. Based on the trait owned by cloud computing then the purpose of technology implementation in the company and the investment planning mentioned earlier can be achieved.

2.2 Related Research

Previous research related to review literature on Cloud Investment and its adoption on the company already existed previously, such as research conducted by Müller, S. Holm, S. Søngagaard, J. in 2015 which discusses the 3 levels of the maturity level of firm that is business efficiency, business effectiveness, and business transformation to benefit from cloud computing [10]. While El-Gazzar, Rania in their research in 2015 examined the factors and reasons that influence the organization or company to adopt cloud computing [11], while Radu, Laura Diana with research in 2017 [12] and Sheme, Enida Frasheri, Neki in 2013 [13] examined the green computing and energy efficiency that exist in the application of cloud computing.

3. Research Method

In conducting this research, the research method that used is based on Systematic Literature Review guidelines by Kitchenham and Charters [12]. There are three stages of the method consisting of planning, execution, and yield analysis [12, 13]. The stages in this method focus on planning and execution. The planning stage by identifying existing systematic reviews of interesting phenomena against the appropriate evaluation criteria. The stage consists of determining the database and selection of keywords, criteria, and selection of articles including inclusion and exclusion. Furthermore, the implementation stage by conducting qualitative analyst, quantitative analysis, formulation extraction, and quality assessment.

3.1 Journal Database and Keyword

The search process for this research is based on a well-known online database intended to deepen the understanding of the literature review of Cloud Investment as Energy Efficiency Technology with High Computing and Processing Capabilities, then a related literature search is
conducted to support this research. Table 1 below shows the online database of literature searches used in this study:

| Source          | URL                      |
|-----------------|--------------------------|
| IEEE            | ieeexplore.ieee.org      |
| Science Direct  | sciencedirect.com        |
| Google Scholar  | scholar.google.com       |
| Emerald         | emeraldinsight.com       |

Identification of journals, books, and conferences are in accordance with the discussion conducted in order to search for literature sources. In some journals checks the title and keywords, abstract analysis. The following focuses on combining several complementary keywords that relate to the focus of the research title. In Table 3.1 there are search results for each keyword before abstract filtering and skimming:

Table 2 Journal searching based on selected keyword

| Keyword                  | IEEE  | Science Direct | Google Scholar | Emerald |
|--------------------------|-------|----------------|----------------|---------|
| Cloud Computing          | 47.925| 42.098         | 929.000        | 1.240   |
| Cloud Computing Effectiveness | 2.402   | 9209          | 118.000        | 855     |
| Cloud Computing Investment | 570     | 3592         | 47.900         | 509     |
| Cloud Green Computing    | 1.609  | 12.699        | 204.000        | 191     |
| Technology Investment   | 9.067  | 113.484       | 1.880.000      | 26.412  |
| Infrastructure Investment| 31.281  | 415.751       | 2.190.000      | 51.144  |
| System Performance Improvement | 63.766  | 36.142       | 2.100.000      | 10.869  |
| Energy Efficiency        | 8.419  | 144.388       | 1.570.000      | 3.750   |
| Green Computing          | 7.208  | 36.142        | 1.760.000      | 40.213  |

3.2 Criteria and Literature Selection

Based on Systematic Literature Review (2017) by Dang & Pekkola, there are two criteria for selection of literature namely Inclusion and Exclusion, the sorting of literature search results is done by filter and selecting the literature search results that have been obtained before based on inclusion and exclusion criteria.

Table 3 Inclusion & Exclusion Criteria

| Inclusion                                      | Exclusion                                      |
|-----------------------------------------------|------------------------------------------------|
| International Journal                         | Local Journal                                  |
| Study related with Cloud Efficiency, Effectiveness & Investment | Study not-related with Cloud Efficiency, Effectiveness & Investment |
| 2010 – 2018 Journal                           | < 2010 Journal                                 |

With the keywords which used in table 2 are obtained 128 journal articles in accordance with the keyword, after eliminating article selection with Exclusion criteria then obtained 68 journals that become candidates from the journal used. Furthermore, after elimination with inclusion criteria then the analysis based on the title, abstract, and evaluation based on the suitability and completeness of the contents of the article so that the candidate of the article to 30. This selection is done repeatedly to check for errors in the selection process.

Table 4 Journal Selection Result

| Inclusion | Keyword | Candidate | Chosen |
|-----------|---------|-----------|--------|
| IEEE      | 31      | 14        | 7      |
| Science Direct | 38      | 19        | 9      |

3
3.3 Qualitative Analysis

Furthermore, a qualitative analysis is conducted through 30 titles of literatures obtained earlier and serve as the main reference. Qualitative analysis is a more detailed analysis of 30 previously obtained literature. Qualitative analysis includes a detailed analysis of the theme of literature, literature extraction, and literary quality assessment.

a. Analysis based on themes

The analysis is conducted to 30 journals previously obtained and used as the main reference, from the analysis results are obtained 4 types of themes in research related Firm Investment on Cloud as Efficient & Effective Technology. The themes obtained represent the domains of the main research topics and research developments in the domain from the 30 previously obtained literature. Through domain themes that formulated in table 5, are obtained further opportunities research related to Firm Investment on Cloud as Efficient & Effective Technology.

| Theme Classification | Descriptions |
|----------------------|--------------|
| Cloud Energy Efficiency | Studies on cloud computing in terms of Energy efficiency, cloud computing are considered as environmentally friendly technologies and require far less power than conventional technologies with equivalent performance, therefore this technology can be called green computing, because it has an eco-friendly nature that can benefit companies in power saving, and the environment. |
| Cloud Price Advantage | Studies on cloud computing in the aspect of Price Advantage, cloud computing is considered to have advantages in terms of cost is cheaper to compare the conventional system so that makes this element is one of the key factors of the use of cloud computing. |
| Cloud Performance Benefit | Cloud performance benefit is a study on the performance aspects and advantages of cloud computing applications, cloud computing is considered to have excellent scalability and computing performance that can be a major factor in the use of cloud computing for the company. |
| Cloud Firm Adoption | Cloud firm adoption is a study on aspects of cloud computing acceptance in the company, what companies need and can implement cloud computing, what factors make cloud computing acceptable to a company. |

b. Extraction

A collection of literature related information on themes, bibliography, type of publications, and quantitative relevance is shown in the extracting literature table. Table 6 describes the description of literature extraction.

| Item                  | Descriptions                                                                 |
|----------------------|-------------------------------------------------------------------------------|
| Theme                | Is the major topic in a study. Based on the literature that obtained, there are several themes concerning Firm Investment on Cloud as Efficiency & Effective Technology. Table 5 describes the grouping of themes in this study. |
| Bibliography         | Contains information about author, publication year, and title of literature. |
| Type Publication     | Types of literature publications include books, journal articles, or conference articles. |
| Qualitative          | Quantitative includes community, research methods, distribution, number of citations, and categories. |
c. Quality Assessment
Referring to Dang & Pekkola's (2017) study of the systematic review [9], a measurement is required to assess the quality of the literature content. Positive answers are rated as 1 (Y), negative as 0 (N), and some 0.5 (P). All 30 title of literatures are performed on the assessment included with the respective scores obtained in the attachment. Assessment of the quality of the literature aims to assess the quality of the 30 literatures that serve as the main reference by using 3 questions. Table 7 describes the three questions used in conducting a quality literature assessment.

| No | Question | Answer                                      |
|----|----------|---------------------------------------------|
|    |          | Y                                           |
| Q1 | Is the content literature related to Firm Investment on Cloud as Effective & Effective Technology? | The content of the selected literature is closely related to the research. |
|    |          | P                                           |
|    |          | N                                           |

| Q2 | Is the purpose of research in the literature clearly stated? | The purpose of the literature is clearly stated. |
|    |                                                               | The purpose of the literature is not clearly stated. |
|    |                                                               | The purpose of the literature is not clearly stated. |

| Q3 | Does the research method in the literature explain clearly about the research stages? | The literature research method clearly explains the research stages. |
|    |                                                                                   | The literature research method not very clear explaining the stages of the study. |
|    |                                                                                   | The literature research method does not clearly explain the stages of the study. |

d. Journal Category Analysis
Journal category refers to the form of research conducted on the journal used. There are 4 types of journal category in this study which include:

| Table 8 Journal Category |
|--------------------------|
| Category | Descriptions                                      |
|----------|---------------------------------------------------|
| Algorithms & Method | Research Algorithms is a study that contains an algorithmic method, a procedure or a formula to solve a problem, based on the appropriate sequence of actions according to the topic of this study (Firm Investment on Cloud Efficiency & Effective Technology) |
| Architecture & Framework | Architecture & Framework research is a research that contains a design of the system structure as well as the foundation of a suitable work based on the topic of this research (Firm Investment on Cloud Efficiency & Effective Technology) |
| General Issue | Generalized Issue research is a study that contains a general problem and enrichment related to a material and topics related to the topic of this research (Firm Investment on Cloud Efficiency & Effective Technology) |
| Model | The research modeled by Model & Method is a study that contains a system / service implementation and analysis on an organization / company and generally related to the topic of this research (Firm Investment on Cloud Efficiency & Effective Technology) |

4. Result
In this section will show the results of research visually (graph) and tables both quantitative and qualitative along with the description of the results.

4.1 Qualitative Result
The qualitative result contains two parameters namely category and theme. The classification of the theme and category aims to answer the research question in this study “What aspects that
affect the adoption and investment of cloud technology in a firm”. There are several steps that must be done to classify the categories and themes, the steps are stated below.

a. Map the journal based on categories by observe journal form and research purpose.

b. Group the journal based on the theme: The journal with cloud energy efficiency are mostly discussed about power and green computing element on cloud. Cloud price advantage are mostly discussed about comparison cloud and conventional system element by finance viewpoint. Cloud Performance Benefit mostly discus about comparison cloud and conventional system element by productivity viewpoint. Lastly Cloud Firm Adoption are discussed conformity element of cloud computing with the firm requirement and needs.

c. 1 Journal can have multiple theme

The classification of the 30 journals by category and theme is shown in table 9, as well as figure 1 which visualize the journal theme variant in number, due to extent and development of the research topic, a journal title can concurrently more than 1 theme.

| Table 9 Journal Classification by Category & Theme |
|---------------------------------------------------|
| **Category** | **Journal** | **Theme** | **Cloud Energy Efficiency** | **Cloud Price Advantage** | **Cloud Performance Benefit** | **Cloud Firm Adoption** |
|--------------|-------------|-----------|-----------------------------|--------------------------|----------------------------|------------------------|
| Algorithms & Method | [1]          | ✓         | ✓                           | ✓                        | ✓                         | ✓                      |
|               | [22]         | ✓         |                             |                          |                           |                        |
|               | [23]         | ✓         |                             |                          |                           |                        |
|               | [32]         | ✓         | ✓                           | ✓                        | ✓                         | ✓                      |
| Architecture & Framework | [3]          | ✓         | ✓                           | ✓                        | ✓                         | ✓                      |
|               | [14]         | ✓         |                             |                          |                           |                        |
|               | [17]         | ✓         |                             |                          |                           |                        |
|               | [18]         | ✓         | ✓                           | ✓                        | ✓                         | ✓                      |
|               | [20]         | ✓         |                             |                          |                           |                        |
|               | [25]         | ✓         |                             |                          |                           | ✓                      |
|               | [27]         | ✓         |                             |                          |                           | ✓                      |
| General Issue | [15]         |           |                             |                          |                           | ✓                      |
|               | [16]         |           |                             |                          |                           | ✓                      |
|               | [19]         |           |                             |                          |                           | ✓                      |
|               | [26]         |           |                             |                          |                           | ✓                      |
|               | [28]         |           |                             |                          |                           | ✓                      |
|               | [30]         |           |                             |                          |                           | ✓                      |
|               | [31]         |           |                             |                          |                           | ✓                      |
|               | [33]         |           |                             |                          |                           | ✓                      |
|               | [35]         | ✓         | ✓                           | ✓                        | ✓                         | ✓                      |
| Model        | [2]          |           |                             |                          |                           | ✓                      |
|               | [4]          |           |                             |                          |                           | ✓                      |
|               | [21]         |           |                             |                          |                           | ✓                      |
|               | [24]         |           |                             |                          |                           | ✓                      |
|               | [29]         | ✓         | ✓                           | ✓                        | ✓                         | ✓                      |
|               | [34]         | ✓         | ✓                           | ✓                        | ✓                         | ✓                      |
|               | [36]         | ✓         | ✓                           | ✓                        | ✓                         | ✓                      |
|               | [37]         | ✓         | ✓                           | ✓                        | ✓                         | ✓                      |
|               | [38]         | ✓         | ✓                           | ✓                        | ✓                         | ✓                      |
|               | [39]         |           |                             |                          |                           | ✓                      |
4.2 Quantitative Result
The Quantitative results explain the distribution of literature based on the development of research from year to year on research on the topic of Firm Investment on Cloud as Efficient & Effective Technology. Figure 2 below is the distribution over time of the research journal. The result shows that the increase of journal publication with topic in accordance with the research topic exponentially every 3 years.

5. Discussion
a. Cloud Energy Efficiency
Cloud energy efficiency is a theme domain that focuses on energy efficiency elements, which are typically measured by saving and efficiency efforts on power consumption based on cited sources [14, 22, 25, 27, 29, 32, 38] with various research forms. There are two kinds of research that attempt to make an improvement by constructing an algorithm that can automatically maintain energy by suspending or turning off on a PM (Physical Machine) server with the underloaded state [32], as well as the efficiency of resource usage [25]. At the firm and end-user level, cloud computing is a technology that reduces hardware usage followed by a decrease in power consumption so that energy savings can occur, cloud enables companies to save and share physical and virtual resources, thus reducing computing costs including operating costs [3]. These findings when associated with the research topic "Firm Investment on Cloud Efficiency & Efficiency" in Figure 1, shows a significant increase in research on the topic of Firm Investment on Cloud as Efficient & Effective Technology.
Effective Technology" then the factors causing investment by the company to cloud computing has been met in this theme.

b. Cloud Price Advantage
Investment is a term that is closely related to finance and economics, therefore the price advantage of a technology adoption is very important. Cloud Price Advantage is a theme that is often mentioned in cloud computing journals because it is an important factor that indicates advantage factor of using cloud computing technology [3, 17, 20, 24, 29, 32, 34, 35, 37]. Cloud infrastructure is a cost-effective model for providing exceptional services such as 'reducing hardware maintenance complexity', 'real-time workload balancing'. Furthermore, cloud computing negates activity such as purchasing servers, software, data center space or network equipment because user clouds purchase those resources as a fully outsourced service [3], therefore, the investment aspect of cloud computing in a firm in terms of price advantage has been fulfilled, by minimizing the cost of resources, including expensive networking equipment, servers, IT personnel, etc. Resource share resulting the reduction of costs requirement and fund [29, 35].

c. Cloud Performance Benefit
Cloud performance and benefit are important things in cloud investment in a company. Performance Benefit is the most frequent theme discussed in the journal which used in this research topic related to Firm Investment on Cloud as Efficient & Effective Technology. This theme appears as the main subject 15 times on journal which used, it proves that the performance and benefits of cloud computing are very concerned in the investment of technology within the firm beyond other aspects. Most of the journals mention the scalability of cloud computing, processing speed, comparability and methods proposed to increase the speed of the cloud system [1,18, 22, 23, 25], research on cloud computing capability and performance in new sectors [4, 21, 23], the system migration to cloud computing by considering the benefit aspects [1, 28], as well as other aspects which indicate that cloud computing has good performance and potential because its development occurs in many aspects [3, 16, 19, 34, 37, 38 ] as the basis of a positive consideration in cloud investment.

d. Cloud Firm Adoption
Investment in technology is closely related to the adoption stages of the technology. Investment occurs when at least the early stages of adoption have been resolved. Journals were used in this study broadly discusses the valuation of a technology, the integration phase, and variables mapping that causing certain technologies can be adopted [26, 31, 33, 36, 39]. Some of the variables that affect the adoption of a technology, especially the cloud computing as follows.
- Implementation depends on the firm’s technological, environmental contexts and organizational.
- Fulfill 5 adoption variables (Organization): relative advantage, firm size, top management support, competitive pressure, and trading partner pressure
- Fulfill 3 adoption variables (Cloud system): complexity, compatibility, and technology readiness

6. Conclusion
This research conducted a literature review of 30 titles of literature which related to the Firm Investment on Cloud as Efficient & Effective Technology. The results of this literature review indicate an increase of research about this topic every year since 2010 to 2018. this result shows a good research development with the topic which discussed. The result of this literature review analysis shows that there are 4 research themes related to Firm Investment on Cloud as Efficient & Effective Technology which are Cloud Energy Efficiency, Cloud Price Advantage, Cloud Performance Benefit, Cloud Firm Adoption. There are 4 types of category research namely Algorithms & Method, Architecture & Framework, General Issue, Model
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