Issues in Information Systems
Volume 23, Issue 1, pp. 214-238, 2022

DOI: https://doi.org/10.48009/1_iis_2021_xx-xx (Note: The DOI will be completed by the editor)

A quantitative study of the relationship between cloud flexibility and on-premise flexibility

Emmanuel Tachu, *University of North Carolina at Charlotte, etachu@uncc.edu*

Abstract

Organizations' obligation toward increased efficiency to meet growing needs, fierce competition, and challenging business goals by leveraging information technology capabilities has compelled many enterprises in the US to adopt cloud computing infrastructure. Given the extensive and historical use of on-premise information technology infrastructure in enterprise environments, there is a need to better understand the relationship between on-premise infrastructure flexibility and infrastructure flexibility in the cloud. An examination of the relationship at a granular level is invaluable for information technology leaders currently exploring cloud computing adoption and those seeking to enhance their cloud infrastructure with hybrid cloud employment models to help meet organizational goals driven by profit margins. Accordingly, this study examines the relationship between on-premise and cloud information technology infrastructure flexibility by analyzing three dimensions of flexibility: connectivity, modularity, and compatibility. The dynamic capability theoretical model was employed because of its emphasis on the profit-making objectives of enterprises. A survey instrument from prior research was adopted for this study. Data were collected from 134 information technology leaders across the US. The results revealed a significant correlation between on-premise information technology flexibility and cloud computing adoption in enterprise environments. The data analysis determined that the averages of the on-premise variables of flexibility are statistically significant predictors of the average cloud dimensions of flexibility. The on-premise modularity dimension of flexibility emerged as the best predictor for cloud adoption.

Keywords: cloud computing flexibility, on-premise information technology flexibility, compatibility, connectivity, modularity

Introduction

There are growing demands and competitive pressure in information technology (IT) services and a need for enterprises and government agencies to provide innovative and changing solutions. Cloud computing offers IT infrastructure services that can help meet some of these demands, especially in an era where data are highly valued (Alsghaier, 2017), and cloud computing is becoming the norm in businesses and governments (Bojanova et al., 2013). The increasing demand for artificial intelligence and computing capabilities for data processing to aid in decision-making across industries also drives cloud computing adoption. Although operational, tactical, and strategic plans may drive decision-making processes regarding cloud computing adoption, variables such as IT flexibility may or may not play a role in shaping, guiding, and facilitating cloud adoption. This variable encompasses numerous constraints and opportunities that may affect the goal of meeting cloud computing adoption roadmaps.

This study defines IT flexibility as the ability and capacity of an organization to quickly adapt and deploy IT infrastructure to meet fast-changing business needs (Ness, 2005). This study seeks to understand whether a correlation exists between IT flexibility and cloud computing adoption in enterprises in the US. This study explores three specific dimensions of IT flexibility, namely connectivity, compatibility, and modularity (Al Mjlae et al., 2019). Research has shown that IT flexibility influences IT effectiveness (Ness, 2005) as far as these three dimensions are concerned. Connectivity represents the degree to which IT infrastructure can be reached from within and outside an organization (Byrd & Turner, 2000). Compatibility is defined by Byrd and Turner (2000) as the ability to communicate across different technological components. Finally, modularity is a measure of the degree of capability of the reconfiguration of IT infrastructure with minimal or no disruptions across platforms (Duncan, 1995).

Research has also demonstrated that IT flexibility and cloud computing are closely related because of their abilities to facilitate the deployment and use of IT resources to meet changing and demanding business needs, especially in the digital transformation of enterprises (Smith & Ugolini, 2017). However, there is a lack of scholarly work exploring possible relationships and correlations between IT flexibility and cloud computing adoption in enterprise environments. Findings from the research are crucial because many industry experts and researchers highlight that cloud computing is becoming the status quo and the next revolution in IT infrastructure (Buyya, 2010).

Overview

Background of the Study

IT infrastructure flexibility has been a critical concept, both in organizations that rely on or leverage IT resources to meet their goals and in technology road-mapping for digital transformation (Strutynska et al., 2019). Flexibility is particularly crucial because of the need for organizations to adapt to changing and growing demands from both internal and external stakeholders (Zubaedah et al., 2017). IT leadership is thus compelled to partner with business leaders and other key stakeholders to ensure the availability of flexibility in their infrastructure (Poindexter, 2019). The flexibility reflected in the use of appropriate on-premise IT infrastructure with hardware and software configurations to provide the needed flexibility can help create a competitive advantage. Infrastructure flexibility can also be achieved by using cloud computing, which is built with flexibility at its core for addressing ever-changing needs (Sharma et al., 2017).

Many studies have examined the flexibility that on-premise IT infrastructure and cloud computing provide in the enterprise environment. However, a gap exists in scholarly material on the relationship between IT flexibility and flexibility from cloud infrastructure (Al Mjlae et al., 2019). There is also a gap in studies regarding how on-premise IT flexibility may or may not influence cloud computing adoption. Research in this area is crucial because while some researchers argue that cloud computing is a sub-set of IT flexibility, others suggest that it can be considered a replacement for IT flexibility (Vithayathil, 2017). This study captured data to investigate the relationship between IT flexibility and cloud computing adoption. Although the latter is driven by several factors, including but not limited to organizational goals, the focus of this study is limited to adoption driven by three dimensions of IT flexibility: compatibility, connectivity, and modularity.

Statement of the Problem

The goal of this study is to understand the relationship between IT flexibility and cloud computing adoption in enterprises. Many researchers have investigated IT infrastructure and cloud computing and how they influence and/or contribute to the flexibility of infrastructure that serves the IT needs of organizations (Gartner, 2017; Nazir, 2012). The present study goes a step further by analyzing whether the existence of on-premise infrastructure flexibility influences cloud adoption, especially given that some researchers view cloud computing as the future for enterprises that already enjoy IT flexibility with their existing infrastructure. Gaps exist in the literature on this subject, and there is a lack of sufficient empirical evidence on the correlation between the variables (Al Mjlae et al., 2019).

Purpose of the Study

The goal of this paper is to provide a quantitative analysis of the relationship between IT flexibility and cloud computing adoption, as well as how the relationships affect decision-making and strategies regarding cloud computing adoption in enterprise environments (Ness, 2005) . The findings from the research are of value to IT leaders in the development of cloud computing adoption strategies (Boules et al., 2017). The emergence of globalization; big data; growing cyber threats; and the need for evolving information governance, risk, and legal requirements are compelling reasons for this research because of the role of cloud computing adoption in the IT space (Lee et al., 2017; Collins, 2014; Ruiter & Warnier, 2011). Findings from the study also provide an opportunity for technology leadership practitioners to review and explore current practices from government and enterprise environments.

Significance of the Study

This quantitative study of the relations between on-premise IT flexibility and cloud computing adoption has the potential to fill the gap in the literature on the subject. The study could add value (Kasi et al., 2009) by serving as an additional tool for IT leaders who are considering or evaluating possibilities of cloud adoption for a complete cloud solution or a hybrid solution leveraging on-premise and cloud infrastructure. In this regard, the findings from the research provide industry experts with key data-driven insights (Editage Insights, 2019): pointers on how on-premise and cloud infrastructure may be related and whether there are any correlations that could either be advantageous or pose potential barriers. IT leadership will consequently have an additional tool to aid in decision-making about cloud computing adoption. Given the potential challenges in migration from an on-premise information infrastructure to a cloud computing model or a hybrid model (VansonBourne, 2017; Ward et al., 2010), IT leaders must make informed decisions backed by industry data from different industries to help navigate the process for seamless transitions (Deloitte, 2018). Data-driven informed decision-making would also assist in preparedness to avoid surprises and thus provide clearer expectations (Softchoice, 2018). The research is equally significant for industry IT experts, especially when faced with fast-changing and fierce competition, which requires dynamic capability and strategic leadership to ensure success (Teece et al., 1997). Finally, for an academic and research audience, this study provides a foundation for similar work in different industries, including but not limited to government agencies in which cloud computing has been adopted Charif & Awad, 2014).

Definitions

Compatibility: A dimension of IT flexibility that Byrd and Turner (Byrd & Turner, 2000) define as the ability to communicate across different technological components.

Connectivity: The dimension of IT flexibility that represents the degree to which IT infrastructure can be reached from within and outside an organization (Byrd & Turner, 2000).

Dynamic Capability: A framework for analyzing the strategic resources and techniques used to create value and competitive advantage for enterprises operating in competitive environments in which rapid technological changes are taking place (Teece et al., 1997).

IT Flexibility: The ability and capacity of an organization to quickly adapt and deploy IT infrastructure to meet fast-changing business needs (Duncan, 1995).

Modularity: Modularity is a measure of the degree of capability of the reconfiguration of IT infrastructure with minimal or no disruptions across platforms (Duncan, 1995).

Cloud Computing: The National Institute of Standards and Technology (NIST, 2015) defines cloud computing 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."

Cloud Computing Adoption: The intent to adopt cloud computing and the strategies used by enterprises to meet their organizational needs (Avram, 2014; Rad et al., 2017).

Theoretical framework

Although the technology acceptance model of technology adoption and its variations appear appropriate for this research, the dynamic capabilities theoretical framework is used. The need to look beyond the technology acceptance model arises because enterprises' core goals are mostly centered on profit-making (Besley & Ghatak, 2017). As a result, aligning IT strategies with business goals means employing IT in ways that address rapidly growing technological change and ever-increasing competition. Teece et al. (1997, p. 509) stipulates that "the dynamic capabilities framework analyzes the sources and methods of wealth creation and capture by private enterprise firms operating in environments of rapid technological change." The dynamic capability theory is also appropriate because the premise for IT flexibility and cloud computing centers on adapting IT in innovative ways to address and tackle changing business needs that continuously have a high demand for IT infrastructure.

Literature review

Information Technology Infrastructure Flexibility and Innovation

Fast changing and growing demands in IT services require continuous innovative and agile solutions through IT infrastructure to meet complex organizational needs, especially given the pressure and fierce competition in a global market. The need for experimentation and continuous research also exerts additional strain on the IT infrastructure of enterprises and government agencies. Organizational demands that require up or downscaling of IT infrastructure to meet dynamic and sometimes uncertain and complex objectives drive the shift to adopting IT flexible infrastructure irrespective of the environment. Duncan (1995) noted that the capabilities of IT infrastructure have become critical in organizations that use IT the provision of services to users and customers. Similarly, Byrd and Turner (Byrd & Turner, 2000)assert that building a flexible IT infrastructure for robustness and speed to meet changing and competitive needs should be a core organizational competency that business and technology leaders must not ignore. In a 2018 conference on cloud computing strategies, Gartner (2018) emphasized that IT and business leaders across industries must embrace cloud computing to benefit from the flexibility that it presents to stakeholders for creating a competitive advantage.

Industry experts, business leaders, and researchers have both varied and similar definitions and terminology for IT infrastructure flexibility. Some terms are used interchangeably based on context and include but are not limited to agile IT, on-demand IT, and utility-based IT (Ness, 2005) . In this research, IT infrastructure refers to physical and software assets that lay the foundation for providing IT services to meet organizational goals such as network communication, computing, data storage and processing, big data analytics, database applications, software development platforms and tools, email services, file sharing, and other services that are deployed using internet technologies. The Oxford Advanced Learner's Dictionary (Hornby & Cowie, 2000, p. 488) describes flexibility as the ability to change to meet new and different needs without breaking. In this research, "IT infrastructure flexibility" is defined as the degree of the existence of characteristics (Nelson et al., 1987) that allow adjustments to IT infrastructure to meet growing, demanding, and changing organizational needs that rely on IT. The characteristics include but are not limited to scalability, resource pooling, rapid elasticity, on-demand automation and self-service, broad network access, and metered services (Mell & Grance, 2011) in the cloud computing space. The IT flexibility aspect related to skillset competency and human resources is not addressed in this work. Instead, the study focuses on structured flexibility that leverages IT infrastructure to adapt to organizational IT needs.

Innovations in IT enter the equation because they have accelerated exponentially (UNCTAD, 2018) and play key roles in driving some of the most promising cloud computing trends across industries in the economy of the United States (National Research Council, 1997). Government agencies and enterprises in the US have consistently leveraged IT innovation and its associated flexibility (Hovlin et al., 2008) as a tool to drive productivity and efficiency in the provision of goods and services to customers and stakeholders.

Engineering, research, development, and innovation clusters across the US continue to play key roles in fueling and advancing IT infrastructure innovation (Baily & Montalbano, 2017). Regions such as Research Triangle Park, Silicon Valley, and Boston's Route 128 are among the nation's top regions that champion and drive IT innovation and entrepreneurship, among other technological fields. Although government policies may not necessarily create entrepreneurship, the US federal government has been supportive of innovation clusters around the country for several decades. It is, however, worth noting that the support was minimal until around 2010 when the government started taking major steps to identify and implement policies to promote the success and growth of innovation and entrepreneurship clusters. IT innovation in the US has benefited from many drivers, including but not limited to the 2010 $50 million allocations to the Department of Commerce's Economic Development Agency that aimed "to support regional innovation clusters" (Chatterji et al., 2013). IT innovation is crucial to gaining traction because businesses, government agencies, nongovernment organizations—to name a few—rely on IT services for business and organizational processes.

Despite an atmosphere in the US that favors and drives IT flexibility and innovation, the country may face obstacles in meeting the human resource needs to maintain pace with the growing demand for IT experts in different specialties. A 2018 United Nations Conference on Trade and Development publication highlighted that the US has a disproportionally low percentage of science, technology, engineering, and math (including computer science) graduates, who are needed to meet growing demand. As a result, science, technology, engineering, and math education has been a centerpiece of the US Department of Education (n.d.) for decades to help close the gap created by the growing need for IT professionals, among other science and engineering professionals.

Compatibility in Information Technology Flexibility

Compatibility is a critical aspect of IT flexibility because it addresses the degree of the capability of different infrastructure components—both software and hardware—for seamless intercommunication, irrespective of vendors, internally and externally in an enterprise. Byrd and Turner (Byrd & Turner, 2000)describe compatibility as the ability to communicate across different technological components. Compatibility can also be linked to the Open Systems Interconnect (OSI) by the Internal Organizations for

Standards that lays out a seven-layer model, which is used to provide standards for the definition of protocols for interconnectivity between different infrastructure architectures (Aschenbrenner, 1986). The seven layers are as follows: the application layer, the presentation layer, the session layer, the transportation layer, the network layer, the data link layer, and the physical layer. Unlike the well-established application of the OSI model in networking, there are still gaps in its implementation in cloud computing. However, the growing implementation and use of application programming interfaces provides increasing opportunities for compatibility because they create interfaces between platforms and different applications (ECIS, n.d). Though the OSI layers are mere recommendations, their purposes include but are not limited to the promotion of and innovation in IT communication infrastructure for the improvement of information systems to meet different business needs (Aschenbrenner, 1986). Compatibility plays an equally key role in IT flexibility because of the emergence of new infrastructure products that must be seamlessly incorporated into existing ecosystems of IT communication infrastructure. The degree of compatibility consequently contributes to decision-making on infra-structure adoption because organizational infrastructures do not exist in vacuums (Duncan, 1995). A high degree of infra-structure compatibility can also provide a competitive advantage because of the added value that accompanies it, and it thus can be leveraged in bargaining with enterprise stakeholders, both internal and external.

The narrowing digital divide and growing technological advancements in IT that rely heavily on interconnectivity for their functionality and effectiveness would otherwise not be feasible without standardization requirements across industries to address compatibility. In a world where technology has become an inevitable part of many sectors, enterprises, and daily life, compatibility is in the public interest because of the technical recommendations and guidelines that it provides (Tassey, 1999). Standardization also plays a considerable role in research and development (Tassey, 1999) by increasing the degree of compatibility in infrastructure development, both hardware and software. Compatibility can also be viewed as an enabler in "an innovation-friendly ecosystem" (Friedrich, 2011) in which engineers, developers, and IT researchers rely on standards for infrastructure applications and hardware that conform to standards for interoperability across environments.

Interestingly, some level of availability as well as in-compatibility of proprietary tools and infrastructure is present in public cloud environments. There are also some limitations to intercloud services with on-premise infrastructure. IT leaders must thus factor incompatibility metrics in cloud adoption planning and deployments (ECIS Cloud Computing Standards, n.d.). Compatibility between on-premise and cloud environments is key because of their ongoing co-existence in enterprise IT infrastructure (Cloud Standards Customer Council, 2017). Overlooking the compatibility dimension in IT infrastructure planning can lead to inconveniences and failures in information sharing across an enterprise, internally and externally (Singh et al., 2007).

Connectivity in Information Technology Flexibility

In the context of IT flexibility, connectivity is a measure of the degree to which IT infrastructure can be reached, for example from different locations and different partners using computer networks, both locally and externally (Keen, 1991). In enterprise environments, the need for in-formation sharing between business partners and cross-team collaboration relies greatly on connectivity because it breaks communication barriers that would otherwise limit access to information. For organizations engaged in virtual environments, connectivity is a core component. It even becomes critical for the continuous operations of businesses in which environmental and societal events dictate the need to work remotely. An example is during the COVID-19 pandemic, when the World Health Organization (2020) and the Centers for Disease Control and Prevention (2020) recommended that people stay at home, while some US states issued stay-at-home orders (Jenkins & Banse, 2020).

Without the information flexibility dimension of connectivity, it would be practically impossible for enterprises using public clouds to be functional because of the lack of physical access to the underlying infrastructure. However, in on-premise environments, organizations can take the necessary steps to access their infrastructure if connectivity is removed from the equation. Growing emerging technologies, such as the internet of things; the adoption of telemedicine; and e-commerce are examples that highlight the role of the connectivity factor in on-premise IT and cloud computing. However, the degree of importance varies in different environments. As Duncan (1995) states, connectivity in IT infra-structure acts as a tool for the elimination of barriers resulting from the spread of resources across different physical locations, thus serving as a key factor for sharing IT resources.

In an era in which IT as a service is gradually becoming the norm, connectivity becomes an inevitable component that must be considered at every level of infrastructure planning and deployment (Talib & Abdullah, 2012). It may be challenging for enterprises to have control over connectivity—especially internet connectivity—given the complexities in routing technologies and algorithms that enterprises may not have control of in ever-growing and congested networks (Narten, 1989; Campista et al., 2014; Sahhaf et al., 2017). However, enterprises can leverage dedicated and leased lines for more control and some level of guarantee of connectivity. The growing dependence on and use of big data analytics in enterprise environments also dictate the need for connectivity, especially considering computing and storage capabilities (in remote locations, on-premise, or in the cloud) that enterprises must rely on (Kune et al., 2016).

Methodology

Research Design

In this study, a nonexperimental quantitative correlational research design was employed to answer the research questions and hypotheses (Sullivan, n.d.). A qualitative method was not used because it cannot be leveraged to collect data and analyze or measure the relationship between the dependent and independent variables (Apuke, 2017; Bacon-Shone, 2015). Given this need to rely on an adequate sample size for generalization, a quantitative study provides the best approach for the research (Swanson & Holton, 2005). Additionally, the use of a qualitative study poses challenges that make replication of the study practically impossible due to the lack of quantifiable data (Eyisi, 2016). The inclusion of subjective interpretation in a qualitative method can also lead to different results when trying to replicate the research (Damaskinidis, 2019). Moreover, the goal of analyzing the relationship between the variable and the survey instrument dictates the use of a quantitative method for this research primarily because of the need to use statistical data. With the use of such data, replication of the research becomes feasible if other researchers wish to conduct the same or a similar study and make a statistical comparison.

An online survey instrument was used to collect data from IT leaders in enterprises across the US. Compared to a survey by mail, an online survey allows for easier and faster data collection from a sample population. The survey instrument was also posted to cloud computing and IT leadership groups on LinkedIn, notably #cloudcomputing, #technologymanagement, #itleader-ship, #technologyleaders, and #digitaltransformation. The intention behind reaching out to these groups was to capture data from IT leaders with cloud computing knowledge across different industries in the US.

The survey instrument was adapted from one used by Bani (2011). Survey participants met the screening criteria set to ensure that they were knowledgeable about cloud computing and were involved in IT decisions in their respective organizations. The survey ensured the anonymity of the sample, and confidentiality was guaranteed to the participants.

Participants responded to the survey by selecting the extent to which they agreed or disagreed with the statements provided on an ordinal scale between 1 (strongly disagree) and 7 (strongly agree) with a neutral (4) option. A quantitative research method was chosen because it is best suited for assessing the relationship between different variables (Almeida et al., 2017) given the need for objectivity in the research findings. Furthermore, statistical analysis was leveraged for assessing the variables in the study. IT flexibility was the independent variable, and cloud computing adoption was the dependent variable. Pearson's r test was employed to determine the strength of the relationship, if any, between the variables "IT flexibility" and "cloud adoption." Pearson's correlation coefficient (r) is an appropriate statistical tool because data from survey participants were captured on an ordinal scale (Mukaka, 2012).

Research Questions and Hypotheses

Research Question 1: To what extent, if any, does IT flexibility influence cloud computing adoption in an enterprise?
H10: There is no significant correlation between IT flexibility and cloud computing adoption in an enterprise.
H1A: There is a significant correlation between IT flexibility and cloud computing adoption in an enterprise.
Three additional sub-questions and three sets of sub-hypotheses are considered in the research:
Research Question 2: To what extent, if any, does the IT flexibility dimension of compatibility influence cloud computing adoption in an enterprise?
H20: There is no significant correlation between compatibility and cloud computing adoption in an enterprise.
H2A: There is a significant correlation between compatibility and cloud computing adoption in an enterprise.
Research Question 3: To what extent, if any, does the IT flexibility dimension of connectivity influence cloud computing adoption in an enterprise?
H30: There is no significant correlation between connectivity and cloud computing adoption in an enterprise.
H3A: There is a significant correlation between connectivity and cloud computing adoption in an enterprise.
Research Question 4: To what extent, if any, does the IT flexibility dimension of modularity influence cloud computing adoption in an enterprise?
H40: There is no significant correlation between modularity and cloud computing adoption in an enterprise.
H4A: There is a significant correlation between modularity and cloud computing adoption in an enterprise.
Research Question 4: To what extent, if any, does the current stage of cloud computing adoption influence an enterprise's preference for on-premise infrastructure or cloud infrastructure?
H50: There is no significant correlation between the cloud computing adoption stage and an enterprise's preference for on-premise infrastructure or cloud infrastructure.
H5A: There is a significant correlation between the cloud computing adoption stage and an enterprise's preference for on-premise infrastructure or cloud infrastructure.

Target Population and Sample

The target population was IT and technical leaders and managers in enterprises across different industries in the US who were both knowledgeable about cloud computing and involved in their respective organizations' IT decisions to meet departmental or organizational goals with on-premise and/or cloud resources. The choice to only invite IT and technical leaders was made because of their expertise in working in partnership with business leaders towards the alignment of IT strategies with organizational goals

(McKeen & Smith, 2017; Pearlson et al., 2020). The participation of IT and technical leaders consequently increased the quality and response rate of the survey (Wright & Schwager, 2008). Additional IT staff who are not necessarily in leadership roles but who understand cloud computing—for example, network administrations and engineers, system administrators, and engineers—were also targeted as potential participants. Other IT staff were included because teamwork dictates participation and feedback from junior and nonmanagement staff to leadership in decision-making processes (Alghamdi & Bach, 2018).

Participants were selected from a random sample of IT and technical leaders in enterprises in the US. SurveyMonkey was used to send out the survey to potential participants. SurveyMonkey is a company that provides the survey platform used to create the survey for this research. The company has a database of potential survey participants, who were invited to partake. Data from the participants were then downloaded for inferential statistical analysis. A sample size of 128 was determined by using G*Power 3.1.9.7 with a power (1-β err prob) of 0.95 for one-tailed Pearson's r correlations test.

Instrumentation

Permission was obtained to utilize the survey instrument used by Bani (2011). Several other researchers have tested the survey instrument for validity and reliability in their work involving "cloud computing adoption" and "IT flexibility" as variables. To ensure that the instrument's validity and reliability were not compromised, the format of the sur-vey was not altered. Bani's (2011) research focused on "assessing the relationships among IT flexibility, IT-business strategic alignment, and IT effectiveness: an investigation of business intelligence implementation." The survey instrument has also been used by other re-searchers—including Jose, Ray, and Henseler (2018), in a study on the "impact of IT infrastructure flexibility on mergers and acquisitions." For the present study, the survey was sent via SurveyMonkey to 3,000 IT leaders in the US from an email list purchased from Exact Data. This list was uploaded to SurveyMonkey to reach the target audience.

A contractual agreement was made with centi-ment.co to collect enough data to satisfy the previously determined sample size of 128 (G*Power, 2020). A total of 134 complete responses were collected, which surpassed the set sample size. To measure the quality of the answers provided and to ensure participants' attention (Kung et al., 2018), centiment.co included an additional question in the survey and requested a particular response, as indicated below:

"Recent research on decision-making shows that choices are affected by context. Specifically, we are interested in whether you actually take the time to read each question. To show that you are paying attention, please check only the 'Enthusiastic' option as your answer".

The data provided by centiment.co were from participants who selected the correct answer ("Enthusiastic") to the question. However, responses to this question were not used for statistical analysis in this study. All 134 participants provided complete responses to all the questions. They responded using a seven-point Likert-type scale: 1 for strongly disagree, 2 for disagree, 3 for somewhat disagree, 4 for neutral, 5 for somewhat agree, 6 for agree, and 7 for strongly agree (Bani, 2011). The responses were exported in XLSX format for analysis using IBM SPSS and R Studio. The analysis was performed at a 95% confidence level. Data cleaning involved using RStudio to convert the Likert scale responses to numeric values.

The independent variables related to the questions around connectivity, modularity, and compatibility in on-premise infrastructure. The descriptive table here-with lists data about participants who agreed (Likert 5–7) to the questions asked.

Ethical Considerations

Participants were kept anonymous for the survey to protect their privacy, and confidentiality was maintained during and after the survey. However, email addresses were collected from participants who were interested in receiving information about the findings of the research. The survey was designed to ensure that personal and identifiable information was not collected from the participants. Furthermore, participants were provided with an informed consent form detailing the goals of the survey and stating that the collected data were for statistical analysis only. Included in the informed consent form was a communication method that participants could use to ask questions, express concerns, seek clarification, or raise any other issues that needed attention. Ethical considerations were in accordance with the Institutional Review Board guidelines and any additional recommendations from the University of the Cumberlands Graduate School. Research ethics and compliance were also considered following guidelines from the Collaborative Institutional Training Initiative to gain the confidence and trust of participants and help achieve a high research quality (CITI, 2008).

Findings

To study the relationship between on-premise, IT flexibility and cloud computing adoption, research questions were designed around the connectivity, modularity, and compatibility dimensions of flexibility that are common to both on-premise and cloud environments. To obtain a granular understanding of the relationships between the dimensions and individual variables, a correlations analysis was performed for all the variables, as indicated in the table below.

Table 1: Predicting Cloud Adoption from On-Premise Scales with Regression

Variable	B	Std. Error	Beta	*t*	*p*
Constant	.87	.23		3.80	< .01
On-Premise Connectivity	.16	.06	.19	2.51	< .01
On-Premise Modularity	.29	.07	.30	4.25	< .01
On-Premise Compatibility	.40	.07	.77	5.80	< .01

Note. r^2 Adj = .81.

The null hypothesis is rejected. The table shows that on-premise variables (dimensions) averages are statistically significant predictors of the average of all cloud variables to a large degree (r^2 Adj = .81, $p <$ .01). On-premise modularity is the best predictor of Cloud Item Average (*Beta* = .77, $p < .01$).

Table 2: Variables-Average Correlations

		1	2	3	4	5	6	7
1	On-Premise Connectivity	1.00						
2	On-Premise Modularity	.79*	1.00					
3	On-Premise Compatibility	.85*	.83*	1.00				
4	On-Premise Total	.94*	.92*	.95*	1.00			
5	Cloud Connectivity	.80*	.73*	.82*	.84*	1.00		

Table 2 (Continued)

		1	2	3	4	5	6	7
6	Cloud Modularity	.74*	.81*	.78*	.83*	.77*	1.00	
7	Cloud Compatibility	.77*	.80*	.86*	.86*	.81*	.87*	1.00
8	Cloud Total	.82*	.84*	.88*	.90*	.92*	.94*	.95*

Note. * $p < .001$

RQ1 asked, To what extent, if any, does IT flexibility influence cloud computing adoption in an enterprise? The corresponding hypotheses were as follows:
H10: There is no significant correlation between IT flexibility and cloud computing adoption in an enterprise.
H1A: There is a significant correlation between IT flexibility and cloud computing adoption in an enterprise.

To address the overall relationship between on-premise IT flexibility for the identification of any predictors that would drive cloud computing adoption, a multiple linear regression analysis was done. Based on Pearson's r output table, the bivariate correlation revealed strong positive correlations among connectivity, modularity, and compatibility between on-premise and cloud. According to the analysis represented on the Likert plots in the appendix, the strong entry points for cloud infrastructure among participants who were evaluating cloud computing were middleware, interconnectivity, seamless access, and available data. For those trialing cloud computing, the largest differences in agreement were found to be transparent access, middleware, seamless access, available data, legacy, added functionality, and variations. Participants who were implementing cloud computing exhibited strong agreement for transport, entry points, interconnectivity, seamless access, available data, and added functionality. Finally, for participants who were using cloud computing, the strongest agreements were found to be transparent access, entry points, seamless access, available data, reusability, legacy, and added functionality.

Compatibility Correlation Analysis

Table 3: Compatibility Correlations

		var10	var11	var12	var13	var22	var23	var24	var25
var10	Pearson Correlation	1							
	Sig. (two-tailed)								
	N	134							
var11	Pearson Correlation	.139	1						
	Sig. (two-tailed)	.109							
	N	134	134						
var12	Pearson Correlation	.372**	.165	1					
	Sig. (two-tailed)	.000	.057						
	N	134	134	134					

Table 3 (Continued)

		var10	var11	var12	var13	var22	var23	var24	var25
var13	Pearson Correlation	.313**	.327**	.286**	1				
	Sig. (two-tailed)	.000	.000	.001					
	N	134	134	134	134				
var22	Pearson Correlation	.401**	.284**	.163	.370**	1			
	Sig. (two-tailed)	.000	.001	.060	.000				
	N	134	134	134	134	134			
var23	Pearson Correlation	.322**	.357**	.354**	.391**	.352**	1		
	Sig. (two-tailed)	.000	.000	.000	.000	.000			
	N	134	134	134	134	134	134		
var24	Pearson Correlation	.250**	.301**	.316**	.393**	.362**	.324**	1	
	Sig. (two-tailed)	.004	.000	.000	.000	.000	.000		
	N	134	134	134	134	134	134	134	
var25	Pearson Correlation	.388**	.264**	.373**	.539**	.282**	.408**	.475**	1
	Sig. (two-tailed)	.000	.002	.000	.000	.001	.000	.000	
	N	134	134	134	134	134	134	134	134

** Correlation is significant at the .01 level (two-tailed).

RQ2 asked, To what extent, if any, does the IT flexibility dimension of compatibility influence cloud computing adoption in an enterprise? The corresponding hypotheses were as follows:

H20: There is no significant correlation between compatibility and cloud computing adoption in an enterprise.

H2A: There is a significant correlation between compatibility and cloud computing adoption in an enterprise.

A Pearson correlation analysis of the variables under the compatibility dimension revealed positive correlations between the independent and dependent variables, with significant values less than .01. The compatibility correlation analysis also showed statistically significant positive correlations between the independent variables and the dependent variables at a 95% confidence interval.

Given the need to understand the correlations be-tween the dimensions of connectivity, modularity, and compatibility, a Pearson correlation was performed. The outcome of the analysis revealed positive Spearman's correlations between the dimensions, with significance levels less than .01. The null hypothesis is hence reject-ed. This suggests positive correlations between the dimensions on-premise and in the cloud because for var10 (on-premise) and var22 (in the cloud), $rs = 40$, $p < .01$; for var11 (on-premise) and var23 (in the cloud), $rs = .36$, $p < .01$; for var12 (on-premise) and var24 (in the cloud), $rs = .32$, $p < .01$; and for var13 (on-premise) and var25 (in the cloud), $rs = .54$, $p < .01$.

Connectivity Correlation Analysis

Table 4: Connectivity Correlations

		var2	var3	var4	var5	var14	var15	var16	var17
var2	Pearson Correlation	1							
	Sig. (two-tailed)								
var3	Pearson Correlation	.372**	1						
	Sig. (two-tailed)	.000							
var4	Pearson Correlation	.308**	.341**	1					
	Sig. (two-tailed)	.000	.000						
var5	Pearson Correlation	.190*	.202*	.311**	1				
	Sig. (two-tailed)	.028	.019	.000					
var14	Pearson Correlation	.302**	.191*	.333**	.430**	1			
	Sig. (two-tailed)	.000	.027	.000	.000				
var15	Pearson Correlation	.191*	.311**	.253**	.318**	.298**	1		
	Sig. (two-tailed)	.027	.000	.003	.000	.000			
var16	Pearson Correlation	.148	.160	.351**	.230**	.280**	.353**	1	
	Sig. (two-tailed)	.088	.065	.000	.008	.001	.000		
var17	Pearson Correlation	.241**	.246**	.287**	.370**	.322**	.406**	.310**	1
	Sig. (two-tailed)	.005	.004	.001	.000	.000	.000	.000	

** Correlation is significant at the .01 level (two-tailed).

* Correlation is significant at the .05 level (two-tailed).

[c] Listwise N = 134

RQ3 asked, To what extent, if any, does the IT flexibility dimension of connectivity influence cloud computing adoption in an enterprise? The corresponding hypotheses were as follows:

H30: There is no significant correlation between connectivity and cloud computing adoption in an enterprise.

H3A: There is a significant correlation between connectivity and cloud computing adoption in an enterprise. The output of the correlation analysis in the table indicates positive Pearson correlation values for all associations between the connectivity variables. The null hypothesis is thus rejected. After analysis, the data suggest that a significant positive correlation exists between the other variables under the connectivity dimension of flexibility, because for var2 (on-premise) and var14 (in the cloud), $rs = 30$, $p < .01$; for var3 (on-premise) and var15 (in the cloud), $rs = .31$, $p < .01$; for var4 (on-premise) and var16 (in the cloud), $rs = .35$, $p < .01$; and for var5 (on-premise) and var17 (in the cloud), $rs = .37$, $p < .01$.

Modularity Correlation Analysis

Table 5: Modularity Correlations

		var6	var7	var8	var9	var18	var19	var20	var21
var6	Pearson Correlation	1							
	Sig. (two-tailed)								
	N	134							
var7	Pearson Correlation	.242**	1						
	Sig. (two-tailed)	.005							
	N	134	134						
var8	Pearson Correlation	.297**	.269**	1					
	Sig. (two-tailed)	.000	.002						
	N	134	134	134					
var9	Pearson Correlation	.247**	.408**	.188*	1				
	Sig. (two-tailed)	.004	.000	.029					
	N	134	134	134	134				
var18	Pearson Correlation	.467**	.256**	.202*	.382**	1			
	Sig. (two-tailed)	.000	.003	.019	.000				
	N	134	134	134	134	134			
var19	Pearson Correlation	.235**	.585**	.275**	.254**	.225**	1		
	Sig. (two-tailed)	.006	.000	.001	.003	.009			
	N	134	134	134	134	134	134		
var20	Pearson Correlation	.225**	.353**	.377**	.410**	.214*	.278**	1	
	Sig. (two-tailed)	.009	.000	.000	.000	.013	.001		
	N	134	134	134	134	134	134	134	
var21	Pearson Correlation	.276**	.384**	.296**	.385**	.361**	.474**	.304**	1
	Sig. (two-tailed)	.001	.000	.001	.000	.000	.000	.000	
	N	134	134	134	134	134	134	134	134

** Correlation is significant at the .01 level (two-tailed).
* Correlation is significant at the .05 level (two-tailed).

RQ4 asked, To what extent, if any, does the IT flexibility dimension of modularity influence cloud computing adoption in an enterprise? The corresponding hypotheses were as follows:

H40: There is no significant correlation between modularity and cloud computing adoption in an enterprise.
H4A: There is a significant correlation between modularity and cloud computing adoption in an enterprise.

A correlation analysis was conducted between the variables that fall under the modularity dimension of flexibility.

The null hypothesis is rejected. The table shows positive Pearson correlation analysis values for all the variables, which yielded statistically significant values less than .05 while using a 95% confidence interval: for var6 (on-premise) and var18 (in the cloud), *rs* = 48, $p < .01$; for var7 (on-premise) and var19 (in the cloud), *rs* = .59, $p < .01$; for var8 (on-premise) and var20 (in the cloud), *rs* = .39, $p < .01$; and for var9 (on-premise) and var21 (in the cloud), *rs* = .39, $p < .01$.

Correlation Analysis with Cloud Adoption Stage

Table 6: Regression of Mean Scores

95% Confidence Interval		t-statistic	p-value
0.990	1.113	33.7960	<.001
0.222	0.245	39.1910	<.001
-0.036	0.018	-0.6638	0.5080
-0.017	0.029	0.5348	0.5937
-0.028	0.047	0.4849	0.6286

RQ5 asked, To what extent, if any, does the current stage of cloud computing adoption influence an enterprise's preference for on-premise infrastructure or cloud infrastructure? The corresponding hypotheses were as follows:

H50: There is no significant correlation between the cloud computing adoption stage and an enterprise's preference for on-premise infrastructure or cloud infrastructure.
H5A: There is a significant correlation between the cloud computing adoption stage and an enterprise's preference for on-premise infrastructure or cloud infrastructure.

A regression analysis was performed to explore whether the use of cloud computing or the state at which the participants enterprises are with regard to cloud computing influenced their responses. Given that the data were captured using an ordinal scale, the mean score across all cloud computing questions and the mean score across all on-premise computing questions for a linear regression analysis were taken, including the stage of use as a categorical predictor.

Mean_cloud = intercept + B1 * mean_on_premise + B2 * stage + error
The regression revealed that for every one-unit change in mean cloud score, the mean on-premise score increased by 0.234, which is a statistically significant change ($p < .0001$). The null hypothesis is thus retained. The outcome from the regression determined that the current stage in an enterprise's cloud computing adoption is not a significant predictor of the mean cloud computing score.

Conclusion

Summary

The purpose of this nonexperimental quantitative correlational study was to examine the relationship, if any, between IT infrastructure flexibility and cloud computing adoption in enterprise environments by looking at three core dimensions specific to IT infrastructure: compatibility, connectivity, and modularity. The sample included IT leaders in the US with cloud computing knowledge who participated in an online survey on the SurveyMonkey platform. Based on the findings, a significant correlation exists between IT flexibility and cloud computing adoption in enterprise environments. Many studies have been conducted on cloud computing adoption in enterprises. However, there is a gap in studies on how on-premise IT flexibility influences cloud computing adoption when observing the dimensions of flexibility on-premise versus in the cloud. It can thus be concluded that the study's objectives were met and contributed to the literature in the cloud computing space.

Based on the statistical analyses performed, it was determined that the cloud adoption stage of enterprises does not correlate significantly with decisions regarding cloud computing adoption, irrespective of the three core dimensions of flexibility involved: connectivity, modularity, and compatibility. The study found significant positive correlations between the three dimensions of flexibility. Based on the data analysis, it was determined that, to a large degree, the averages of the on-premise variables of flexibility are statistically significant predictors of the average of all cloud items (r^2 Adj = .81), with the on-premise modularity dimension of flexibility standing out as the best predictor.

Research Question 1 asked to what extent, if any, IT flexibility influences cloud computing adoption in an enterprise. The hypotheses for this question were the following:

$H1_0$: There is no significant correlation between IT flexibility and cloud computing adoption in an enterprise.
$H1_A$: There is a significant correlation between IT flexibility and cloud computing adoption in an enterprise.

Based on the results from the data analysis, there is a significant correlation between IT flexibility and cloud computing adoption in an enterprise because on-premise variable (dimension) averages are statistically significant predictors of the average of all cloud variables to a large degree (r^2 Adj = .81, $p < .01$). Given the breakdown of IT infrastructure on-premise and in the cloud into three dimensions—compatibility, connectivity, and modularity—data analysis indicated that on-premise modularity was the best predictor of Cloud Item Average (Beta = .77, $p < .01$). The research results suggest that the correlation is driven by the reusability of software modules, the ability of seamless remote work to access centralized resources, and the capability of enterprises to easily handle variations of different data formats.

Research Question 2 asked to what extent IT flexibility dimension of compatibility influences cloud computing adoption in an enterprise.

$H2_0$: There is no significant correlation between compatibility and cloud computing adoption in an enterprise.
$H2_A$: There is a significant correlation between compatibility and cloud computing adoption in an enterprise.

The findings showed that there is a significant correlation between compatibility and cloud computing adoption in an enterprise. As a result, this indicates that three factors drive correlation: when software applications can be easily transported and used across multiple platforms, when infrastructure user

interfaces provide transparent access to all platforms and applications, and when infrastructure makes extensive use of middleware to integrate key enterprise applications.
Research Question 3 asked to what extent, if any, IT flexibility dimension of connectivity influences cloud computing adoption in an enterprise.

$H3_0$: There is no significant correlation between connectivity and cloud computing adoption in an enterprise.
$H3_A$: There is a significant correlation between connectivity and cloud computing adoption in an enterprise.

The findings showed that there is a significant correlation between connectivity and cloud computing adoption in an enterprise mostly driven by the degree of systems interconnectivity, the flexibility to incorporate electronic links to external stakeholders, seamless access to centralized resources deployed using a web browser or other remote access tools, and the availability of data to everyone in real time or near real time.

Research Question 4 asked to what extent, if any, IT flexibility dimension of modularity influences cloud computing adoption in an enterprise.

$H4_0$: There is no significant correlation between modularity and cloud computing adoption in an enterprise.
$H4_A$: There is a significant correlation between modularity and cloud computing adoption in an enterprise.

Findings from the modularity dimension showed positive Pearson correlation analysis values for all the variables giving statistically significant values less than .05 within a 95% confidence interval. The findings also showed that modularity was the best predictor of cloud adoption. The outcome was indicative that the considered variables of modularity could play a central role in decision making for migration from on-premise to cloud infrastructure or when considering a hybrid infrastructure. As a result, the key aspects that IT leaders in the US often consider include but are not limited to the reusability of software modules across platforms, the incorporation of legacy systems in ways that do not hamper the development of new applications, the ability to quickly add new functionality to existing applications seamlessly or with minimal interruption or downtime, and the ability for infrastructure to handle variations in data formats and standards deployed to meet organizational goals.

Research Question 5 asked to what extent, if any, the current stage of cloud computing adoption influences the preference for on-premise infrastructure or cloud infrastructure in an enterprise.

$H5_0$: There is no significant correlation between the cloud computing adoption stage and a preference for on-premise infrastructure or cloud infrastructure in an enterprise.
$H5_A$: There is a significant correlation between the cloud computing adoption stage and a preference for on-premise infrastructure or cloud infrastructure in an enterprise.

To understand whether the current stage of an enterprise about its cloud computing infrastructure showed a correlation with cloud computing adoption, research questions sought to obtain responses from IT leaders in the US. The stages considered included discussions or evaluations about cloud infrastructure, the trial of cloud infrastructure, implementing cloud infrastructure, and using cloud infrastructure. Using regression, it was determined that the current stage in cloud computing adoption of an enterprise is not a significant predictor of the mean cloud computing score. As a result, there is no significant correlation between the cloud computing adoption stage and a preference for on-premise infrastructure or cloud infrastructure in an enterprise.

Limitations of the Study and Future Research

Although cloud computing has become a global trend in IT across industries as an evolutionary paradigm (Pathak et al., 2019), ranging from technical to nontechnical, the data collected were limited to a sample from the US. The lack of global consideration in the data captured is crucial because of possible different cloud adoption priorities and stages that enterprises across the world may fall under (Goasduff, 2019; Lovelock & Anderson, 2019). The findings may consequently not provide an accurate representation in a global context (Olufowote, 2017). A future study could address this, taking a global perspective to include data from across the world.

It is also worth noting that the responses for the sample were taken entirely from IT leaders, thus failing to capture feedback from other major stakeholders in the industry, such as cloud consultants and IT technical advisers. A future study could include other key stakeholders and non-IT leaders in the sample to capture more robust data for analysis.

Furthermore, financial constraints and time factors introduced limitations. Targeting a global audience and additional stakeholders to increase the sample size would have required a large budget and an extended period of time to send the research questionnaire and receive completed responses.

The adoption and use of a previously validated study could also introduce challenges because of the fast-changing IT industry that sometimes warrants review and an update of definitions as well as business strategies and concepts (Sabol et al., 2013). Additionally, the study did not segregate the data captured by enterprise size and industry size. Capturing and segregating data may have had an impact on the study's findings because IT infrastructure and cloud decisions could vary across industries and according to the size of the enterprises involved, especially given different levels of technical and financial resources involved (IDG, 2015).

A further potential limitation relates to the hiring of a research-based company to use their resources and tools for collecting data from the target sample. The limitation here is that the company could only reach out to IT professionals in their database. Although the company has thousands of IT experts, sample bias could have been introduced because of the potential lack of responses from IT experts who were not comfortable working with or providing their contacts to third parties for various reasons, including but not limited to personal information privacy concerns, although the data received did not include any personally identifiable information.

Another potential sample bias may have been introduced because of the use of an online portal, Survey-Monkey. Although using an online portal facilitated and accelerated the process, some IT professionals still prefer to provide responses on paper (Nulty, 2008).

The findings of the research in part supported the conclusions drawn by Al Mjlae et al. (2019) in their study about the "impact aspects of IT flexibility specific to cloud computing adoption on IT effectiveness." Their study found statistical evidence that the three aforementioned core dimensions of IT flexibility played key roles in ensuring IT effectiveness in cloud computing.

Implications

Results from the research outlined empirical evidence about the significant relationship between the three core dimensions of flexibility when observing on-premise and cloud infrastructure. The findings can serve as a foundation for IT leaders when considering dynamic capability theory to identify the dimensions of flexibility that matter most for them in their strategies for addressing rapidly growing technological change and increasing competition. Based on the research findings, cloud computing adoption or expansion for organizations would be facilitated by observing the compatibility, modularity, and connectivity dimensions against specific business needs in an effort to gain the best from cloud computing capabilities. The research findings recommend that cloud computing adoption should be evaluated at a granular level targeting specific business goals for best-in-class solutions that leverage infrastructure flexibility. The findings also highlight the adoption and use of hybrid environments because of the balance that IT leaders must leverage when deciding which infrastructure options could provide optimum business capabilities (Teece et al., 1997).

References

Alghamdi, A., & Bach, C. (2018). Developing teamwork at workplace. *International Journal of Business and Management Invention (IJBMI)*, *7*(2), 28-40. https://www.ijbmi.org/papers/Vol(7)2/Version-3/D0702032840.pdf

Almeida, F., Queiros, A., & Faria, D. (2017). Strengths and Limitations of Qualitative and Quantitative Research Methods. *European Journal of Education Studies, 3*(9), 369-387. DOI: 10.5281/zenodo.887089.

Al Mjlae, S., Mohamad, Z., & Suryani, W. (2019). Impact Aspects Of IT flexibility Specific To Cloud Computing Adoption On IT Effectiveness. *Journal of Theoretical and Applied Information Technology, 97*(3), 1041-1059. doi:10.4337/9781783475896.00015.

Alsghaier, H. (2017). The Importance of Big Data Analytics in Business: A Case Study. *American Journal of Software Engineering and Applications, 6*(4), 111-115. doi:10.11648/j.ajsea.20170604.12.

Apuke, O. D. (2017). Quantitative research methods a synopsis approach. *Kuwait Chapter of the Arabian Journal of Business and Management Review*, *6*(11), 40-47. DOI: 10.12816/0040336.

Aschenbrenner, J. R. (1986). Open systems interconnection. *IBM Systems Journal*, *25*(3.4), 369-379. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.92.8945&rep=rep1&type=pdf

Avram, M. G. (2014). Advantages and challenges of adopting cloud computing from an enterprise perspective. *Procedia Technology*, *12*, 529-534. https://www.sciencedirect.com/science/article/pii/S221201731300710X.

Bacon-Shone, J. (2015). *Introduction to Quantitative Research Methods.* The University of Hong Kong. DOI: 10.13140/2.1.4466.3040.

Baily, M. N., & Montalbano, N. (2017). *Clusters and Innovation Districts: Lessons from the United States Experience*. The Brookings Institution. https://www.brookings.edu/wp-content/uploads/2017/12/es_20171208_bailyclustersandinnovation.pdf

Bani, J. (2011). Assessing the relationships among information technology flexibility, IT-business strategic alignment, and information technology effectiveness: An investigation of business intelligence implementation (Order No. 3449293) (Doctoral dissertation). Capella University. https://search.proquest.com/docview/862076363?accountid=10378.

Benitez, J., Ray, G., & Henseler, J. (2018). Impact of Information Technology Infrastructure Flexibility on Mergers and Acquisitions. *MIS quarterly*, *42*(1), 25-43.

Besley, T., & Ghatak, M. (2017). Profit with purpose? A theory of social enterprise. *American Economic Journal: Economic Policy*, *9*(3), 19-58. doi.org/10.1257/pol.20150495

Bojanova, I., Zhang, J., & Voas, J. (2013). Cloud computing. *It Professional*, *15*(2), 12-14. https://www.researchgate.net/publication/260305826_Cloud_Computing

Boules, N., Douglas, K., Feldman, S., Fix, L., Hager, G., Hailpern, B., Hebert, M., Lopresti, D., Mynatt, B., Rossbach, C., Wright, H. (2017). *The Future of Computing Research: Industry-Academic Collaborations, Version 2.* Computing Community Consortium. https://cra.org/ccc/wp-content/uploads/sites/2/2016/06/15125-CCC-Industry-Whitepaper-v4-1.pdf

Buyya, R. (2010). Cloud Computing - The Next Revolution in Information Technology. *Proceedings of the 2010 International Conference on Internet Computing, ICOMP 2010, July 12-15*. DOI: 10.1109/PDGC.2010.5679963

Byrd, T. A., & Turner, D. E. (2000). Measuring the Flexibility of Information Technology Infrastructure: Exploratory Analysis of a Construct. *Journal of Management Information Systems*, *17*(1), 167-208. doi:10.1080/07421222.2000.11045632

Campista, M. E. M., Rubinstein, M. G., Moraes, I. M., Costa, L. H. M., & Duarte, O. C. M. (2013). Challenges and research directions for the future internetworking. *IEEE Communications Surveys & Tutorials*, *16*(2), 1050-1079. 10.1109/SURV.2013.100213.00143.

CDC. (2020). *How to Protect Yourself & Others.* https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html

Centiment. (n.d.). *Glossary*. https://help.centiment.co/reference/glossary

Charif, B., & Awad, A. I. (2014). Business and government 'organizations' adoption of cloud computing. In *International Conference on Intelligent Data Engineering and Automated Learning* (pp. 492-501). Springer. DOI: 10.1007/978-3-319-10840-7_59.

Chatterji, A., Glaeser, E., & Kerr, W. (2014). Clusters of entrepreneurship and innovation. *Innovation policy and the economy*, *14*(1), 129-166. http://www.hbs.edu/faculty/Publication%20Files/130424-CGK-IPE_45be2057-0f20-4dc2-98d4-e422198bd55c.pdf

Cloud Standards Customer Council. (2017). *Interoperability and Portability for Cloud Computing: A Guide, Version 2.0.* https://www.omg.org/cloud/deliverables/CSCC-Interoperability-and-Portability-for-Cloud-Computing-A-Guide.pdf

Collaborative Institutional Training Initiative. (2008). *Request for Information and Comments on the Implementation of Human Subjects Training and Education Programs*. https://www.citiprogram.org/citidocuments/admin/citi_ohrp_response_final_092908.pdf

Collins, E. (2014). Intersection of the cloud and big data. *IEEE Cloud Computing*, *1*(1), 84-85. Doi: 10.1109/MCC.2014.12.

Damaskinidis, G. (2017). Qualitative Research and Subjective Impressions in Educational Contexts. *American Journal of Educational Research, 2017, 5*(12), 1228-1233. DOI: 10.12691/education-5-12-10.

Deloitte. (2018). *The cloud is here: embrace the transition How organizations can stop worrying and learn to ""think cloud"".* https://www2.deloitte.com/content/dam/Deloitte/ca/Documents/consulting/ca_cloud_pov_EN_doc.PDF

Duncan, N. B. (1995). Capturing Flexibility of Information Technology Infrastructure: A Study of Resource Characteristics and Their Measure. *Journal of Management Information Systems, 12*(2), 37-57. doi:10.1080/07421222.1995.11518080.

ECIS Cloud Computing Standards. (n.d.). *Cloud Computing Standards, Compatibility and Interoperability: Ensuring a thriving competitive market.* http://www.ecis.eu/wp-content/uploads/2014/10/Cloud-Computing-Standards-Compatibility-and-Interoperability_final-version1.pdf

ECIS Cloud Computing Standards. (n.d.). *Ensuring a Thriving Cloud market: Why interoperability matters for business and government.* http://www.ecis.eu/wp-content/uploads/2014/11/Cloud-Computing-Standards-Compatibility-and-Interoperability1.pdf

Editage Insights. (2019). *What researchers want from academic publishing: Report based on over 2,500 researchers' comments.* https://www.editage.com/insights/what-researchers-want-from-academic-publishing-report-based-on-over-2500-researchers-comments

Eyisi, D. (2016). The usefulness of qualitative and quantitative approaches and methods in researching problem-solving ability in science education curriculum. *Journal of Education and Practice*, *7*(15), 91-100.

Friedrich, J. (2011, September). Making innovation happen: the role of standards and openness in an innovation-friendly ecosystem. In *2011 7th International Conference on Standardization and Innovation in Information Technology (SIIT)* (pp. 1-8). IEEE. doi: 10.1109/SIIT.2011.6083609.

G*Power. (2020). *G * Power 3.1 Manual.* https://www.psychologie.hhu.de/fileadmin/redaktion/Fakultaeten/Mathematisch-Naturwissenschaftliche_Fakultaet/Psychologie/AAP/gpower/GPowerManual.pdf

Gartner. (2017). *Cloud Strategy Leadership. Gartner Insights on How and Why Leaders Must Implement Cloud Computing*. https://www.gartner.com/imagesrv/books/cloud/cloud_strategy_leadership.pdf

Gartner. (2018). *Gartner Says the Future of IT infrastructure Is Always On, Always Available, Everywhere*. https://www.gartner.com/en/newsroom/press-releases/2018-12-03-gartner-says-the-future-of-it-infrastructure-is-always-on-always-available-everywhere

Goasduff, L. (2019). *Cloud Adoption: Where Does Your Country Rank?* Gartner. https://www.gartner.com/smarterwithgartner/cloud-adoption-where-does-your-country-rank/

Hornby, A. S., & Cowie, A.P. (2000). *Oxford advanced learner's dictionary* (6th ed.). Oxford University press .

Hovlin, K., Ohlin, E. H., Härviden, M., & Wikström, M. A. (2008). *Information technology in the United States: Environments, initiatives and trends.* ITPS, Swedish Institute for Growth Policy Studies. https://www.tillvaxtanalys.se/download/18.1af15a1f152a3475a818f62/1454509215069/Information+technology+in+the+United+States-08.pdf

IDG. (2015). *Role & Influence of the Technology Decision-Maker 2015*. https://www.idg.com/tools-for-marketers/2015-role-influence-of-the-technology-decision-maker/.

Jenkins, A., & Banse, T. (2020). *Washington Gov. Inslee Announces Statewide Stay-At-Home Order*. OPB .https://www.opb.org/news/article/washington-governor-inslee-coronavirus-stay-at-home-order/

Kasi, P. M. (2009). Research: What, Why and How? A Treatise from Researchers to Researchers. AuthorHouse. DOI: 10.13140/2.1.3274.1442.

Keen, P. (1991). Shaping the future: Business design through information technology. Harvard Business School Press.

Kent, S. (2019). *Federal cloud comnputing strategy.* Executive Office of the President of the United Stated. https://www.whitehouse.gov/wp-content/uploads/2019/06/Cloud-Strategy.pdf

Kune, R., Konugurthi, P. K., Agarwal, A., Chillarige, R. R., & Buyya, R. (2016). The anatomy of big data computing [Special Issue]. *Software: Practice and Experience*, *46*(1), 79-105 . https://arxiv.org/ftp/arxiv/papers/1509/1509.01331.pdf

Kung, F. Y., Kwok, N., & Brown, D. J. (2018). Are attention check questions a threat to scale validity?. *Applied Psychology*, *67*(2), 264-283. doi: 10.1111/apps.12108.

Lee, J. H., Kim, Y. S., Kim, J. H., & Kim, I. K. (2017, October). Toward the SIEM architecture for cloud-based security services. In *2017 IEEE Conference on Communications and Network Security (CNS)* (pp. 398-399). IEEE. doi: 10.1109/CNS.2017.8228696.

Lovelock, J., & Anderson, E. (2019). *Market Trends: Cloud Spending Data Shows Divergent Geographic Priorities*. Gartner. https://www.gartner.com/en/documents/3947406/market-trends-cloud-spending-data-shows-divergent-geogra

McKeen, J. D., & Smith, H. A. (2017). *.ITStrategy: Issues and Practices.* Pearson.

Mell, P., & Grance, T. (2011). *The NIST definition of cloud computing*. National Institute of Standards and Technology's. https://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf

Mukaka, M. M. (2012). A guide to appropriate use of correlation coefficient in medical research. *Malawi medical journal*, *24*(3), 69-71. http://www.bioline.org.br/pdf?mm12018.

Mvelase, P., Sithole, H., Modipa, T., & Mathaba, S. (2016). The economics of cloud computing: A review. In *2016 International Conference on Advances in Computing and Communication Engineering (ICACCE)* (pp. 159-167). IEEE. http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8073741&isnumber=8073703

Narten, T. (1989). Internet routing. In *Symposium proceedings on Communications architectures & protocols* (pp. 271-282). ACM. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.66.6265&rep=rep1&type=pdf

National Institute of Standards and Technology. (2015). *Final Version of NIST Cloud Computing Definition Published.* https://www.nist.gov/news-events/news/2011/10/final-version-nist-cloud-computing-definition-published.

Nazir, M. (2012). Cloud computing: overview & current research challenges. *IOSR journal of computer engineering*, *8*(1), 14-22.

Nelson, K. M., Nelson, H. J., & Ghods, M. (1997). Technology flexibility: conceptualization, validation, and measurement. In *Proceedings of the Thirtieth Hawaii International Conference on System Sciences* (Vol. 3, pp. 76-87). IEEE. doi:10.1109/hicss.1997.661572

Ness, L. R. (2005). Assessing the relationships among IT flexibility, strategic alignment, and .ITeffectiveness: study overview and findings. *Journal of Information technology management*, *16*(2), 1-17.

Nulty, D. D. (2008). The adequacy of response rates to online and paper surveys: what can be done?. *Assessment & evaluation in higher education*, *33*(3), 301-314.

Olufowote, J. (2017). Limitations of research. In M. Allen (Ed.), *Sage Encyclopedia of Communication Research Methods* (pp. 863-864). Doi: 10.4135/9781483381411.n297.

Pathak, N., Anwar, S., Singhal, V., Sharma, N., & Shukla, A. K. (2019, March). Trends and Augmentations of Cloud Computing. In *2019 6th International Conference on Computing for Sustainable Global Development (INDIACom)* (pp. 373-377). IEEE.

Pearlson, K. E., Saunders, C. S., & Galletta, D. F. (2020). *Managing and using information systems: A strategic approach*. John Wiley & Sons.

Poindexter, W. (2019). *Bridging the Leadership Gap Between Tech and Business.* MITSloan Management Review. https://sloanreview.mit.edu/article/bridging-the-leadership-gap-between-tech-and-business/

Rad, B. B., Diaby, T., & Rana, M. E. (2017). Cloud computing adoption: a short review of issues and challenges. In *Proceedings of the 2017 International Conference on E-commerce, E-Business and E-Government* (pp. 51-55). ACM. DOI: 10.1145/3108421.3108426.

Read "maximizing U.S. interests in Science and Technology Relations with Japan" at nap.edu. Science, Technology, and Innovation in the United States | Maximizing U.S. Interests in Science and Technology Relations with Japan |The National Academies Press. (n.d.).

Ruiter, J., & Warnier, M. (2011). Privacy regulations for cloud computing: Compliance and implementation in theory and practice. In *Computers, privacy and data protection: an element of choice* (pp. 361-376). Springer. DOI: 10.1007/978-94-007-0641-5_17.

Sabol, A., Šander, M., & Fučkan, Đ. (2013). The concept of industry life cycle and development of business strategies. In *International conference: Active Citizenship by Management, Knowledge Management & Innovation Knowledge and Learning (*pp. 635-642). ToKnowPress. http://www.toknowpress.net/ISBN/978-961-6914-02-4/papers/ML13-300.pdf

Sahhaf, S., Tavernier, W., Papadimitriou, D., Careglio, D., Kumar, A., Glacet, C., Coudert, D., Nisse, N., Fàbrega, S. L., Vila, P., Camelo, M., Audenaert, P., Colle, D., & Demeester, P. (2017). Routing at large scale: Advances and challenges for complex networks. *IEEE network*, *31*(4), 108-118. ff10.1109/MNET.2017.1600203ff. ffhal-01547511.

Sharma, M., Husain, S., & Zain, H. (2017). Cloud Computing Architecture & Services. *IOSR Journal of Computer Engineering*, *19*(2), 13-18.

Singh, N., Lai, K. H., & Cheng, T. E. (2007). Intra-organizational perspectives on IT-enabled supply chains. *Communications of the ACM*, *50*(1), 59-65.

Smith, E., & Ugolini, M. (2017). Building information and communication technology (ICT) value-propositions for the post-information age. In *2017 56th FITCE Congress* (pp. 1-9). IEEE. doi: 10.1109/FITCE.2017.8092999.

Softchoice. (2018). *The 5 stages of successful cloud migration.* https://m.softchoice.com/web/newsite/documents/solutions/5StagesToSuccessfulCloudMigrationGuide_Updated.pdf

Strutynska, I., Kozbur, G., Dmytrotsa, L., Sorokivska, O., & Melnyk, L. (2019, June). Influence of Digital Technology on Roadmap Development for Digital Business Transformation. In *2019 9th International Conference on Advanced Computer Information Technologies (ACIT)* (pp. 333-337). IEEE. doi: 10.1109/ACITT.2019.8780056.

Sullivan, L. E. (Ed.). (n.d). Nonexperimental Research in Quantitative Research. In *The SAGE Glossary of the Social and Behavioral Sciences* (p. 351). Sage. http://sk.sagepub.com/reference/behavioralsciences/n1722.xml.

Swanson, R. A., & Holton, E.F., III. (2005). *Research in organizations: Foundations and methods of inquiry.* Berrett-Koelher.

Talib, A. M., & Abdullah, R. (2012, November). A model of information technology as a service (ITaaS) in cloud computing: A case of collaborative knowledge management system. In *2012 International Conference on Advanced Computer Science Applications and Technologies (ACSAT)* (pp. 83-86). IEEE. doi: 10.1109/ACSAT.2012.24.

Tassey, G. (1999). *Standardization in Technology-Based Markets*. National Institute of Standards and Technology. https://www.nist.gov/system/files/documents/2017/05/09/researchpolicypaper.pdf

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic management journal*, *18*(7), 509-533.

UNCTAD. (2018). *Harnessing Frontier Technologies for Sustainable Development.* Technology and innovation report 2018. https://unctad.org/en/PublicationsLibrary/tir2018_en.pdf
United States Department of Education. (n.d.). *Science, Technology, Engineering, and Math, including Computer Science.* https://www.ed.gov/stem.

VansonBourne. (2017). *The CIO in 2017: Challenges and opportunities of cloud migration.* https://www.trustmarque.com/wp-content/uploads/2018/02/Challenges_and_opportunities_of_cloud_migration_trustmarque.pdf

Vithayathil, J. (2017). Will cloud computing make the Information Technology (I.T.) department obsolete? *Information Systems Journal*, *28*(4), 634-649. DOI: 10.1111/isj.12151.

Ward, C., Aravamudan, N., Bhattacharya, K., Cheng, K., Filepp, R., Kearney, R., Peterson, B., Shwartz, L., Young, C. C. (2010). Workload migration into clouds challenges, experiences, opportunities. In *2010 IEEE 3rd International Conference on Cloud Computing* (pp. 164-171). IEEE. doi:10.1109/cloud.2010.84

WHO. (2020). *Coronavirus disease (COVID-19) advice for the public.* https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public

Wright, B., & Schwager, P. H. (2008). Online Survey Research: Can Response Factors Be Improved? *Journal of Internet Commerce, 7*(2), 253-269. doi:10.1080/15332860802067730.

Zubaedah, S. Y., Ranti, B., & Luhukay, J. (2017). Successful information technology adaptation process to enable business agility. 11th International Conference on Business and Management Research (ICBMR 2017). In *Advances in Economics, Business and Management Research* (pp. 524-536). *Atlantis*. doi.org/10.2991/icbmr-17.2017.48.