Systematic Review on Ethical Issues in Cloud Computing

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Abstract

Cloud computing is the new age of computing systems which swiftly gaining attention and traction in business. It offers technology services online through web-based tools and applications, rather than a direct connection to a server. There are several ethical issues in cloud computing which raise concerns to organizations in adopting cloud computing to their settings such as data privacy. In most cases, these ethical issues are depending on specific applications and settings. The main purpose of this paper is to identify ethical issues in cloud computing in people, process, and technology perspectives. The paper describes how the systematic review was conducted, how ethical issues were collected and analyzed and it concludes by discussing means of managing them in general. As a result, there are 25 cloud computing ethical issues identified which are categorized into three categories based on Leavitt's Diamond. Most issues identified are in the Technology category, followed by Process and finally People.

Keywords*: Cloud computing; ethical issue; people; process; technology.*

1. Introduction

Cloud computing can be described as a current buzz word and trends as it is viewed as one of the fastest-growing segments in the computing industry that will take over and affect many or most aspects of computing (Timmermans, Stahl, Ikonen, & Bozdag, 2010). According to The National Institute of Standards and Technology, cloud computing is defined as: "A model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell & Grance, 2011).

It is clearly indicated that the advent of cloud computing has been one of the most significant technological advances in recent years. Despite its massive benefits,

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cloud computing has also raised new ethical issues for users and organizations (Faragardi, 2017). Timmermans, Stahl, Ikonen, & Bozdag (2010) highlighted that the most obvious issue is privacy, which can arise as a problem particularly concerning data storage, control, and access and usage rights. For example, previously all data are stored locally in own storage and only the owner has the right to access the data. However, with the advent of cloud computing, questions about how to access certain data and how it is maintained can no longer be answered as in-house. This comes into sight because cloud computing is still in the infancy stage as the research literature mostly comes from computer science and concerns the technology (de Bruin & Floridi, 2017). Faragardi (2017) identified that one of the main concerns to shift from traditional computing systems to the cloud is ethics which most often the ethical issues be subject to on specific applications and circumstances. Hence, this triggers a concern on the ethical issues of cloud computing utilization. The questions such as *"What are common ethical issues in cloud computing?"* and *"What is the highest concern in cloud computing?"* keep pondering on the user's minds.

Therefore, this paper aims to discover the answer to these questions by analyzing current studies on cloud computing ethical issues. This paper is structured as follows. The next section will discuss the overview of cloud computing and what are the common issues arises. Next in Section 3, is the explanation of the methodology, which is Systematic Literature Review (SLR). This is followed by a discussion on the findings in Section 4 on the ethical issues from reviewed articles. Finally, in Section 5, the paper concludes the topic discussed with the recommendation for future works.

2. The Overview of Cloud Computing

Cloud computing is a model for delivering information technology services in which resources are retrieved from the Internet through web-based tools and applications, rather than a direct connection to a server. Sallehudin, Razak, Ismail, Fadzil, and Baker (2019) simplified cloud computing as a model for providing on-demand access to computing services via the Internet. This means that software is delivered over the Internet via a Web browser rather than installed directly onto the user's computer.

There are three types of services in Cloud Computing which are Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).

a) Software as a Service (SaaS) – It is a software distribution model in which a third-party provider hosts applications and makes them available to customers over the Internet. The service provider will install all the applications and software required and ready for use by the user.
b) Platform as a Service (PaaS) – PaaS provides a platform for computer users through the provision of hardware, networking and operating systems. Users will design and develop their own applications in this model. It also linked between SaaS and IaaS.

c) Infrastructure as a Service (IaaS) – It is a form of cloud computing that provides virtualized computing resources over the internet. IaaS provides storage space and basic computing to users so they can develop the application in its own environment.

2.1 Issues in Cloud Computing

An increasing number of businesses are choosing cloud services due to its scalability, cost-effectiveness, performance and immediate availability. The use of cloud computing is more cost-effective as it relies heavily on the allocation of organizational resources to achieve the desired degree of consistency and in the current economic scale (Sallehudin, Razak, & Ismail, 2016). In spite of the benefits that cloud computing has offered, cloud services may face glitches as a result of which they become temporarily unavailable and this causes interruption to the services and sales administration specifically for the companies dependent on cloud services (de Bruin & Floridi, 2017). Furthermore, there are many challenges and issues that involve this technology such as ethics and data privacy. Data privacy is a big challenge to cloud computing users as any stored information is sensitive and accessible only to authorized parties (Faragardi, 2017). The privacy issue was further supported by Tontaş & Bernardino (2016) in which the acceptance of cloud computing, therefore, will be determined by privacy issues addressed by cloud service providers and the countries where the data centers are located.

Furthermore, as the pool of data available in the cloud grows richer, it becomes particularly attractive to cyber crooks. So, in the event that confidential client's data are stolen, who shall hold the responsibility? This question is still debatable until now, is it the software developer, the hosting provider or the end-user itself. Nevertheless, every party needs to relook on its roles to ensure all the ethical measures in cloud computing are everyone responsibilities. Notwithstanding concerns for the ethical issues, the question of what can be done proactively about the ethics of cloud computing does not have easy answers as many undesirable phenomena in cloud computing will only appear in time (Tontaş & Bernardino, 2016). Hence we started off with this review paper to understand the overall aspects of cloud computing ethical issues and to identify the most crucial issues that need to be addressed.

3. Research Methodology

This section divides the research method into four subsections, which are a research question, research strategy, defining classification scheme, and mapping relevant studies (Findings). The research method was adopted from Salehi, Selamat, and Fujita (2015) and also follow guidelines proposed by Kitchenham and Charters (2007) and Petersen, Feldt, Mujtaba, and Mattsson (2008). Figure 1 illustrates the research method of the study and presents the research question in the study by defining the appropriate classification scheme.

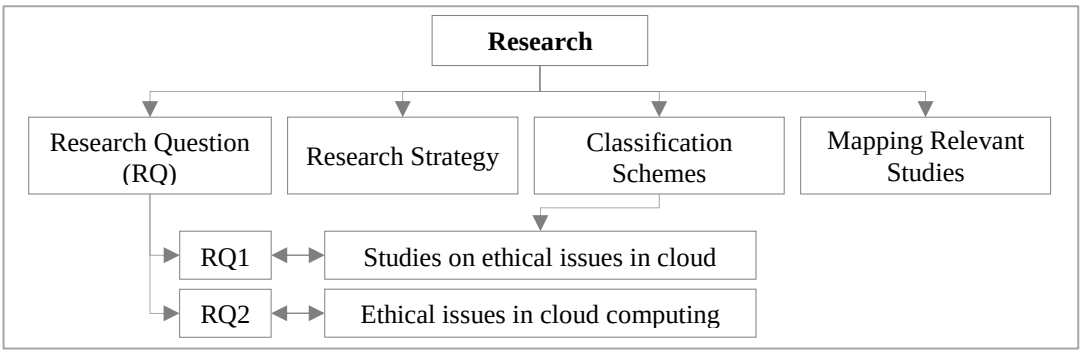

Figure 1: Research method diagram

3.1 Research Question

This study summarizes current existing ethical issues in cloud computing and suggestion to manage the issue. In constructing the research question, the study adopts the research question formulation method from Petticrew and Roberts (2008), which consists of five elements often known as PICOC. Table 1 shows the criteria and scope of the research question formulation.

Table 1: Formulation of research question

Criteria	Scope
Population (P)	Organization, industry, and practitioners.
Intervention (I)	Studies on ethical issues in cloud computing.
Comparison (C)	Ethical issues in cloud computing.
Outcomes (O)	List of existing ethical issues in cloud computing.
Context (C)	Reviewed studies of existing ethical issues in cloud computing.

Based on the five criteria in the research question formulation, the study defines the following research questions (RQs) to achieve the purpose:

RQ1: What are the present studies on ethical issues in cloud computing?

RQ2: What are the existing ethical issues in cloud computing?

3.2 Research Strategy

According to Salehi et al. (2015), there are three factors have influenced our research strategy: (i) search strings, (ii) search scope and (iii) search method. The search string used is "*ethical issues*", "*cloud computing*" which are combined using Boolean "AND" Boolean "OR" in the titles, keywords, and abstracts. The inclusion criteria for the selection of studies were searched scope of this study is based on automatic searches limited to the Science Direct (SD) and IEEE Xplore (IEEE) studies, which are published between January 2013 and December 2017. The search was performed in the recent five years' state-of-art. Figure 2 shows steps in conducting the systematic literature review.

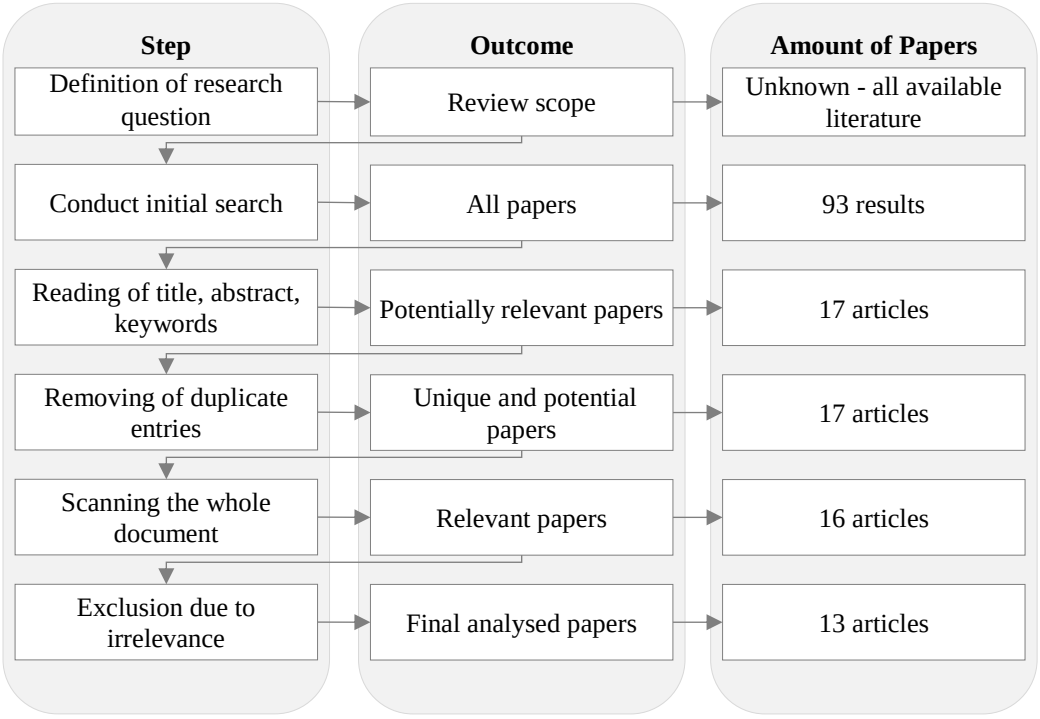

Figure 2: Steps in conducting the systematic literature review

The inclusion criteria also include papers written in English and the content must include ethical issues in cloud computing. The exclusion criteria apply to those articles that are not written in English, not focusing on particular ethical issues in cloud computing and did not match the research question stated. Finally, relevant studies are used for mapping through a defined classification scheme to identify the existing ethical issues in cloud computing.

3.3 Defining Classification Scheme

The articles were selected through three perspectives that focus on people, process and technology based on Leavitt's Diamond (Duncan & Whittington, 2015; Leavitt, 1965). These categories are adopted to map the studies in order to arrange the existing ethical issues in cloud computing.

4. Findings

Based on Figure 2, there are 93 articles have been identified from the initial phase of the search process by using the search terms defined in section research strategy. In the first filtration of the searching, only 17 articles were potentially relevant to this study based on the screening of titles, abstract and defined keywords. Next, each of these articles was filtered by eliminating any duplicates and via an in-depth reading of the full text in order to verify all articles meet the inclusion criteria as defined earlier. The process left out a total of 16 articles. Lastly, 13 articles were accepted for review after the filtration by exclusion due to irrelevance to this study. Therefore, this has answered research question 1 of this systematic review.

A total of 5 out of 13 articles was published in the year of 2017 which are the highest number of articles for this study. The year of 2014 has the least number of article, which is a total of 1 article. Table 2 depicts the number of articles per year reviewed for this study.

Table 2: Number of articles per year

Year	Count of Article
2013	2
2014	1
2015	3
2016	5
2017	2
Total	13

4.1 Ethical Issues Analysis

To answer the research question 2, thorough readings of all 13 articles were conducted to identify the cited ethical issues in cloud computing. The study follows the thematic analysis technique proposed by Braun and Clarke (2006). The thematic technique that consists of six (6) phases was implemented in this study to form the list of ethical issues in cloud computing. Figure 3 illustrates the process of conducting the thematic analysis technique.

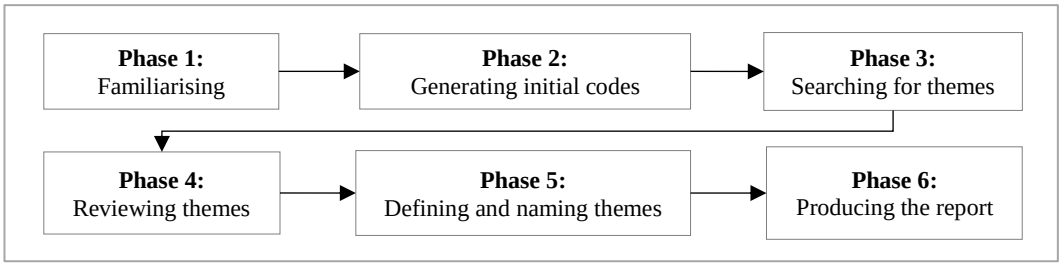

Figure 3: Thematic analysis technique (Braun & Clarke, 2006)

To assist the analysis, this study applied the Leavitt's Diamond (People-Process-Technology) (Leavitt, 1965). The justification is these three elements play vital roles in determining the ethical usage of cloud computing. As such, people by themselves have to do work. How they do their work and what they do their work with is the key question here. Next, the process helps people do better work. A process defines and standardizes work, preventing people from reinventing the wheel every time they begin working and finally technology helps people do faster more innovative work. From on the thematic analysis process, the list of ethical issues in cloud computing with total cited and perspective were tabulated in Table 3.

Table 3. Results of existing ethical issues in cloud computing

No.	Ethical Issues	Total Cited	Perspective
1	Cyber safety	1	Technology
2	Personal data protection	2	Technology
3	Cost of ownership	1	Process

No.	Ethical Issues	Total Cited	Perspective
4	Vulnerability towards attacks	1	Technology
5	Data privacy	7	Technology
6	Data confidentiality	1	Technology
7	Control of access to information	1	Process
8	Commercialization of information	1	Process
9	Ownership information	1	Process
10	Governance of information	1	Process
11	Electronic information transfer	1	Process
12	Data security	4	Technology
13	Data anonymity	1	Technology
14	Information downloads	1	Technology
15	Protection of human values	1	People
16	Advancement of human values	1	People
17	Equity	1	People
18	Well -being	1	People
19	Responsibility	1	People
20	Informed permission	1	Process
21	Informed acceptance	1	Process
22	Data usage	1	Process
23	People behaviour	1	People
24	Data protection	1	Technology
25	Cybersecurity	1	Technology

A total of 25 ethical issues in cloud computing was identified from a thematic analysis of the 13 articles. The most highlighted ethical issues in cloud computing are data privacy, which cited in 7 articles. The second most important ethical issues in cloud computing are data security which cited in 4 articles. Based on the review, it was found that ethical issues in process perspective such as control of access to information, commercialization of information, and governance of information were least highlighted in the articles. Besides that, the ethical issue in people perspectives such as equity, wellbeing, and responsibility was also least mentioned in the articles. Total ethical issues in cloud computing mentioned by each article are illustrated in Table 4.

Table 4: Total ethical issues cited in cloud computing by each article

Author (Date)	No of Cloud Computing Ethics Issues
(Wakunuma & Masika, 2017)	7
(Olaronke & Oluwaseun, 2016)	6
(Ratten, 2013)	5
(Salleh & Janczewski, 2016)	3
(Xhafa, Qassem, & Moore, 2014)	3
(El-Gazzar, Hustad, & Olsen, 2016)	2
(Voronova & Kazantsev, 2015)	2
(Tontaş & Bernardino, 2016)	2
(Macías & Guitart, 2016)	2
(Thakur, Qiu, Gai, & Ali, 2015)	2
(Chang, Walters, & Wills, 2013)	1
(Kouatli, 2016)	1
(Artífice, Sarraipa, Jardim-Goncalves, Guevara, & Kadar, 2017)	1

It was found that Wakunuma and Masika (2017) have highlighted most ethical issues in cloud computing with a total of 7 issues followed by Olaronke and Oluwaseun (2016) and Ratten (2013) with a total of 6 and 5 issues. Articles from Artífice et al. (2017), Kouatli (2016) and Chang et al. (2013) have the least mentioned ethical issues in cloud computing with a total of 1 ethical issue each. Figure 4 illustrates the total ethical issues in people, process, and technology perspectives.

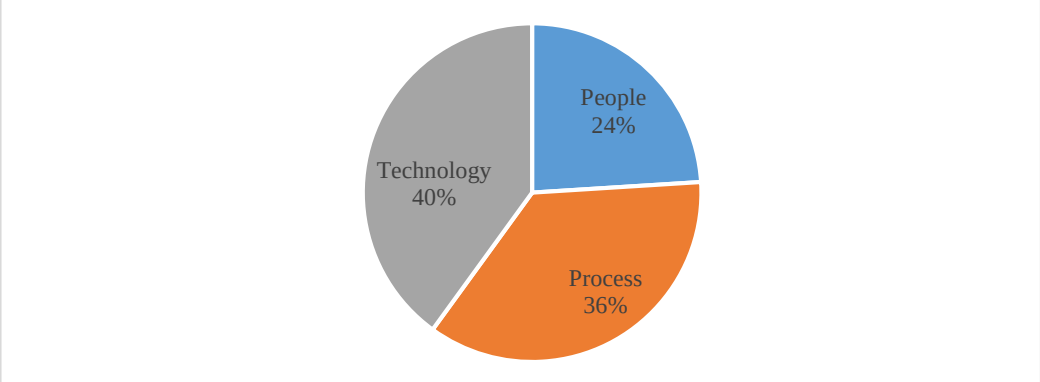

Figure 4: Total ethical issues cited in people, process, and technology perspectives

Based on Figure 5, ethical issues from technology perspectives were cited the most in the 13 reviewed articles with 40% and a total of 10 ethical issues cited. The ethical issues from people perspectives were cited the least in the 13 reviewed articles with 24% and a total of 6 ethical issues cited. Ethical issues from process perspectives were cited with 36% and a total of 9 ethical issues cited.

5. Discussion and Conclusion

This paper summarized the list of ethical issues in cloud computing according to three perspectives; people, process, and technology. Result of the systematic review and data analysis were discussed where the results show ethical issues in technology perspective were most discussed in the systematic review. To be precise, the ethical issue of data privacy is the most cited in the study. This shows that data privacy is the biggest concern in cloud computing. This paper was concluded with the general recommendation to manage the ethical issue in data privacy of cloud computing. With the right diligence process and plausible care, users can avoid the ethical dangers in data privacy of cloud computing.

From this literature review, it is evident that an ethical issue in the data privacy of cloud computing in the technology perspective is the biggest ethical issues highlighted. These findings indicate the relevancy of looking at an ethical issue in data privacy of cloud computing from several viewpoints, and such how these issues may play a role in encouraging/discouraging organizations' cloud computing adoption and how it affects user's confidence in releasing data to the cloud. This fact unlocks future research prospects to investigate more on cloud computing ethical issues and to propose a solution in combating this.

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