Understanding the Factors Affecting the Small and Medium Enterprises Adoption of Cloud computing: A Literature Review

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Abstract

Cloud computing is increasingly popular and brings many benefits to organizations. However, the adoption of cloud computing (CC) is influenced by many different factors. The current study is based on the Technology-Environment-Organization (TOE) framework to discover the influencing factors in the decision to adopt CC in SMEs. Quantitative methods have been used to analyze relevant articles. The findings of this study suggest that 28 factors influence the decision to adopt CC in SMEs. Moreover, top management support, technology readiness, security concern, and relative advantage have a stronger impact on CC adoption in SMEs. The findings of this study add to the present CC literature and help practitioners better comprehend the elements that drive CC adoption. As a result, they can develop a clear strategy for enhancing CC adoption in their enterprises.

Keywords: Cloud Computing Adoption, Environment Context, Organization Context, Technology Context

1. Introduction

Cloud computing adoptions bring many benefits for organizations such as cost savings, increased flexibility, and simple access to data sources (Gangwar, Date, & Ramaswamy, 2014). However, to use cloud computing, enterprises need to invest in information technology infrastructure systems. Therefore, they expect to make a profit when they apply cloud services (Priyadarshinee, Raut, Jha, & Gardas, 2017). The application of new technology helps organizations increase their competitive advantage and have many development opportunities. The globalization process is happening quickly. Therefore, the strong development of technology plays a huge role in developing the national economy in general and the business environment of enterprises in particular (Ezer Osei Yeboah-Boateng, 2014). Enterprises also face challenges such as information security, risks during use when they apply new technologies. Therefore, firms always have to consider carefully before they choose to adopt new technology. CC has brought many positive benefits in various fields such as sustainable construction (Oke, Kineber, Al-Bukhari, Famakin, & Kingsley, 2021), the banking industry (Niazmand, 2015), healthcare (Ali, Shrestha, Soar, & Wamba, 2018), manufacturing industry (Oliveira, Thomas, & Espadanal, 2014; Wang, Gao, & Fan, 2015), service sector (Jianwen & Wakil, 2020). SMEs account for a large proportion and have an important contribution to the economies. However, SMEs are currently facing many difficulties in terms of having insufficient investment capital, low quality of human resources, limited access to new technologies, and difficulties in finding markets for products (Kumar, Samalia, & Verma, 2017a). Many previous studies determined the actors influencing CC adoption in organizations (Akar, Mardiyan, & Systems, 2016; Rahimli, 2013; Stieninger et al., 2018). However, there is still a lack of comprehensive studies on the factors affecting the adoption of CC in SMEs. Therefore, this study will contribute to providing an overview of the factors influencing the decision to use CC in SMEs from the application of the TOE framework.

This study consists of five main parts. The first section contains an introduction that includes the reasons for conducting this research. An overview related research issues constitutes the second part. The research methods are presented in the third part. The fourth part presents the findings and discussion of the research on the factors affecting the choice to adopt CC in SMEs results and the final part is the conclusion.

2. Literature review

2.1 What is cloud computing?

Currently, CC is mentioned by the authors in many different aspects. Many perspectives on CC focus on specifications. Cloud computing is a model that makes computer resources available to users. It is classified as a technological service that consists of hardware and software. Users can access any resource in the cloud anytime and anywhere just connected to the internet (Ali, Warren, & Mathiassen, 2017; Armbrust et al., 2010). According to Novais, Maqueira, and Ortiz-Bas (2019), CC provides three main types of services including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). IaaS provides computing infrastructure such as servers, networks, operating systems,

and storage, through virtualization technology. Companies are the person who directly manages and controls the entire infrastructure. The most significant advantage of using IaaS is that firms can scale up and down based on their needs and capabilities. IaaS also saves businesses money and time by eliminating the need to purchase and manage physical servers and other data center infrastructure. In contrast, when firms use SaaS they will be in charge of managing aspects such as their applications, runtime, operating systems, middleware, and data. PaaS provides an environment for organizations to create applications that can be customized and developed to meet their specific needs. Firms can easily develop applications and save costs without having to pay attention to the network, storage, and servers when using this service. SaaS is a service that firms that need any application will rent and will use it directly via the internet environment. Most are web applications, so companies won't need to install any other software. When this service is used, the enterprise's data is saved on the server, ensuring data security. Companies are not responsible for updating hardware or application software. Recently the explosion of big data and information technology has made many researchers as well as businesses interested in exploiting and using CC as well as the benefits that it brings (Abd Elmonem, Nasr, & Geith, 2016).

2.2 Structure of cloud computing

Public clouds, private clouds, hybrid clouds, and community clouds are four CC models in use today. The characteristics of each cloud type are different. Public CC is the most popular cloud deployment model. The public cloud's services and applications are all hosted on the same cloud system. Public cloud can be accessed by multiple users at the same time. Data on the cloud will be managed and protected directly by service providers. These resources are available to the public so operating costs are lower. However, the security of this type of cloud is also lower. Businesses that require high security often choose to re-apply the private cloud (Vafamehr & Khodayar, 2018). Private cloud computing is often used for businesses. Enterprises can proactively use, upgrade, manage, and ensure information security when using private cloud resources. However, organizations often have difficulty in applying the service. The cost of building and maintaining the system is high. Private cloud internal use is limited to businesses, external users can not use it. Hybrid clouds are a combination of private clouds and public clouds. They are typically created by the enterprise, and management is shared by the enterprise and the public cloud provider. The purpose of combining platforms like this will bring higher performance to businesses. Applying enterprise hybrid cloud can cut internal storage capacity because they can move all unnecessary data to their external cloud and only store the most important data on the spot. Community clouds are CC services built by companies that work together and provide services to the community. However, to build a community cloud, businesses need to have many similarities such as the same business sector and common concerns about security policies. And the cost of building and deploying community clouds is very expensive.

2.3 The technology-organization-environment framework (TOE)

The TOE structure is one of the most mainstream and valuable structures for data innovation frameworks execution look in organizations. According to Tornatzky and Fleischer (1990), the application of technological innovation in organizations is affected by three main contexts including the technology, organization, and environment (Tornatzky & Fleischer, 1990). The technology context refers to the technology-related factors inside and outside the organization (Trigueros-Preciado, Pérez-González, & Solana-González, 2013). Ming, On, Rayner, Guan, and Patricia (2018) proposed a research model in which technology context includes relative advantage and cost saving. Gangwar et al. (2014) developed a research model that technology context consists of relative advantage, compatibility, and complexity while Karkonasasi, Baharudin, Esparham, Mousavi, and Suhaimi Baharudin (2016) mentioned three factors, cost saving, security concern, and reliability in the technology context. The organizational context describes the resource factors within the organization that influence the decision to adopt innovation within the organization. Kumar, Samalia, and Verma (2017b) proposed a research model in which the organization context includes top management support and firm size. Hani Al-Mascati and Al-Badi (2016) suggested a research model in which organization context contains technological readiness, top management support, IT management support, and firm size. Environment context includes factors outside the organization that influence an organization's decision to adopt cloud computing. Gangwar (2018) provides a research model with two factors (competitive pressure and vendors support) belonging to the environmental context. Lai, Sun, and Ren (2018) proposed a research model in which environmental context includes competitors and government policy while Lian, Yen, and Wang (2014) mentioned two factors, government policy and industry pressure in this context.

3. Research Method

3.1 Research methods

The study uses a quantitative method and a framework based on the TOE framework. The aim of the current study is to find out the factors influencing the adoption of CC in SMEs. This study uses the analysis frequency to show variables that have an impact to adopt CC in SMEs from related articles.

3.2 Paper selection

This study uses keywords such as factors, affecting, cloud computing, adoption, and SMEs to find relevant publications. In the first step, the authors read titles and abstracts to select papers that have the keywords appear (86 articles). Then, the authors read full articles to choose papers concerned with factors that have an impact on SMEs when they adopt CC. In the end, 30 papers were selected from five main sources of scientific paper databases: Science Direct, Research gate, Emerald Insight, Springer Link, and Academia (Figure 1). The papers were carried out in twenty countries (Figure 2.). This shows that CC has been applied in SMEs in many countries in the world.
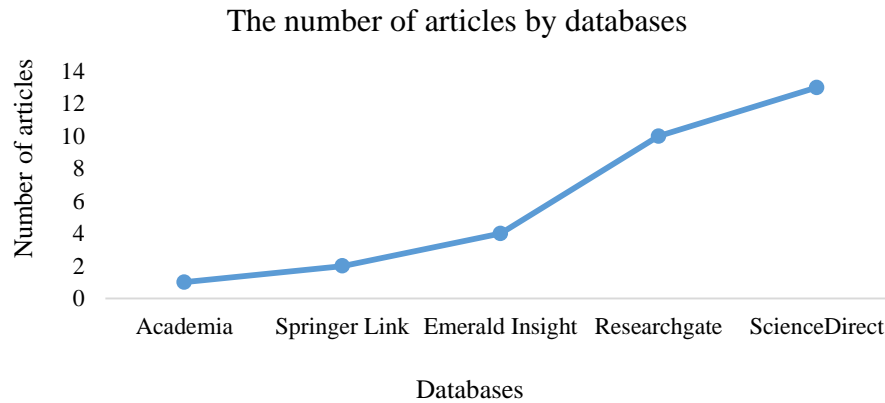
The number of articles by databases

Figure 1. The number of articles by databases
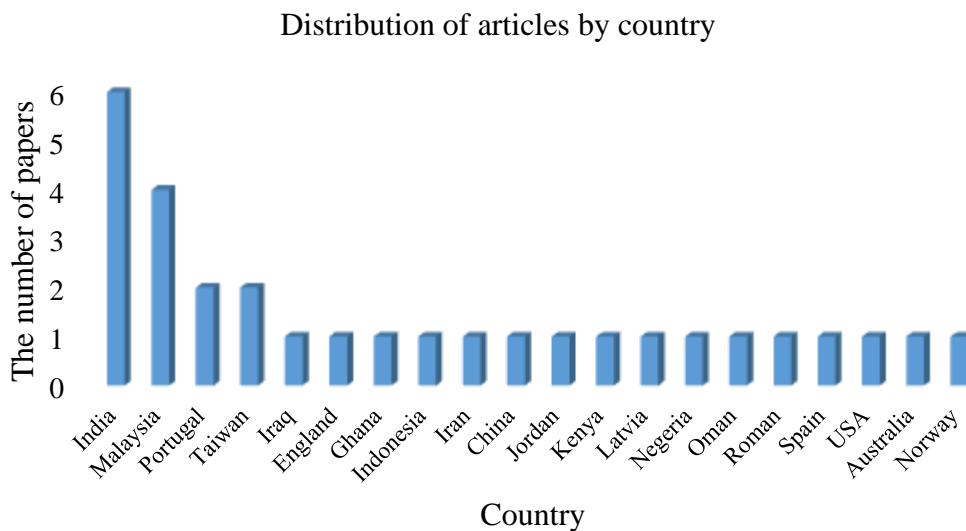
Distribution of articles by country

Figure 2. Distribution of articles by country

4. Findings and Discussion

Table 1 and Figure 3 present 28 factors recognized through frequency, cumulative, and rank for each factor. From the four highest-ranked factors, top management support ranked first followed respectively by technology readiness, security concern, and relative advantage. These four factors all have the percentage of the article mentioned higher than thirty percent of the total review articles. The cumulative percentage of these four factors is 38.562%. These factors were the most important factors that influence the adoption of CC in SMEs. Some factors elasticity, ecological sustainability, risk analysis, integrity, data sensitivity, strategy, and geo-restriction ranked lowest.

Table 1. Factors Affecting the Adoption of CC by SMEs

Variables	Category	Freq.	Cumulative	Rank
Top management support [1]	OC	18	11.765	1
Technology readiness [2]	TC	16	10.458	2
Security concern	EC	14	9.150	3
Relative advantage	OC	11	7.190	4
Organization readiness [3]	OC	9	5.882	5
Knowledge and training	OC	8	5.229	6
Compatibility	TC	8	5.229	6
Competitive pressure	EC	8	5.229	6
Vendor support [4]	EC	7	4.575	7
Cost issues	OC	7	4.575	7
Size of organization	OC	6	3.922	8
Complexity	TC	5	3.268	9
Ease of use and convenience/simplicity	TC	5	3.268	9
Reliability	TC	4	2.614	10
Trialability	TC	4	2.614	10
Trust	OC	4	2.614	10
Sharing and collaboration	OC	4	2.614	10
Governmental support	EC	2	1.307	11
Organizational risk	OC	2	1.307	11
Partner pressure	EC	2	1.307	11
Competitive advantage	OC	2	1.307	11
Elasticity	TC	1	0.654	12
Ecological sustainability	TC	1	0.654	12
Risk analysis	TC	1	0.654	12
Integrity	OC	1	0.654	12
Data sensitivity	TC	1	0.654	12
Strategy	OC	1	0.654	12
Geo-restriction	EC	1	0.654	12

* OC: Organization context, TC: Technology context, EC: Environment context

[1] Including top management support, transformational leadership, management style

[2] Including technology readiness, IT resources, computer self-efficacy, facilitating conditions, availability of good internet connection, adequate telecom services

[3] Including organization readiness, competency of the enterprise, previous technological experience, business concern, prior experience, the organization support

[4] Vender support, supplier efforts, service providers' support, efficient service delivery.
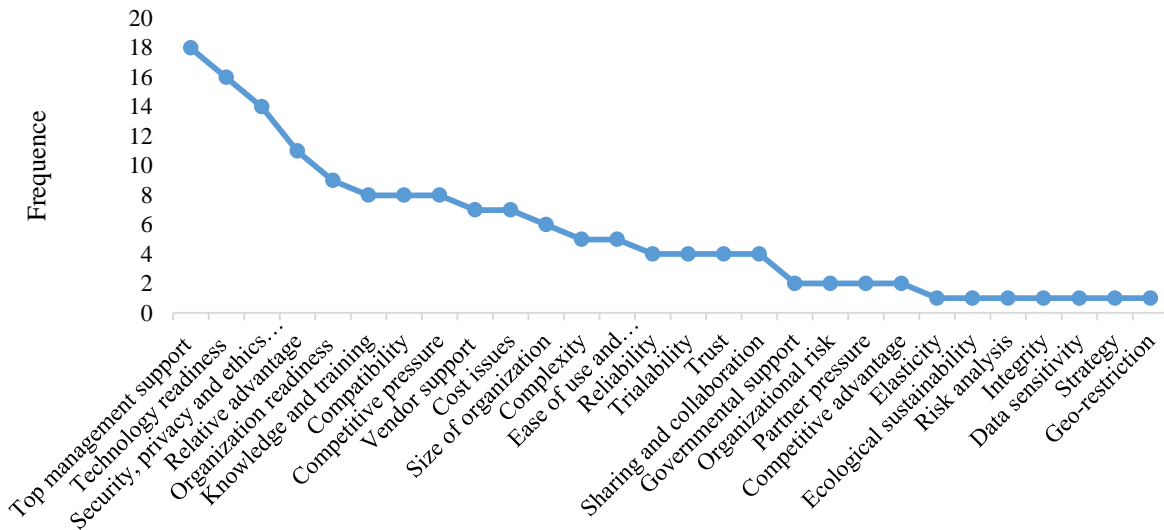
Figure 3. Factors frequency affecting the SMEs adoption of CC

Figure 4 presents the factors influencing the decision to adopt CC of SMEs based on the TOE framework. The organization context includes top management support and the other eleven factors. Top management support is the most important in the organization context. Moreover, organization context is a category that has the greatest influence on the adoption of CC in SMEs. Because the number of factors in organization context is the largest and many factors have high ranks. Technology context incorporates technology readiness and the other nine factors. According to, the number of factors ranked second after organization context. In this technology context, technology readiness ranked first. Technology readiness is an indispensable element for firms to apply new technology. Security concerns and the other five factors are included in the environmental context.

Technology context. The results of current study reveal that the technology context consist of technology readiness, compatibility, complexity, ease of use and convenience, reliability, trialability, elasticity, ecological sustainability, risk analysis, data sensitivity. In this category, technology readiness and compatibility are two factors that have the most important influence on SMEs' decision to apply CC in SMEs. Technology readiness refers to the readiness of information technology infrastructure and IT professionals. This is considered an important factor in affecting the decision of enterprises to adopt CC (Ming et al., 2018). If businesses are ready for the technology, implementing CC will have many advantages. According to Calisir, Altin Gumussoy, and Bayram (2009) compatibility refers to the suitability of the innovation to consumer requirements. Compatibility is a significant factor in the adoption of CC (Alshamaila, Papagiannidis, & Li, 2013; Raut, Gardas, Jha, & Priyadarshinee, 2017). Organizations will consider the compatibility of new technology with business needs when deciding whether or not to implement it. As a result, vendors must have a clear strategy for delivering CC products that meet the needs of their customers. Next, complexity is also an key factor influencing CC adoption. Complexity refers to how difficult it is to understand and

operate the system (Sohaib, Naderpour, Hussain, & Martinez, 2019). Therefore, complexity is considered a barrier for businesses when applying new technology. On the contrary, the ease of use factor will be has a positive influence on the decision to adopt the technology of enterprises.

Organization context. Our findings show that organization context includes top management support, relative advantage, organization readiness, knowledge and training, cost reduction, size of organization, trust, sharing and collaboration, competitive advantage, organizational risk, integrity, strategy. Top management support and relative advantage are the two most important factors influencing decision to use CC in SMEs. Top management support is an important factor affecting the decision to apply CC in SMEs. This is consistent with finding of Alshamaila et al. (2013); Carreiro and Oliveira (2019); Kumar et al. (2017b); Ming et al. (2018). If the leaderships understand benefits of CC they will support in applying to create value for the company. Support from upper management can assist ensure that all of the resources needed to implement new technologies are available (Premkumar & Potter, 1995).

Relative advantage is an important factor that influence to adopt CC in SMEs. Rogers (1995) defined relative advantage as "The degree at which an innovation is perceived as better than the idea it supersedes". According to the Diffusion of Innovation (DOI) theory of Rogers (2003) relative advantage was the factor that has a great influence on the application of information technology innovation. As companies identify the relative advantages of adopting CC, they will develop a clear strategy to adopt this technology. Enterprises' decisions to use CC are also influenced by their knowledge and training. Employees that know how to use CC will be more confident in their usage of new technology and will be less likely to take risks. Therefore, before applying CC, businesses need to have a training plan to help employees understand the benefits and how to use CC. Similarly, Gangwar et al. (2014) found that training and education as significant determinants of CC adoption.

Environment context. The results of this study indicate that the environment context contain security concern, vendor support, competitive pressure, governmental support, partner pressure, geo-restriction. Security concern has an important impact to adopt CC in SMEs. This is finding is similar to some previous studies (Abubakar, 2014; Gupta, Seetharaman, & Raj, 2013; Raut, Priyadarshinee, Gardas, & Jha, 2018; Sohaib et al., 2019). Information technology infrastructure systems that protect and store data and access control of unrelated parties are always a concern for data accesses. This shows that organizations are very concerned about security, privacy, and ethics when they apply CC. Competitive pressure has a influence on the application of CC SMEs. Competitive pressure refer to the amount of competition an organization faces in its industry (Zhu & Kraemer, 2005). Competition promotes organizations in finding new solutions to improve production efficiency. Sohaib et al. (2019) found competitive pressure has a critical impact on CC adoption in SMEs. Vendor support is critical when organizations come to implementing new technologies. Many SMEs lack high-quality human resources, businesses frequently encounter technical difficulties when implementing new technology. Vendor support will assist them in promptly and efficiently resolving technology-related difficulties. Alshamaila et al. (2013) evidenced that the active support of vendors plays an important role in promoting the application of CC.

According to Tan, Chong, Lin, Eze, and Systems (2009), SMEs can run more efficiently if they use the correct information technology. Nonetheless, SMEs often lack information technology experts as well as budget sources for investment in building and maintaining the information technology infrastructure. Therefore, finding reputable suppliers is a very important factor for SMEs when they apply new technology. The government should provide information on reputable and quality cloud service providers for SMEs. Thanks to that, SMEs can easily find suitable suppliers.
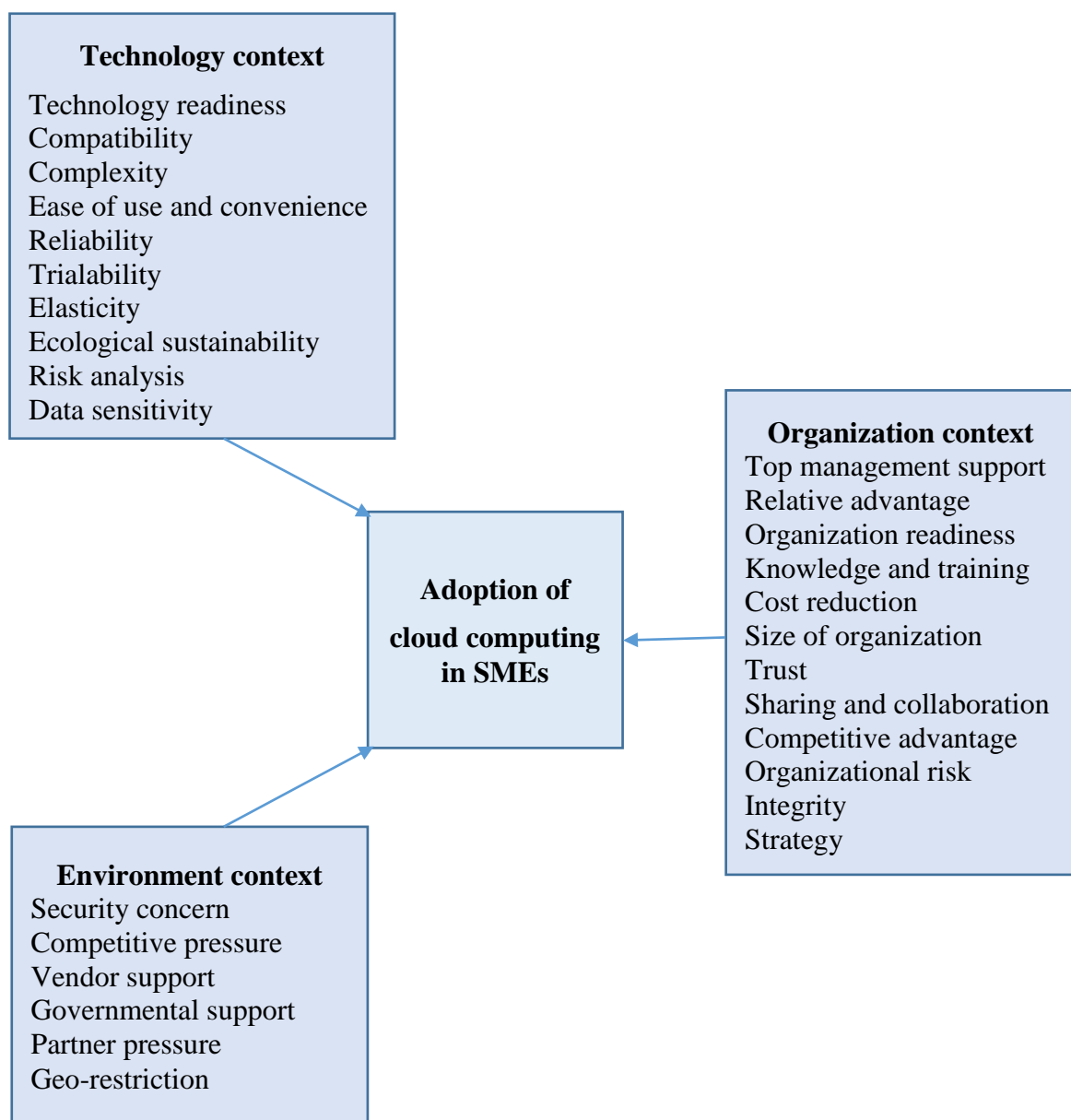
Technology context

Technology readiness
Compatibility
Complexity
Ease of use and convenience
Reliability
Trialability
Elasticity
Ecological sustainability
Risk analysis
Data sensitivity

Adoption of cloud computing in SMEs

Organization context
Top management support
Relative advantage
Organization readiness
Knowledge and training
Cost reduction
Size of organization
Trust
Sharing and collaboration
Competitive advantage
Organizational risk
Integrity
Strategy

Environment context
Security concern
Competitive pressure
Vendor support
Governmental support
Partner pressure
Geo-restriction

Figure 4. The conceptual framework

5. Conclusions

The purpose of this study conducted a review of the factors affecting CC adoption in SMEs. This study analysis of articles with relevant content according to CC and is based on the TOE framework. In this study, 28 factors affecting CC were identified. Some factors have high frequency and cumulative that are top management support, technology readiness, security concern, and relative advantage. The findings of this study are important to help managers, suppliers, policy makers understand the factors affecting the decision to adopt CC in SMEs. Therefore, they can build detailed strategies to enhance CC adoption. This study also has some limitations. First, the number of related articles reviewed in this study is limited. There may be a lot of research related to the research problem that has not been covered. In the future, it is advisable to expand the dataset source. Second, the factors that influence the application of CC in different types of enterprises are different. Hence, studies that provide an overview of the elements affecting the application of CC in each specialized industry should be conducted in the future.

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