COST FACTORS ANALYSIS OF CLOUD COMPUTING SERVICES: A REVIEW OF LITERATURE

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ABSTRACT

In the current financial crisis and the growing need for quality information flow in organizations are under increasing pressure to provide more from less. The use of cloud computing in organizations relieves a load of sophisticated Information Technology (IT) infrastructure administration and maintenance operations while also resulting in significant cost savings. The use of cloud computing services appears to offer significant cost advantages particularly start-up companies since frequently they do not operate an internal IT infrastructure. Cloud promises to deliver affordable, reliable, and flexible computing solutions to the education sector and enable it to compete more effectively with bigger organizations. In this paper, the particular cost types and factors of Total Cost of Ownership (TCO) are presented for cloud computing services. A comparative analysis of cloud-based hosting versus conventional (on-premise) application deployment has also been summarized. This paper aims to spur the communities on the knowledge of cloud computing implementation investment consideration in the perspective of Malaysian organizations and how to estimate costs of cloud-based systems before they enter the operational phase. Systematic literature review applied in this study, analysis of real cloud computing services for the development and evaluation of the basic mathematical model. This is necessary to make economical IT investment decisions for or against cloud computing more objective.

Keywords: TCO, Cloud Computing, IT investment, Cloud computing services

1. INTRODUCTION

Cloud computing boosts IT productivity by providing easy access to hardware and software resources, as well as increased business agility. Cloud computing is a technology model that enables users to take advantage of the best computational resources available from service providers. Many firms choose not to study and analyze their options because of the predicted benefits of cloud computing, such as great adaptability and low prices. On a different note, despite its potential benefits, the adoption rate of cloud computing in Malaysia has been poor and the lack of studies that provide a holistic investigation related to the cost impact of cloud computing adoption may have hindered decision making on the adoption of cloud computing in Malaysia organizations.

The paper is structured as follows. In the following section, we define the term cloud computing and its cost-specific benefits based on the extant literature. Next, we explore the related cost involved in the TCO. Then we explain the methodology used to collect data for this research. We outline the findings and the discussion of the research data and its reliability. We finally draw conclusions based on the contributions made in terms of implications to service providers and managers.

2. RELATED WORK

From a historical perspective, cloud computing could be traced to the grid computing era of the 1990s, which allowed the networking of many computing devices to work together primarily in scientific research. Grid computing evolved to utility computing in the late 1990s, which attempted to provide metered computing services similar to utility services. From there, Software as a Service (SaaS) was initiated in the early 2000s allowing users to access commercially available software online for a fee instead of acquiring licensed applications. The transition from grid computing to cloud computing has transformed computing operations, which used to require major capital investment into a readily available, affordable commodity [1]. There are various definitions of cloud computing. The United States National Institute of Standards and Technology (NIST) presented a basic definition of cloud computing as a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources includes networks, servers, storage, applications, and services. It can be rapidly provisioned and released with minimal management effort.

The entire cloud computing services could be divided into three services and four deployment models. The cloud service model is shown in Figure 1. Service models describe what kind of services can be obtained from the cloud. Cloud service delivery is divided into three typical models and various derivative combinations. Depending on the model selected, the cloud provider delivers differentiated services. These services are generally classified according to the level of the IT architecture they reside in. The cloud provider determines how the service is offered within the agreed-upon Service Level Agreements (SLA), and how the services on underlying layers may be accessed [2]. Software as a Service (SaaS) is the topmost layer of cloud computing. This is a software distribution model in which applications are hosted by a vendor or service provider and made available to customers over a network, typically the Internet. Platform as a Service (PaaS) is a paradigm for delivering operating systems and associated services over the Internet without downloads or installation. Infrastructure as a Service (IaaS) involves outsourcing the equipment used to support operations, including storage, hardware, servers, and networking components [3], [4].
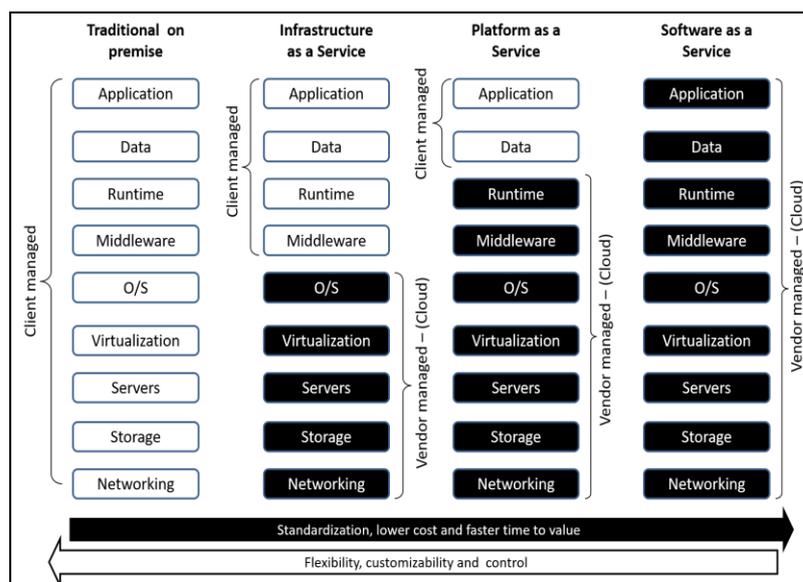

Figure 1: Cloud service model [3]

Cloud computing has been proposed to reduce the total cost of computing [5]. By adopting cloud computing, a firm can reduce the time devoted to system maintenance and routine upgrades. Cloud computing also reduces infrastructure costs, decreases energy consumption, and lowers

maintenance expenditures [6], [7]. Vendor specialization enables cloud service providers to offer IT functions at lower costs and pass the cost savings from economies of scale to the end-user [8], [9]. As an enabler of the swift adoption of changing technologies, cloud computing offers cost-effective ways to transform businesses ([7]. Perceived benefits refer to the operational and strategic benefits an organization is expected to receive from cloud computing; some of these are mobility, efficient reduction of computing costs, easy installation and maintenance, and easy data analysis over the Internet [10].

3. METHODOLOGY

The Systematic Literature Review (SLR) approach is used to realize the aim of this study. SLR is referred to as a process of identifying, evaluating, and interpreting all available research relevant to research questions, area of study, or rising phenomenon of interest. Analyzing previous studies is an important endeavor in all disciplines [11]. A systematic literature study should consider quality literature, provide a basis for any research, indicate the novelty of the research works, and propose future studies and benefits [12]. The key activities within SLR including scoping, screening, planning, and identifying.

The entire review process was conducted with specific guidelines to reduce the possibility of researcher bias. The development of research questions is an important activity in this study with the main objective to answer research questions highlighted below:

RQ1. What is the percentage of the cost difference between cloud computing and on-premises?

RQ2. What are the factors of TCO cost that need to be considered toward cloud computing migration?

4. ON-PREMISES VS CLOUD COMPUTING COST FACTORS

Cost is claimed as a critical issue in implementing advanced technology like cloud computing in the organization [13]–[20]. In the context of higher education, cloud computing could be a technological innovation that both reduces IT costs for the institution and eliminates many of the time-related constraints for students, making learning tools accessible to a larger number of students. Bedward and Fokum (2014) identify a key driver for HEIs growth, is the cost savings which would be a significant achievement for any institution. Hailu, (2012a) has the same finding as Yoo and Kim (2018) that indicated cloud computing provides powerful computing systems with much lower cost compared to the traditional infrastructure.

Providing IT services in the cloud shifts much of this expense to a pay-as-you-go model, hence offers remarkable cost advantages according to one view [21]. The cloud changes the nature of many traditional factors of cost-saving. [21]–[24] listed all factors considered while calculating the cloud cost as infrastructure, hardware, software, service vendor, staffing, long term strategy, integration, configuration, and training. The methods that are commonly used for cloud computing are Return on Investment (ROI), Net Present Value (NPV), the Internal Rate of Return (IRR), Economic Value Added (EVA), Total Cost of Ownership (TCO) productivity of employees [25].

According to [26], computer systems are no doubt an important asset for any firm, and for a better quality of business, firms must have all the latest hardware resources available in the market. US educational establishments recognized the potential of cloud computing to increase efficiency and improve cost. Cloud computing can also offer new ways for an organization to explore up-to-the-minute research opportunities by sharing cloud computing resources with other businesses. The cloud model provides the organization the ability to deploy new IT platforms, services, applications, and test environments. According to the Edtech article reviewed by [26], organizations are moving toward cloud computing applications to increase the efficiency and mobility effectiveness of the system with minimum cost. Firms can increase efficiency by 55 percent, mobility by 49 percent, and cost by 25 percent. Kawatra illustrates the comparative cost analysis by using the TCO method for cloud computing implementation service and on-premise for the education institution as in Table 1 – Table 3.

Table 1: Upfront cost [22]

On-Premise		AWS cloud-based	
Configuration	Cost	Configuration	Cost
Technical Readiness		Technical Readiness	
Network Start-Up	7,900.00	Network Start-Up	NIL
HP Switch	20,000.00	HP Switch	NIL
Online UPS (20KVA)	110,000.00	Online UPS (20KVA)	NIL
Power and cooling	84,000.00	Power ad cooling	42,000.00
Antivirus	24,000.00	Antivirus	NIL
HP Deskjet	25,000.00	HP Deskjet	25,000.00
Racktus Wifi controller	175,000.00	Racktus Wifi controller	75,000.00
Wifi access control	45,000.00	Wifi access control	5,000.00
Software SQL server	360,000.00	Software SQL server	2,916.00
Windows OS (Client)	14,000.00	Windows OS (Client)	NIL
Windows server	3,000.00	Windows server	792.00
Recurring Cost			
Configuration/ customization		Configuration/ customization	
20 Core2 Duo Processor	50,000.00		
Server with ITB	120,000.00		
Implementation/ integration		Implementation/ integration	
Installing migration cost	20,000.00	Migration cost	NIL
Total	**742,900.00**	**Total**	**24,467.00**
Difference		**618,433.00**	
Termination Cost			
On-Premise		AWS cloud-based	
Unplanned repair cost	12,000.00		
Total	**12,000.00**	**Total**	
Difference		**12,000.00**	

Kawatra analyzed the details of a 12-month cost comparison in Table 3.3 indicated that cloud computing has seen beneficial in higher education to increase the growth according to all different parameters which include upfront cost, recurring cost, and termination cost. Therefore, after opting for cloud computing, the organization can see a great amount of saving for a university because of the percentage difference for the recurring cost to 33.6 percent while the upfront cost to 35.7 percent and 100 percent for termination cost.

In other research by [21], made a comparison of the cost between on-premise options and Cloud Computing. Two cost estimates were created, the first for building and setting up IT infrastructure in-house in the Federal University of Technology (FUTO), Nigeria while the second cost estimate will be for setting up IT in the cloud for the same Institution. Table 2 states the cost estimate for the various items in the work breakdown structure used to deploy IT on-premise and in the Cloud for FUTO.

Table 2: Estimated Cost of IT infrastructure between on-premise and cloud service [21]

WBS Items	On-Premise ($ USD)	Cloud Service
Project Management	16320000.00	5520000.00
Staffing	9900000.00	4800000.00
Hardware	9550000.00	900000.00

Software	6000000.00	2000000.00
Service providers	7007392.00	8165680.00
Hosting	100000.00	0.00
Testing	1555000.00	290000.00
Training	880000.00	220000.00
		21895680.00
	51312392.00	

Comparing the percentage difference of Cloud vs. In-house, the total cost of the In-house project is 51312392.00 while the total cost of the Cloud-based project is 21895680 [(56443631 – 21895680) / 51312392] x 100 = 57.3%. This result shows that Cloud Computing has a way of greatly reducing Capital Expenditure costs. Research by [24] has proven that the costs associated with Cloud Computing Services are really low. They found that particular cost types and factors are frequently underestimated by practitioners. The study compares the cost of hosting LMS services between on-premise and cloud-hosted approaches in higher education, taking Tanzania as a case study. The study found that institutions can significantly reduce the cost of LMS implementation by adopting a cloud-hosted approach. [24], used the Total Cost of Ownership (TCO) approach, where the costs were divided into two main categories: up-front costs which cover hardware, software, and Auxiliary Server Equipment as shown in Table 3, and operational cost which include maintenance, hosting and Power Consumption as shown in Table 4 in recurrent or monthly costs. Therefore, "Total cost = Up-front costs + Operational cost".

Table 3: Upfront cost comparison (On-premise and cloud computing service) [24]

Upfront	Quantity	On-Premises	On Cloud	Remarks
Server Hardware & OS	1	7894.5	NIL	Pre-installed OS
Backup Server Hardware & OS	1	7894.5	NIL	Pre-installed OS
Uninterrupted Power Supply (UPS)	2	2072	NIL	Two UPSs
Auxiliary Server Equipment	1	2000	NIL	
LMS		NIL	NIL	Open-source software
Content Development Software	1	5580	5580	
Multimedia integration tools	1	NIL	NIL	Open-source software
Total		25441	5580	

Table 4: Operational cost comparison (On-premise and cloud computing service) [24]

OPERATIONAL	Monthly Cost	On-Premises	On Cloud
Maintenance Cost (based on salaries of two staff for 36 months)	1000	36000	NIL
Hosting Costs	60	2160	21232.08
Cooling systems and power consumption	100	3600	NIL
Total		41760	21232.08

Generally, the study has shown that institutions can reduce the significant cost of running LMS courses by hosting LMS services into the cloud service. The cost comparison of cloud-hosted versus on-premises hosted approach is 43 percent and more specifically, the study has found that institutions can save approximately $40,388.92 in 3 years by hosting Moodle LMS and its

services in the cloud. The findings of this study are consistent with a study conducted by [23]. Chandra and Borah compared TCO for replacing five computers by migrating all its services into the cloud. The study found the savings per user per month were $942.60 whereas the savings for replacing office PCs by migrating its services into the cloud were $33.05. [27] further noted that Florida Atlantic University reduced ICT costs by at least $600,000 by migrating the Blackboard LMS and its services into the cloud. Similarly, Wake Community College witnessed annual ICT costs dropped from $1.04 million to $570,000 annually which is nearly 50 percent by migrating IT services in the cloud.

Furthermore, in cloud computing implementation factor, many other researchers put cloud computing helped to reduce the cost in the areas of procurement of hardware infrastructure, installation, and maintenance [14], [16], [17], [19], [28]–[34]. [5] in their research summarized that SMEs adopting cloud services is expected to decrease external costs and make them less located. According to [19], the cost of acquiring, implementing, and maintaining a robust and reliable IT infrastructure is very high and has led many universities in developing countries to lag in technological advancements in ICT infrastructure. Sabi added that cost factors are expected to be moderated by the size of the organization such as larger organizations will more easily afford the cost of cloud computing than smaller organizations.

As reported from Applied Research (ECAR), because of the funding crisis, higher education is placing pressure on the institution to make the available dollars stretch as far as possible so as not to reduce services. Several alternatives may help IT organization, and thus institution reduces their cost if they are prepared to make the changes that will truly deliver efficiency. Those alternatives include centralizing IT services and systems, purchasing a scale; outsourcing services, platforms, and infrastructure, and standardizing business processes [35]. Thus, cost-effectiveness is the strongest driver affecting IT decision-makers when deciding to implement cloud computing opportunities [8].

According to [36] calculating cost comparisons between cloud IaaS versus on-premises infrastructure is complex, even with simplifying assumptions, and is dependent upon the specific solution being deployed. While it varies wildly depending upon the specifics of the system being deployed, for midmarket/ enterprise businesses, cloud-based solutions represent a potential cost savings of 30% (despite all conceivable advantages being given to on-premises).

In general, the company today always looks for a cost-effective solution for IT infrastructure. Hence most organizations spent 50 percent of their budget to balance the IT infrastructure [6]. According to [37], operating a private data center and managing software licensing to meet growing computing processing demands is complex and costly. [30] showed that the financial benefits of cloud services vary and the cost is found to be the main reason for enterprises that moved back from the cloud. However, with such a vast amount of allocated budget, less than 10% of their servers could be utilized, resulting in a big waste of money. There are significant cost savings that can be realized by virtualizing end-user computing, server storage, network operations, and large organizations can learn from best practices to achieve significantly higher server utilization rates and lower Total Cost of Ownership (TCO). This impact is contradicted with traditional computing. Company servers need to be replaced and the system needs to be upgraded almost every three years and needs to be maintained and administrated, which increases the total cost of IT operations radically.

5. RESULT

The literature review led to the selection of several cost factors in diverse industries. Table 5 lists the most common antecedents, along with their definitions.

Table 5: Definition of the cost factor

Factor	Definition	Authors
Hardware	Hardware is an important physical asset of an organization for technology infrastructure development. Organizations need to have the latest model of hardware	[22], [38]

	resources in the market include client computers, network and internet devices, UPS, and computer servers.	
Software	The system interacts with the user and for application and operating system. Software development is needed for both computer clients and servers. It includes organization IS and utility software for antivirus, data protection software, integration software and communication,	[39], [21]
Backup server/ Data recovery	The equipment for recover any consumption in the organization. This is for preparation for any data loss and business continuity. This is included the policy of data centers to protect the client data during DR.	[22], [25], [23]
Uninterrupted Power Supply	An uninterruptible power supply (UPS) is a device that allows a computer to keep running for at least a short time when the primary power source is lost. UPS devices also protect from power surges.	[24]
Upgrading hardware and software	Upgrading is the process of replacing a product with a newer version of the same product. In computing and consumer electronics, an upgrade is generally a replacement of hardware, software, or firmware with a newer or better version, to bring the system up to date or to improve its characteristics.	[40], [40]
Hosting	Web hosts are companies that provide space on a server owned or leased for use by clients, as well as providing Internet connectivity, typically in a data center. Web hosts can also provide data center space and connectivity to the Internet for other servers located in their data center.	[36]
Staffing	Expert of databased and network administrator	[21]
Training	Training for client/staff on monitoring/handling network, databased and infrastructure.	[25]
Maintenance	The cost was involved in any system error, hardware, software, network, and security problems.	
Network and configuration	Cos of network and internet configuration.	[25]
Monthly commitment	A predetermined amount of fee the organization commits to spending each month for the technology provider.	
Ongoing cost	The costs that the investment company would have to pay in the absence of any purchases or sales of investments such as additional storage and upgrade network speed.	[36]

With a systematic search strategy, the initial search result identified 80 articles. The Mendeley tool was used to remove duplicates before deploying the inclusion and exclusion criteria which reduced the result to 50 articles. A total of 48 articles was selected as the primary study after applying the quality assessment. During the analysis of the primary study, cost factors were identified for further discussion based on cost comparison analysis. Given that the cloud computing implementation cost factors in table 6 guide the further discussion and research analysis in specific industries or sectors.

Table 6: Cost factors

Factor	Authors
Hardware	[42], [21][22]–[24][36], [21]
Software	[21], [36], [39], [43]
Backup server	[22]–[24]
Rack, Uninterrupted Power Supply and Cooling systems.	[39] [24] [36] [43]
Upgrading hardware and software	[43]
Hosting	[24] [21]
Staffing	[21] [21]
Training	[43] [21]
Maintenance cost	[24] [36] [43] [44]
Network startup and configuration	[21] [21] [36]
Monthly commitment	[36] [21] [44]
Ongoing cost	[24] [36] [43] [44]

After a thorough examination of the literature on cloud computing implementation costs, the cost model is developed. The eleven most common cost antecedents were chosen as the driving variables for an organization's adoption of cloud computing. Figure 2 depicted a model of important factors to consider when deciding whether or not to utilize cloud computing technology.
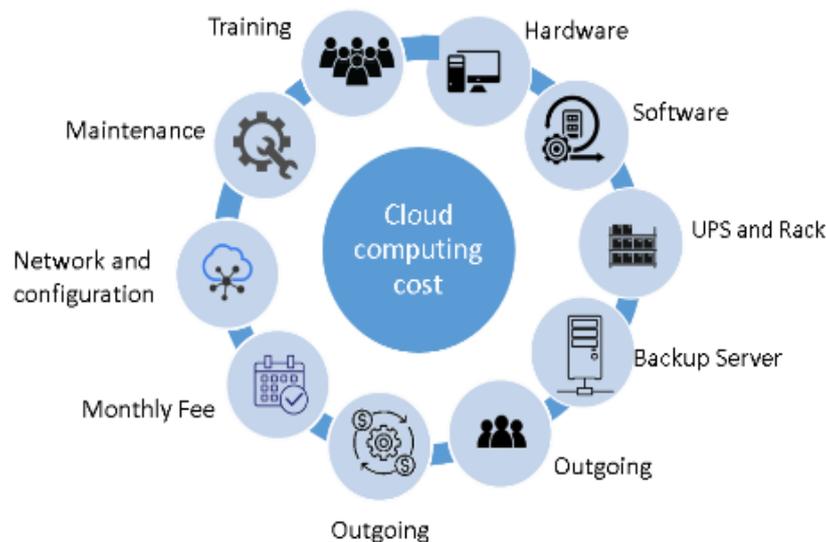

Figure 2: Model of cloud computing implementation cost

According to Deckler {36} calculating cost comparisons between cloud IaaS versus on-premises infrastructure is complex, even with simplifying assumptions, and is dependent upon the specific solution being deployed. While it varies wildly depending upon the specifics of the system being deployed, for midmarket/ enterprise businesses, cloud-based solutions represent a potential cost savings of 30% (despite all conceivable advantages being given to on-premises). A study by [24] has shown that institutes can reduce the significant cost of running learning system courses by hosting the services into the cloud service and the institutions can save 43% of cloud-hosted comparing on-premises hosted approach. Chandra and Borah [23] further noted that Wake Community College witnessed annual ICT costs dropped annually which is nearly 50 percent by migrating IT services in cloud computing. Analysis by [22] showed that after opting for cloud computing, the organization can see a great amount of saving for a university because of the percentage difference for the recurring cost to 33.6 percent while the upfront cost to 35.7 percent and 100 percent for termination cost. In another study by [21] the percentage difference of Cloud vs. In-house, the total cost of the In-house project is 57.3% and this result shows that cloud computing has a way of greatly reducing Capital Expenditure costs.

6. DISCUSSION

A crucial point in cloud computing vs on premise cost comparison is an initial investment in hardware and infrastructure. It can be extended for On-Premises systems. Not to mention the ongoing costs of maintenance, storage space, power consumption, and dedicated IT support. Infrastructure also requires a regular, large investment to stay up to date. The cost analysis in this study is based on numerous aspects such as the size of the organization, the industry, and the level of implementation. This paper looked at the fundamentals of cost analysis and cost differentiation in the context of a business include educational institutions. Cost factors are examined to generate basic cost knowledge based on what organizations should be aware of during the decision-making stage of cloud computing procurement. According to research pieces of literature, cloud computing deployment costs are 30-50 percent less than on-premises computing.

7. CONCLUSION AND FUTURE RESEARCH

Cloud computing gives a new perspective to the business sector in terms of cost-benefit analysis and introduces various parameters, which can influence the organization to adopt this technology. So, by adopting these parameters, the organization relieves itself from the complex IT infrastructure as well as maintenance cost of the same. Cloud computing is a beneficial system in many aspects, considering the economic situation of the organization across the world. However, there are a significant number of challenges associated with cloud adoption along with the benefits. Present work can serve as a good analysis tool for the business organization while looking for a migration to cloud services. In summary, this study provides new insight into understanding the cost factors of cloud computing implementation. With references systematically derived from previous works of literature, the study presents the basic elements involved in the cost of migration that decision-makers need to consider before requiring this technology in their organization. Future works for this study include several steps of content validity, pilot survey, questionnaire distribution, and data analysis in the context of Malaysian organizations specifically Higher Education Institutions.

8. ACKNOWLEDGMENT

REFERENCES

[1]   M. J. O. Sullivan and D. Grigoras, "Integrating Mobile and Cloud Resources Management using the Cloud Personal Assistant," *Elsevier*, vol. 50, no. 01, pp. 20–41, 2015.

[2]   R. Kassim, N. Aziati, A. Hamid, and L. Nordin, "Potential Benefits And Obstacles Of Cloud Computing Implementation In Higher Education Institutions (Heis): A Delphi Study," *J. Crit. Rev.*, vol. 7, no. 8, pp. 93–98, 2020.

[3]   Q. Alajmi and A. S. Sadiq, "Cloud Computing Delivery and Delivery Models : Opportunity and Challenges," *Adv. Sci. Lett. J.*, vol. 24, no. 6, pp. 4040-4044, 2018.

[4]   M. Joshi, "Emerging Trends of Cloud Computing in Education Methodologies : A Review," *Int. J. Adv. Res. Comput. Sci. Softw. Eng.*, vol. 5, no. 12, pp. 3–6, 2015.

[5]   Y. Alshamaila, S. Papagiannidis, and F. Li, "Cloud computing adoption by SMEs in the north east of England: A multi-perspective framework," *J. Enterp. Inf. Manag.*, vol. 26, no. 3, pp. 250–275, Apr. 2013.

[6]   S. Marston, S. Bandyopadhyay, and a Ghalsasi, "Cloud Computing - The Business Perspective," *2011 44th Hawaii Int. Conf. Syst. Sci.*, pp. 1–11, 2011.

[7]   R. Martins, T. Oliveira, and M. A. Thomas, "An empirical analysis to assess the determinants of SaaS diffusion in firms," *Comput. Human Behav.*, 2016.

[8]   A. Benlian and T. Hess, "Opportunities and risks of software-as-a-service: Findings from a survey of IT executives." *Decis. Support Syst.*, vol. 52, no. 1, p. Pages 232-246, 2013.

[9]   S. Jones, "Cloud computing procurement and implementation: Lessons learnt from a United Kingdom case study," *Int. J. Inf. Manage.*, vol. 35, no. 6, pp. 712–716, 2015.

[10]   M. Armbrust, A. D. Joseph, R. H. Katz, and D. A. Patterson, "Above the Clouds : A Berkeley View of Cloud Computing," 2009.

[11]   R. T. Watson, "Analyzing the Past to prepare for the Future: Writing a Literature Review," vol. 26, no. 2, 2002.

[12]   S. Miskon and E. Fielt, "A Systematic, Tool-supported Method for Conducting Literature Reviews in Information Systems QUT Digital Repository : © Copyright 2011 please consult authors," *19th European Con. on Info. Sys., ECIS 2011*, June 2011.

[13]   R. Bedward and D. T. Fokum, "A Cloud Computing Adoption Approach for Jamaican Institutions," in *IEEE*, 2014, pp. 1–6.

[14]   A. Rahimli, "Factors Influencing Organization Adoption Decision On Cloud Computing," *Int. J. Cloud Comput. Serv. Sci.*, vol. 2, no. 2, pp. 140–146, 2013.

[15]   V. Chang, R. J. Walters, and G. Wills, "Review of Cloud Computing and Existing Framework for Cloud Computing," in *Adv. in Cloud Comput. Res.*, NOVA Publishers, 2014.

[16]   A. Abubakar, J. Bass, and I. Allison, "Cloud Computing: Adoption Issues for Sub-Saharan Africa SMEs," *Electron. J. Inf. Syst. Dev. Ctries.*, vol. 62, no. 1, pp. 1–17, 2014.

[17]   A. Hailu, "Factors Influencing Cloud-Computing Technology Adoption in Developing Countries," 2012.

[18]   O. Ali, J. Soar, and J. Yong, "An investigation of the challenges and issues influencing the adoption of cloud computing in Australian regional municipal governments," *J. Inf. Secur. Appl.*, vol. 27, pp. 19–34, Dec. 2015.

[19]   H. M. Sabi, F. M. E. Uzoka, K. Langmia, F. N. Njeh, and F. Han, "Conceptualizing a Model for Adoption of Cloud Computing in Education," *Int. J. of Info. Manage.,* vol. 36, no. 2, Elsevier Ltd, 2016, pp. 183–191.

[20]   M. Stieninger, D. Nedbal, W. Wetzlinger, G. Wagner, and M. a. Erskine, "Impacts on the Organizational Adoption of Cloud Computing: A Reconceptualization of Influencing Factors," *Procedia Technol.*, vol. 16, pp. 85–93, 2014.

[21]   I. G. Ndukwe and A. E. Chukwudi, "Cost Benefits of Cloud vs In-house IT for Higher Education," *Int. J. Comput. Sci. Secur.*, vol. 7, no. 1, pp. 1–10, 2015.

[22]   K. Kawatra and V. Kumar, "Cost benefit analysis of cloud computing in education," *Int. J.

Bus. Inf. Syst., vol. 27, no. 2, pp. 205–221, 2018.

[23] D. G. Chandra and D. M. Borah, "Cost Benefit Analysis of Cloud Computing in Education," in *Int. Con. on Comput, Comm. and Appli. (ICCCA)*, 2012, pp. 1–6.

[24] J. S. Mtebe, "eLearning Cost Analysis of On-Premise versus Cloud-hosted Implementation in Sub-Saharan Countries eLearning Cost Analysis of On-Premise versus Cloud-hosted," *African J. Inf. Syst.*, vol. 6, no. 2, 2014.

[25] P. Maresova and V. Sob, "Effective Evaluation of Cloud Computing Investment – Application of Cost Benefits method Analysis," in *Bus. Admin. and Man., Economica Man.*, no. July, 2017.

[26] K. Kawatra and V. Kumar, "Cost Benefit Analysis of Cloud Computing in Education," *Int. J. Bus. Inf. Syst.*, vol. 27, no. 2, pp. 205–211, 2018.

[27] K. Rahimah, N. Latipah, R. Mahat, U. K. Lumpur, and J. D. Takzim, "The Organizational Critical Success Factors of Cloud Computing," vol. 1, no. 1, pp. 38–55, 2016.

[28] A. S. Idris, N. Anuar, M. M. Misron, and F. H. M. Fauzi, "The readiness of Cloud Computing: A case study in Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam," *2014 Int. Conf. Comput. Sci. Technol. ICCST 2014*, vol. 2014, 2015.

[29] I. M. Al-Jabri, "The Perception of Adopters and Non-Adopters of Cloud Computing : Application of Technology-Organization-Environment Framework," *The Fourteenth Int. Conf. on Elec. Business & The First Global Conf. on Internet and Info. Sys., Taipei*, 2014, pp. 250–257.

[30] M. H. Raza, A. F. Adenola, A. Nafarieh, and W. Robertson, "The Slow Adoption of Cloud Computing and IT Workforce," in *Procedia Computer Science*, 2015, vol. 52, pp. 1114–1119.

[31] A. A. Dahiru, J. M. Bass, and I. K. Allison, "Cloud Computing Adoption in Sub-Saharan Africa: An analysis using Institutions and Capabilities," in *Int. Con. on Info. Society*, 2014, pp. 98–103.

[32] P. F. Hsu, S. Ray, and Y. Y. Li-Hsieh, "Examining Cloud Computing Adoption Intention, Pricing Mechanism, and Deployment Model," *Int. J. Inf. Manage.*, vol. 34, no. 4, pp. 474–488, 2014.

[33] T. Oliveira, M. Thomas, and M. Espadanal, "Assessing the Determinants of Cloud Computing Adoption : An Analysis of the Manufacturing and Services Sectors," *Inf. Manag. Elsevier*, vol. 51, no. 5, pp. 497–510, 2014.

[34] S. K. Yoo and B. Y. Kim, "A Decision Making Model for Adopting a Cloud Computing System," *Sustain.*, vol. 10, no. 8, 2018.

[35] E. Hahlstrom and J. Bichsel, *Educause Center for Anal. and Res. (ECAR)*. MBS Direct, 2014.

[36] G. Deckler, "Cloud vs. On-premises Costs," *Fusion Alliance*. Fusion Alliance, pp. 4–8, 2016.

[37]   I. M. Al-Jabri, M. I. Eid, and M. S. Sohail, "A Group Decision-Making Method for Selecting Cloud Computing Service Model," *IJACSA) Int. J. Adv. Comput. Sci. Appl.*, vol. 9, no. 1, pp. 449–456, 2018.

[38]   K. Nanath, "A Model for Cost-Benefit Analysis of Cloud Computing A Model for Cost-Benefit Analysis of Cloud Computing," *J. Int. Technol. Inf. Manag.*, vol. 22, no. 3, pp. 93–109, 2013.

[39]   P. Maresova, "Application of the Cost Benefit Analysis Method in Cloud Computing in the Procedia Application of the Cost Benefit Analysis method in Cloud Computing in the Czech Republic," *Procedia - Soc. Behav. Sci.*, vol. 00, no. April, 2013.

[40]   P. S. Parte, "Impact of Cloud Computing in E-Learning," *Int. J. of Innovative Sci., Engineering & Tech.*, vol. 4, no. 1, pp. 2015–2018, 2017.

[41]   A. Qasim and S. Ali, "What Should Be Done to Achieve Greater Use of Cloud Computing by Higher Education Institutions", *7th IEEE Annual Info. Technol, Elect. and Mobile Comm. Conf., IEEE IEMCON 2016,* June, 2016.

[42]   N. Kratzke, "Cloud Computing Costs and Benefits: An IT Management Point of View," in *2012*.

[43]   O. Ali and A. Shrestha, "Analysis of the total cost of ownership for cloud computing technology adoption: A case study of regional municipal government sector," in *Pro. of the 28th Australasian Conf. on Info. Sys., ACIS 2017*, 2017.

[44]   B. Martens, M. Walterbusch, and F. Teuteberg, "Costing of Cloud Computing Services : A Total Cost of Ownership Approach Costing of Cloud Computing Services : A Total Cost of Ownership Approach," *45th Hawaii Int. Conf. on Sys. Sci. (HICSS-45)*, January, 2012.