Proposing Deployment Model to Promote the Adoption of Cloud Computing in the Public Sector of Myanmar

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ABSTRACT

Using the right technology in an organization can increase business processes and productivity as a competitive advantage. The utilization of cloud Computing is growing up in all government and private institutions by reducing costs and enhancing the system's performance, and effective IT resources management by using its computing resources through the internet. By realizing the potential benefits, the government of Myanmar is intensely interested in adopting cloud computing technology to effectively implement Ministries' specific systems and/or common public service delivery. Therefore, the government of Myanmar focused on the expansion of the Government's Fiber Network and Telecommunication Infrastructure Network. However, the implementation of cloud shared infrastructure and adoption rate of cloud-based services at all ministries level are still behind compared to the regional countries. This study, therefore, identifies the critical success factors to promote the adoption of cloud across the government of Myanmar based on a literature review and case study on the Republic of Korea and Vietnam. TOE framework and the Open Data Center Alliance (ODCA) cloud maturity model (CMM) was conducted as of the analysis framework to know each country's current cloud maturity level and suggest the recommendations as of the holistic view. The research identified a comprehensive deployment model and strategic guidance to encourage and transform government ICT through rapid adoption of cloud services at all ministries level by setting the required policies, and guidelines to achieve the national and regional ICT master plan.

Keywords: Public Sector; Cloud Computing; Deployment-Models; Technology Promotion; CMM

1. INTRODUCTION

Governments worldwide seek ways to enhance service delivery to citizens through the use of creative information and communication technologies (ICTs) rather than traditional online web services [6] due to rising consumer demands for government services. Cloud Computing technology, one of the innovative ICTs, can address these challenges with the successful development of the next-generation digital government services from the cost-saving perspective and increase productivity by sharing IT resources and providing dynamically extendable infrastructure on different devices [3, 6]. Therefore, it has been recognized as a strategic approach to the government's IT infrastructure and services [3].

Understanding the potential benefits of Cloud Computing, Myanmar's e-Governance Master Plan (2016-2020) aims to enhance Governance Services through the Cloud-based shared infrastructure by aligning with the Fourth Strategic Initiative of ASEAN ICT Masterplan (2016~2020): "Strategic 4.3 Support Cloud Computing Development". The performance of fixed broadband infrastructure is a key driver to use cloud computing services [3,5,7,12,14,15]. Meanwhile, Myanmar's fixed-broadband speed, mínimum acceptable speed defined for cloud service provisions [5], can support all types of cloud applications as speed test global index result. However, the coverage of high-speed fixed-broadband network penetration is weak less than 1%[9]. At present, the investment and usage of the government's ICT are mainly relying on Ministries' own datacenter and server rooms. Among them, the majority of the government agencies (80%) are running their core systems as of the legacy system [11]. All ministries initiated cloud as the basic services: email, Office 365, etc. through the public cloud, and can't use widely for core business functions except Central Bank of Myanmar and Ministry of Education. Therefore, it is needed to analyze the current maturity level to be realized government intention in cloud technology based on the national master plan. Currently, no studies are exploring the Government's readiness to migrate and accelerate cloud computing in Myanmar. There are relatively few studies to research cloud computing in the public sector context[7]. This study addresses the following questions:

- What is the current situation of the cloud maturity level of Myanmar?

- Which cloud deployment model is suitable to enhance cloud technology adoption in the public sector of Myanmar to provide better online services, from a government IT management perspective?

The main objective of this study is to propose a suitable cloud deployment model and recommendations to enhance the adoption of cloud in the public sector by raising the awareness of cloud technology among government organizations.

2. LITERATURE REVIEW

A review of the literature was conducted to understand the background knowledge of cloud computing that involves the technology adoption model, identify the critical success factors for government to enhance the delivery of cloud services in the cloud computing strategy of the public sector aspects.

2.1. Cloud Computing

Many researchers mentioned the definition of cloud computing based on the National Institute of Standards and Technology (NIST) [1, 4, 5, 6, 8, 10, 14]. According to the NIST, *"cloud computing is a model for enabling 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."*

Under this definition, there are five essential characteristics, three types of cloud services, and four deployment models for all standard cloud services. There are four deployment models to choose from if an organization considers migration to the cloud.

- Public Cloud Model: Public cloud services are available to any organization, and the cloud infrastructure exists under the cloud service provider rather than the users.
- Private Cloud Model: The private cloud model is targeted for specific use by a single organization, operated by a particular organization, a third party, or a combination of them.
- Community Cloud Model: Community Cloud deployment model is provided for exclusive use by a specific community of cloud service customers who need to share requirements (i.e., mission, security requirements, policy, and regulation), and all computing resources are operated and controlled by at least one or more of the organizations in the community.
- Hybrid Cloud Model: The hybrid cloud deployment model consists of at least two different cloud models (private, community, or public) by bounding together using standardized technology to ensure interoperability, data, and application portability.

Many studies used the Technological, Organizational, and Environmental (TOE) framework as the research model to analyze the adoption and implementation of enterprise-level technological innovation including cloud computing technology [1,2,3,7,8,10]. In addition, the case study analysis methodology was also conducted widely to define lesson learn, and best practices based on developed countries [3,4,5,8,15]. The ODCA CMM offers in evaluating the enterprise's cloud maturity and support to develop a comprehensive cloud strategy and accelerate the adoption of cloud from existing level to next higher level [11,12].

According to the method of these previous studies, case study analysis methodology, TOE framework, and the ODCA CMM are suitable to be adapted for this research. By conducting a case study analysis, the differences between the current state and the desired future state can be defined as recommendations and suggestions. TOE framework is widely used to analyze the adoption and implementation of enterprise-level technological innovation, and ODCA CMM is suitable for the assessment of cloud maturity in both public and private sector organizations.

2.4. Cloud Computing Trends in Public Sector

Governments around the world vigorously encouraged the use of cloud computing aims to reduce information system development and operational costs and to manage efficient IT resources [2, 3, 4, 6, 13]. International Data Corporation reported that the global public cloud services market expanded 26.0% year-on-year in 2019 with total revenues of $233.4 billion [16]. A two-fold rise in the government sector's adoption rate in the public cloud, with an average growth rate of 17.7% annually through 2021, according to the Gartner Report. The following Table 1 describes the cloud initiatives in the public sector of developed countries by developing central cloud policy/strategy [3,4,5,7,10].

Table 1. Cloud Initiatives in Developed Countries

Country	Nature of Cloud Initiatives
U.S	Started with National Level "Cloud First Strategy" in 2012 Cloud Governance: composed of 7 organizations, leading by the Federal CIO Council. Cloud-based e-government project plan: migrate more than three services into the cloud The General Accounting Office: to monitor the progress status of the transition to cloud
Japan	Used the "Kasumigaseki Cloud Strategy" Private G-Cloud: a single cloud platform that can consolidate all government ICT systems The Ministry of Internal Affairs and Communications: Leading Ministry regarding cloud
Singapore	Initiated "G-Cloud Policy" Private G-Cloud: G-Cloud platform for systems related to sensitive data of public agencies. Local Cloud Service Providers: for non-critical applications as cost-saving aspects Info-communications Development Authority: Main Ministry regarding cloud

2.3. Key Cloud Computing Success Factors

As of the summary of the selected literature review shown in Table 2, three main components and eight sub-components of cloud adoption factors were defined as crucial success factors regarding technology, organizational, and environmental perspectives.

Table 2. Key Cloud Computing Success Factors

Main Components	Sub-Components	Descriptions	Resources
Technology- IT Infrastructure	Broadband Quality	Fixed Network Performance	[3,5,7,10,12,14,15]
		Mobile Network Performance	
		(upload speed kbps, download speed kbps, latency in milliseconds)	
	Data Center	Data Center Service Providers inside of the country	
	Government ICT services	Online Service Index	
		E-Participation Index	
	Cloud Readiness Index	To know cloud service provision by measuring Broadband quality, data center readiness, Gov't online services.	[1,5,12,15]
Organization- Governance	Top Management Support	Interest-leadership-engagement- commitment	[2,3,7,10,15]
		Government ICT vision	
	Employees' Knowledge	Knowledge of Cloud Computing and Awareness	
		Trained workforce	
Environment- Policy and Regulation	IT Policies	Privacy Policy	[2,3,7,10,13,14,15]
		Data Protection Policy	
		Cyber Security Policy	
	Cloud Related Policies	Open standards policies for the cloud	
		The Strong rule of law adoption of new technology	

3. METHODS

To accomplish this research objective, the conceptual research framework of this study focuses on the combination of the TOE framework, to analyze the key factors that influence the technological innovation decisions in the public sector, ODCA CMM, which guides the country's cloud maturity level in the development of the strategic recommendations and benchmarking analysis, that helps to identify the best practices. The key factors for the TOE framework were derived based on the insights from

previous literature reviews, mainly the context of cloud technology adoption in government entities. TOE framework has been structured to analyze the case studies: the Republic of Korea and Vietnam. South Korea ranks fifth and Vietnam ranks 14th in the 2020 Cloud Readiness Index as of the Asia Cloud Computing Association. Both countries were selected as the case studies to do benchmark analysis. Data gathering in this study were collected from academic research papers that are relevant to the research objective, reports published by WorldBank, ITU-D, and United Nations, and government reports from Myanmar, and Benchmarking countries.

4. RESULTS

Based on the collected data regarding key critical factors that were examined by literature review, and the case study of the Republic of Korea and Vietnam, the TOE framework and ODCA's CMM were used to analyze the gap, define the key findings, and the implications for Myanmar.

4.1. Summary of Gap Analysis Based on CMM and TOE framework

According to the gap analysis between Myanmar and benchmarking countries based on the TOE framework, Myanmar is still behind in all successful factors (8 factors), under three domains: IT Infrastructure, Governance, and Policy and Regulation. The government of Myanmar started the cloud initiative as part of the e-Governance Master Plan. At present, the availability of IT skilled full person within government organizations is very limited in both technology and policy aspects. Knowledge exchange between government and ICT experts from research institutions, academia, and the ICT industry is weak. There is a lack of government guidelines/ standardization for cloud adoption and still weakness in data security and protection. The data collection from key factors of the TOE framework is measured by the criteria from five progressive levels of ODCA's CMM shown in Table 1. Meanwhile, the cloud maturity level of Myanmar is at CMM2 according to the current situation of Myanmar.

Table 1. Analysis of Cloud assessment between Myanmar and Benchmark Countries

Maturity Level	ODCA Cloud Criteria	South Korea	Vietnam	Myanmar
CMM1 (Initial Ad Hoc)	The current ICT environment is figured out and reported to be early cloud potential.	O	O	O
	A few ICT systems are running on virtualized systems, and most are under the traditional IT environment.	O	O	O
	The Private Cloud is used as the priority.	O	O	O
CMM2 (Repeatable Opportunistic)	Processes of IT, procurement, and controls are explicitly considered to use in the cloud environment.	O	O	Partial
	Private cloud is fully used to be the emergence of cloud-aware apps.	O	O	X
CMM3 (Defined Systematic)	Cloud policy and other ICT-related regulations start to be defined to manage and reduce the risk of cloud services.	O	O	X
	Employee's skill in cloud technology starts building up	O	O	X
	The more complex use of SaaS is evident and emerges private PaaS.	O	X	X
CMM4 (Measured Measurable)	Cloud-aware applications can be deployed in all types of cloud deployment models according to the needs of the business.	O	X	X
	Governance infrastructure is in place to measure and manage cloud capability in terms of quantitatively.	O	X	X
CMM5 (Optimize)	All applications' data are located in the appropriate cloud location and migrate according to business requirements.	O	X	X
	The organization has implemented market mechanisms to enhance inter-cloud activities.	X	X	X

Korean government continuously supports financial support and technical support in developing cloud technology & policy, amendments in various ICT-related policies, knowledge awareness programs, pilot projects, and R&D areas in both private and public sectors since 2009. Defining a specific Cloud Committee and main Ministry is also one of the best practices to define each participant's role and responsibilities among stakeholders clearly. Therefore, by leading them, the specific guideline and continuous monitors can be successfully supported to solve the issues and monitor each implementing agency's progress regarding cloud pilot projects implementation. Therefore, South Korea reaches the

position of CMM4, and all types of cloud models can be adopted based on business requirements.

Vietnamese government started cloud adoption through the private cloud deployment model at all ministry levels in 2010, continuously improve the progress of cloud policy development, and amended the security guidelines/laws to comply with the modern ICT environment that is strongly influenced for the country smoothly transit to cloud environment. In addition, the government has a systematic approach for government staff via international cooperation agreement channel with other developed countries to improve in the knowledge of ICT awareness as well as encourage R&D in both private and public sectors. Based on these key criteria, therefore, Vietnam keeps going on the level of CMM 3.

4.2 Key Findings, Implications, and Recommendations

Meanwhile, Myanmar is still early-stage adopting of cloud in the public sector in terms of TOE aspects. This section describes the key findings, implications, and recommendations for Myanmar.

Technological Context

Weakness in broadband Infra and government online services: Robust IT infrastructure is a crucial enabler to adopt cloud computing for the country. Mobile broadband network (3G, 4G) penetration positively impacts the country with a penetration rate of 82% and 2Mbps. At present, despite being convenient for all essential cloud computing services, including email, video conferencing, and web services, there is still a limitation to access the medium and advanced cloud-based services. It is recommended that the government needs a strong commitment to follow up National Broadband Plan-(2019-2023) to leverage accessibility and affordability.

Weakness of government online services: The government's cloud services are considered based on the readiness of online service provision. The maturity level of online public services and utilization of government services in benchmark countries are higher. It's recommended that Myanmar E-Government Steering Committee needs to review the quality of online services and monitor the implementation process of each Ministry. Additionally, need to define clear roles and the responsibility of CIOs to accelerate the adoption of ICT services within an organization.

Organizational Context

Need strong commitment from the executive level: According to Korea's government, it is vital to have strong leadership and a specific council, which will perform as the focal point to resolve all issues related to the cloud for all Ministries. It is recommended that government need to take a leading role in CC adoption, in terms of technical and financial support as well as should establish a specific cloud committee to monitor and measure service.

Less awareness and imperfect understanding in the knowledge of cloud technology at all government levels: Availability of skilled people within the organization is also critical to cloud adoption, as the results from the benchmarking countries. The lack of qualified people in government ministries specializing in cloud computing is also a significant challenge for Myanmar. The study recommends that the government focus on upgrading ICT skills in cloud capacities by arranging ongoing cloud computing training programs within the government and also use international collaboration agreements to raise awareness of cloud technology at all government levels, including the executive level. Improving cloud technology knowledge awareness at the top management level plays the main role to get strong leadership commitment in Myanmar.

Inadequacy of training and knowledge transfer, government funding support, and human resources: There is no clear define human resource development policy regarding capacity building in the public sector, and the link between government, academia and research institutes, and the private sector is still weak. The government of Myanmar should establish a network to do information exchange between the government sector and cloud experts from academia and the private sector. Funding support for

government cloud pilot projects should be initiated central government budget and then the PPP and ODA channel can be considered as a future expansion to continuously upgrade the existing government ICT infrastructure and services through the cloud including training support.

Environmental Context

<u>Absence of Cloud-related Policy and not strengthened in legal frameworks for privacy, security, and data protection:</u> The readiness of cloud policy and strengthened in the legal framework for data security and privacy concern is critical to mitigating the security risks in the cloud computing environment because of the national security concerns according to the benchmark countries. Hence, it is needed to develop a cloud-related policy that can remove the cultural change resistance within government ministries and provide the guideline for ICT leaders as a strategic approach for future ICT development. Cloud computing act/law can be considered as a long-term perspective that can give the roadmap to all Ministries regarding the development of cloud-related projects in terms of technical support as well as including budget allocation policy. In addition, cloud guidelines can support a short terms perspective with the support of technical criteria for cloud technology and information security. Furthermore, it is necessary to implement the legal and regulatory framework by aligning existing ICT-related policies especially to publish national cybersecurity law, revise e-transition law to be compatible with modern technology and develop data protection law that protects users' privacy and data online.
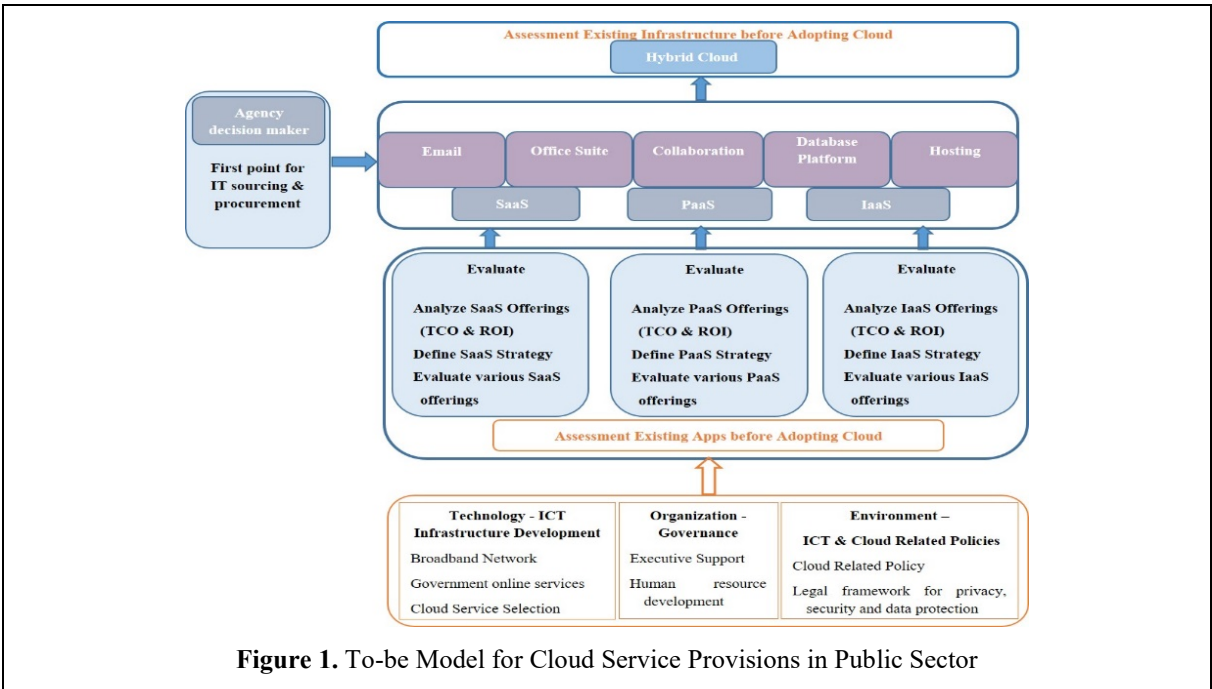
4.3 To-Be Model

Figure 1. To-be Model for Cloud Service Provisions in Public Sector

As shown in Figure 1, there are two main components regarding the proposed to-be model for cloud promotion in this study: the Hybrid cloud deployment model and the essential requirements that are needed to identify before adopting cloud in the organization's working environment with the aim of-
- To ensure the current ICT infrastructure and applications readiness
- To define the willingness of executive-level support and the degree of human resource capacity
- To support policy enforcement and safety of the data in the cloud environment

The technology dimension considers three factors: Broadband Network, Government Online services, and Cloud Service & deployment model selections that are needed to assess before the adoption of cloud computing. The organization attribute considers two factors: Executive Support and Human resource development, as the requirements that affect an organization's decision how the executive level

identifies the functions of cloud computing technology and how technology can affect the whole organization as well as know the degree of human resource capability. The environment dimension considers two factors: Cloud Related Policy and Legal framework to be strengthened in the security aspect. These two factors are important to give the roadmap for CIO as the direction during the implementation of cloud-related projects, and to ensure the safety of data located in the cloud environment. By ODCA's guideline and current situation of infrastructure and policy readiness, the Hybrid cloud deployment model is suggested as of strategic approach.

5. DISCUSSION

The main objective of this research study is to enhance the adoption of cloud in the public sector of Myanmar from the current cloud maturity level to the next higher level by finding out the key promoting factors, suitable deployment models, and strategic recommendations.

Overall, the results of this research showed that factors related to the organizational context and environmental context are a strongly negative impact on Myanmar. These findings show that less awareness and imperfect understanding of cloud technology at all government levels, followed by an absence of cloud policy, weakness in the legal and regulatory framework regarding security issues as well as weakness in the knowledge exchange network between government, academia, and industry.

In terms of limitations regarding the proposed model, it is identified for the Government of Myanmar according to the result of the currently existing infrastructure, and regulatory environment, especially cost-effective and ensure security and privacy concerns. However, Implementation Agencies' existing IT infrastructure is not compatible to integrate with the cloud environment, the upfront cost might be expensive. In addition, the data used in the research relied on only secondary data and the research analysis framework that is applied to TOE and ODCA's CMM. Hence, the proposed models, results, and recommendations can support the future forward for researchers by conducting different benchmark countries, methodology frameworks, and cloud assessment tools to be more understanding of the influence factors and give more strategic guidelines as different dimensions to enhance cloud adoption in the public sector, especially for developing countries.

6. CONCLUSION

As theoretical contributions, this study highlighted critical factors from organizational context and environmental context are strongly influence the promotion of cloud services in the Myanmar public sector. In other words, Top management support, cloud knowledge, cloud-related policy, and data security and privacy policy are the main key drivers to enhance cloud adoption, especially in the public sector with the evidence of past literature, and results of data analysis. In terms of practical contributions, it can help the public sector decision-makers to enhance the existing ICT infrastructure and applications through cloud technology. The results of case studies demonstrated that strong leadership and a cloud-first strategy are critical for all agencies to address the technical and cultural changes required to shift Myanmar's government from a typically segmented ICT service delivery method to a strategic ICT service approach. Furthermore, active policy intervention for capacity building is another key driver to improve absorptive and creative capacity within the organization's functional and technical perspectives.

REFERENCES

1. Ali, K. E., Mazen, S. A., & Hassanein, E. E. (2018). A proposed hybrid model for adopting cloud computing in e-government. Future Computing and Informatics Journal, 3(2), 286–295. https://doi.org/10.1016/j.fcij.2018.09.001

2. Ali, O., & Osmanaj, V. (2020). The role of government regulations in the adoption of cloud computing: A case study of local government. Computer Law & Security Review, 36, 105396. https://doi.org/10.1016/j.clsr.2020.105396

3. Alkhwaldi, A., Kamala, M., & Qahwaji, R. (2018). Analysis of CLOUD-BASED E-government SERVICES acceptance In jordan: Challenges and barriers. Journal of Internet Technology and Secured Transactions, 6(2), 556–568. https://doi.org/10.20533/jitst.2046.3723.2018.0069

4. David C, W. (2010, January). The cloudy future of government IT: Cloud computing and the public sector around the world. AIRCC Publishing Corporation.

5. ITU-D, S. G. 1. (2017). Access to Cloud Computing: Challenges and Opportunities for Developing Countries. https://www.itu.int/net4/ITU-D/CDS/sg/doc/rgq/2014/D14-SG01-RGQ03.1-en.pdf.

6. Mohammed, F., & Ibrahim, O. B. (2019). Drivers of cloud computing adoption for e-government services implementation. Web Services, 1444–1459. https://doi.org/10.4018/978-1-5225-7501-6.ch075

7. Mohammed, F., Ibrahim, O., Nilashi, M., & Alzurqa, E. (2016). Cloud computing adoption model for e-government implementation. Information Development, 33(3), 303–323. https://doi.org/10.1177/0266666916656033

8. Moonasar, V., & Naicker, V. (2020). Cloud capability MATURITY model: A study of South African large enterprises. South African Journal of Information Managment, 22(1). https://doi.org/10.4102/sajim.v22i1. 1242

9. MOTC. FACILITATING Faster Broadband and 5G Adoption in MYANMAR. Ministry of Transport and Communications, 2020.

10. M'rhaouarh, I., Okar, C., Namir, A., & Chafiq, N. (2018). Cloud computing adoption in developing countries: A systematic literature review. 2018 IEEE International Conference on Technology Management, Operations and Decisions (ICTMOD). https://doi.org/10.1109/itmc.2018.8691295

11. Myanmars.NET. (n.d.). Myanmar unicode. Analysis on e-Government Survey Data 2018 by Daw New Ni Soe Yin. https://mcf.org.mm/myanmar-unicode/71-right-competiton/ 493-analysis-on-e-government-survey-data-2018-by-daw-new-ni-soe-yin.html.

12. Open Data Center Alliance. (2016, February 1). Open data center Alliance publishes new CLOUD Maturity Model 3.0.

13. Shin, D.-H. (2013). User centric cloud service model in public sectors: Policy implications of cloud services. Government Information Quarterly, 30(2), 194–203. https://doi.org/ 10.1016/j.giq.2012.06.012

14. Vu, K., Hartley, K., & Kankanhalli, A. (2020). Predictors of cloud computing adoption: A cross-country study. Telematics and Informatics, 52, 101426. https://doi.org/10.1016/ j.tele.2020.101426

15. World Bank Group. (2017). Cloud Readiness Pilot Assessment Report (Vol. 1). Washington, D.C.

16. Worldwide public cloud services Market TOTALED $233.4 billion in 2019 with the top 5 Providers capturing more than one third of the Total, according to IDC. IDC. (n.d.). http://www.idc.com/getdoc.jsp?containerId=prUS46780320.