Int J Syst Assur Eng Manag (April 2020) 11(2):441–449
https://doi.org/10.1007/s13198-019-00872-z

ORIGINAL ARTICLE

An integrated TOE–DoI framework for cloud computing adoption in the higher education sector: case study of Sub-Saharan Africa, Ethiopia

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Received: 10 April 2019 / Revised: 19 July 2019 / Published online: 6 September 2019

Abstract This research paper describes an integrated framework based on both the 'Technology–Organization–Environment (TOE) framework' and 'Diffusion of Innovation (DoI) theory'. The study explores the noteworthy factors and sub-factors which are pertinent for the adoption of cloud computing in the Ethiopian Higher Education (EHE) sector. The technology literature herein was based on technology adoption frameworks and theories which were studied in order to identify a set of factors and sub-factors relevant to cloud computing adoption. It resulted in conceptualizing an integrated TOE–DoI framework for cloud computing adoption in higher education at the university in Ethiopia and in developing its reliable measures. Accordingly, a quantitative study was done with a questionnaire survey comprising 500 respondents in connection with 4 factors (technological, organizational, environmental and socio-cultural). Consequently, the cloud computing adoption in Ethiopia was established using factors and concepts adopted from the study. It confirmed that the TOE–DoI approach to higher education in Ethiopia is authenticated. Thus, the four factors' reliability statistics validated with a Cronbach's alpha a = 0.739, 0.712, 0.761, 0.841, and Cronbach's alpha 'a' based on standard items a = 0.740, 0.713, 0.762 and 0.842 for technology, organizational, environmental, and socio-cultural factors. This indicates that scaling the four aspects therein suggests profound evidence to determine a cloud computing adoption in EHE with TOE–DoI integration.

Keywords TOE · DoI · Ethiopian Higher Education (EHE) · Factors · Integration · Cloud computing

1 Introduction

As technology makes noteworthy developments throughout the modern world, the primary driving force is unquestionably a greater computing capacity. Developed countries have invested greatly in cloud computing systems to adapt to hi-tech advancements within various industries of their economies. However, Cloud adoption is still in its infancy in both developing and underdeveloped nations as they attempt some form of digital transformation of their data systems. Accordingly, the adoption of Cloud computing has positively impacted Sub-Saharan Africa, especially Sub-Saharan Africa, primarily Ethiopia in recent times (Tesfaye et al. 2016). In this hi-tech progression, the Cloud serves as an essential element to Information and Communication Technology (ICT) as hundreds of millions of computer users worldwide can enjoy flexible computing power on-demand via the Internet. This alleviates the pressure on organizations investing in and maintaining costly computer hardware and software resources which inadvertently facilitates and enable developmental strategies for the reduction of poverty and other nuances in the developing world (Hassan et al. 2017; Hiran et al. 2014). This paves the way for the Cloud to become the new standard of computing in deploying essential IT services to individuals, businesses, philanthropic organizations, as well as governments.

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With the adoption (Hiran et al. 2014) and proliferation of technology and immense record keeping, the fusion of cloud technologies has the propensity to blur the lines between the physical and digital realms while decreasing the digital divide between developed underdeveloped nations (Ifijeh 2014; Schnabel 2018). However, this decrease in the gap is highly dependent on the socio-economic and factors of a proposed nation. Nowadays, Cloud computing has become an essential and adoptable technology in many organizations. It has changed various industries with its vibrant scalability and virtualized resources as a service via the Internet. Accordingly, most of the higher educational institutions around the world have become extremely reliant on Information Communications Technology to tune-up their big business requirements. As many Sub-Saharan countries now realize the significance of the Cloud in their technological development, businesses, government institutions, research facilities, and higher education bodies will craft legal policies to curtail older protectionism frameworks in an attempt to streamline the information exchange across all spectrums in the underdeveloped world (Hiran et al. 2019).

In this light, it is essential that from the perspective of underdeveloped countries, the integrated TOE–DoI framework for Cloud computing adoption in Sub-Saharan Africa, Ethiopia be explored. The Diffusion of Innovation (DoI) theory, cultivated by Everett M. Rogers with F. Floyd Shoemaker in 1962, and the Technology–Organization–Environment (TOE) framework by developed Tornatzky and Fleischer in 1990 serve as pioneering implements in appraising the influencing factors for adoption of the Cloud (Bhardwaj et al. 2018). This analysis aims to convey which variables are relevant in adopting a cloud computing system in Higher Education institutions when both the TOE and DoI are united.

1.1 Technology adoption

Technology adoptions is defined as, "The first use of a new product or acceptance of a new technology on a voluntarily basis (Oliveira et al. 2014). Therefore, understanding the priorities of decision factors and characteristics of various information systems is meaningful when organizations analyze the adoption of cloud based solutions. Table 1 outlines common Cloud adoption frameworks and theories prevalent in technology adoption.

2 Literature review

2.1 The DoI theory

The Diffusion of Innovation (DoI) theory was developed by Rural Psychology Professor, Everett M. Rogers, in collaboration with F. Floyd Shoemaker in 1962. It is perhaps one of the oldest social science theories that aims to convey how the likelihood of a new concept (*idea*) or product (*good or service*) gains momentum in its acceptance as it diffuses (*spreads out or is widely accepted and used*) throughout a given population over a period of time until it reaches a point in which the rate of adoption becomes self-sustaining and creates further growth. The DoI theory expounds on the phenomenon that individuals in any society fall into one of five groups based on how early or quickly they adopt new products, ideas, or behaviors and how each new products or ideas require a unique marketing approach to each group (Schnabel 2018). Rogers popularized this "Product Innovation Life Cycle" theory in a book he wrote entitled "Diffusion of Innovations", which has become a staple literary reference for those in the marketing arena.

While studying the adoption intensity of inorganic fertilizers from data collected from 383 smallholder farmers in various regions in Eastern Ethiopia, researchers employed the DoI theory during their analysis of various factors and sub-factors that affected the adoption of these fertilizers in maize and wheat production. Results from the study determined that despite the advantage in crop yield potential as opposed to organic composts, inorganic fertilizers were underutilized. Thus, the farmers were encouraged to form cooperatives in the dissemination of information regarding inorganic fertilizers and other technologically superior agricultural practices using cloud computing technology (Bhardwaj et al. 2018). With the use of cloud diffusion of innovation, the new agriculture initiative served as one of the foundations of information for the farmers. Findings from the study further suggested that the adoption of emerging technologies and research played an integral role in not only increasing agricultural productivity but also lowering the poverty level substantially, thereby fostering the overall growth of the economy in Ethiopia.

2.2 The TOE framework

The Technology–Organization–Environment (TOE) framework was proposed by Rocco DePietro, Edith Wiarda and Mitchell Fleischer in 1990. This framework, popularly cited as "Tornatzky and Fleischer" is considered a derivative of the DoI theory. However, it comprehensively defines the likelihood of a particular firm adopting and utilizing innovations based on technological, organizational, environmental, and socio-cultural factors. The TOE framework suggests that these three factors encompass both the constraints that serve as hurdles and the opportunities that provide an incentive for technological innovation, thereby collectively influencing the manner in

Table 1 Technology adoption theories and frameworks

S. No.	Acronym	Theory/framework	Originated by	Year
1	TAM3	Technology acceptance model 3	Venkatesh and Bala	(2008)
2	UTAUT	Unified theory of acceptance and use of technology	Venkatesh et al.	(2003)
3	TAM2	Technology acceptance model 2	Venkatesh and Davis	(2000)
4	DIT	Theory of diffusion of innovations	Rogers	(1995)
5	TPB	Theory of planned behavior	Ajzen	(1991)
6	TOE	Technology–organization–environment framework	Tornatzky and Fleischer	(1990)
7	TAM	Technology acceptance model	Davis	(1989)
8	IDT	Innovation diffusion theory	Rogers	(1995)
9	ECT	Expectancy confirmation theory	Oliver	(1980)
10	TRA	Theory of reasoned action	Fishbein and Ajzen	(1975)

which companies realize the need for, pursue, and adopt new technology (Baker 2012).

While studying the hindering factors to cloud computing adoption in higher learning institutions from data collected from 69 accredited universities in various regions in Kenya, researchers employed the TOE framework in their online questionnaire aimed at analyzing and ranking the constraining factors to the adoption of cloud computing. Results from the quantitative investigation determined that the new cloud platform's reliability coupled with the lack of IT personnel who were well versed in cloud computing posed issues of great concern. The report further noted that inadequate support and training from Cloud service providers and government policies on cloud computing, data security (Hiran et al. 2014) and confidentiality were noteworthy hindrances to the Cloud's adoption. Thus, recommendations for proactive management with role-based training for Cloud service users as well as the implementation of IT governance policies were made to address all apprehensions (Njenga et al. 2018). With the use of the TOE framework, the new education initiative functioned as a cornerstone in guiding the decision-making process on adoption of cloud computing throughout educational institutions. Findings from the study enhance insightful understanding regarding the adoption of cloud computing in higher education institutions not only in Kenya but also in other developing countries in Sub-Saharan Africa and around the world. Cloud computing can bring many benefits to individuals, entities, and entire nations. Accordingly, there factors to seriously consider during its adoption, especially in developing countries. During 2014 European economic crises, a study of cloud adoption was conducted in Greece pertaining to its national perspective on small and medium enterprises (Filiopoulou et al. 2014).

Rogers (1995) proposed the theory of 'Diffusion of innovation (DIT)' was to begin the foundation for the research on innovation acceptance and adoption of technology. Rogers synthesized research from several diffusion and adoption studies and derived with this DIT theory for the adoption of technological innovations.

Venkatesh and Davis (2000) proposed the TAM Version 2 theory. This research model providing more detail descriptions. This model is useful at three conditions: (1) Pre-implementation, (2) 1-month post-implementation and (3) 3-month post-implementation.

Venkatesh and Bala (2008) integrated TAM Version 2 (Venkatesh and Davis 2000) and the model of the perceived ease of use (Venkatesh 2000), and developed a unique model of technology acceptance known as TAM Version 3. The TAM Version 3 model was experienced in real-world surroundings of technological implementations.

3 Proposed TOE–DoI framework

Figure 1 depicts the TOE–DoI framework factors affecting cloud adoption in Ethiopian Higher Education.

3.1 Technological factors

There are primarily two technological concerns when adopting a cloud computing system. They are the *relative advantage* and *compatibility* issues, each with its own technical variables to consider. Most of the universities around the world have become extremely reliant on Information Communications Technology (ICT) to tune-up their big business requirements. When adopting or migrating to a new technology, especially one as dynamic as the cloud, educational institutions must weigh its pros and cons carefully.

Relative Advantage Relative advantage refers to the degree to which a technological determinant is believed to provide more benefits for an organization. Entities must consider whether the innovation that is being adopted is better than the idea it supersedes. In reference to cloud computing, it is more advantageous than other technologies

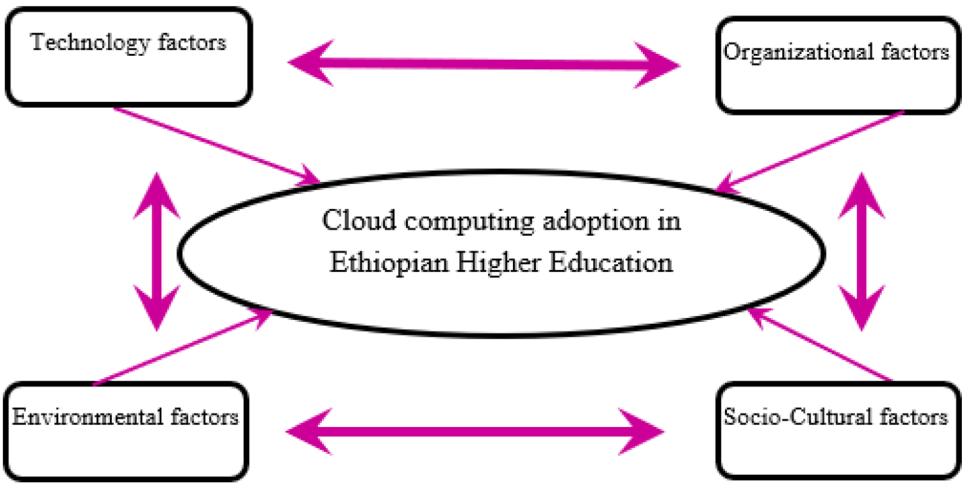

Fig. 1 Proposed framework for the cloud computing adoption in Ethiopia's higher education

because it is more flexible, mobile, and has an infinite range of scalability. Cloud computing in education opens avenues for better research, discussion, and collaboration. With it, users can utilize rented shared resources and rented services on a *pay-as-you-use* basis. This ultimately affects IT infrastructure and software costs on numerous levels.

- *Cost and Manageability* When comparing IT costs, it is much better to adopt a cloud computing system. Investment costs is one of the most important decision-making factors. Consider the initial outlay a college would need for acquiring IT hardware infrastructure like servers, cables, routers, firewalls, uninterruptible power supplies (UBS), heating, ventilation, and cooling (HVAC), units, as well as the physical space to store this equipment. Moreover, consider the costs associated with setting up, troubleshooting, and maintaining all of these components. Finally, consider the costs of licensing software for each user in the organization. The resulting reduction in direct IT spending would be extremely beneficial to start-ups or small business.
- *Efficiency and Flexibility* With cloud computing, not only is the physical infrastructure provided by the cloud service provider on a subscription basis, but all of the needed software applications are readily available. This eliminates the headache associated with procuring, installing, and maintaining IT equipment and software. As a result, an institution can use its overall human and financial resources more efficiently. School administrators can then focus their efforts somewhere else knowing that the cloud services are more than flexible to meet its growth, and because of its continuity, the cloud platform will be more reliable. One of the first essential uses of the cloud is in e-learning as well as traditional courses whose academic resources are accessible online. It provides access to a vast repository of online texts and academic materials, and it also enables the use of online documents and digitized print media in which users from different campuses can access the same material online.

Compatibility Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters (Rogers 1995). The Internet has become the predominant form of information sharing and communication globally. Accordingly, Cloud platforms are in alignment with the Internet platform and will allow education institutions to conveniently import and export applications and customize their academic services seamlessly.

- *Ease of Use and Data Integration* Cloud-based services would be compatible with all existing file formats, user interfaces, and other structured data in an attempt to reduce the level of uncertainty among the users of technology. Students, teachers and the administrators' can access pieces of information from their computers without the installation of a specific program. This usually makes the access more flexible and it facilitates interdepartmental collaboration. Specific area supplies records to a common repository, and also another can provide other with those records. Form, text files, spreadsheets and presentations can also be edited by different people ate the same time from any computer, this enables helping in an efficient distribution of tasks and also improving the quality of the information by boosting peer feedback. Additionally, the time taken to perform tasks, transfer data, and integrate computer data into existing work would be much less. As a result, computer systems would be less complex to understand with higher functionality across various platforms.

The case studies utilized the TOE framework to describe the direct influences of cloud computing on the

organization in a wide range of activities. Accordingly, all the identified factors from prior research regarding cloud computing adoption were considered as options for the decision-making framework to adopt cloud computing. Those factors were placed accordingly by nature into determinants and attributes in the framework. Figure 1 outlines the factors affecting cloud adoption using the TOE–DoI framework.

3.2 Organizational factors

From an organizational standpoint, strategic objectives must be established in order to outline expected outcomes and guide organizational efforts in achieving these objectives. As a result, a university's faculty must support all efforts to ready the institution to meet these objectives and overall goals. Again, when adopting or migrating to the Cloud, decision-makers must weigh its pros and cons carefully.

Organizational Readiness Organizational readiness is described as a manager' perception and evaluation of the degree to which he/she believes that the organization has the awareness, resources, commitment, and governance to adopt an IT system This implies that if an organization claims that it is ready to adopt or migrate to a new platform of technology, it must have both the financial resources and the technical infrastructure to support such an adoption. Many of the toughest challenges related to the Cloud are not with the technology, but with the organization's ability to procure the necessary resources to implement its adoption.

- *Financial Readiness* Financial resources are a key driver of technology adoption in any institution. It is also one of its main constraints, especially in developing countries. From a monetary perspective, it is essential that decision-makers consider the financial readiness and likelihood of migrating to the Cloud. Scarce financial resources restrain IT capabilities that could improve an organization's effectiveness, so Cloud computing attempts to address these economic limitations with useful, user-friendly, and less costly solutions for data needs over the course of the firm's life.
- *Technological Infrastructure* IT infrastructure refers to the composite of physical components like computer and networking hardware, facilities, and various software and network components required for the existence, operation and management of an IT environment. All education establishments should have some sort of effective technology infrastructure with professionals managing them. When these institutions plan to operate in a cloud computing environment, their Cloud IT infrastructure will allow them to become more agile, efficient, and able to innovate more rapidly to meet the growing demands of their users. They will be more responsive to the needs of their students and faculty while providing increasingly better quality of services.

Top Management Support Top management support is considered one of the main success factors in project management. Therefore, effective administrative involvement can considerably improve the success of a new IT infrastructure. Whenever resources are limited, strategies such as shifting resources from low-value adding activities to high-priority activities may beneficial. The perceptions and actions of top business executives on the usefulness of technological innovation in creating values for the firm are referred to as Top Management Support (García-Sánchez et al. 2017). It ensures long term vision, commitment of resources, and optimal management of resources in the establishment and realization of an organization's goals. Studies show that when companies fail to get sufficient top management support for their IT projects, either these projects had little chance of succeeding or they failed altogether.

- *Long-term Vision and Establishment of Goals* A vision is a long-term goal that expresses what an organization wants to become, be known as, or be known for. In this current information age, organizations are accumulating vast amounts of digital data (Schnabel 2018). As the global environment evolves into a more technological one, countless institutions in various industries are incorporating cloud computing strategies into their long-term IT plan because administrators strongly believe that cloud systems can easily scale to their companies' expectations without the need for new capital expenditures on hardware and software purchases, security and maintenance, as well as other associated costs.
- *Commitment of Resources* In order for an organization to effectively and efficiently achieve its goals, it must be ready and willing to commit its resources. Information needs are increasing, and in order for firms to stay competitive in the global market, they need to adopt some information system to accommodate growing demands for information. Management must commit financial resources to acquire a suitable IT infrastructure such as a cloud based system to handle all of its information needs. Moreover, they must train and educate human resources about the use of cloud computing so they can operate freely in this new technological environment.

3.3 Environmental factors

Cloud computing can bring many benefits to organizations and countries around the world. However, pressure from global competitors, government regulations, and comprehensive product support in new technology systems are important factors to consider during a firm's data digitization. These factors may vary depending on the economic, social, and political environments in which organizations operate, but as the internet continues to make information transfer more accessible across international borders, these factors could become relatively uniform.

Competitive Pressure Competitive pressure is the degree of opposition that a company feels from competitors within an industry. As competition usually compels providers of products to increase quality standards, it is a strategic necessity to adopt new technologies to compete in the market, especially when technology directly affects the competition. Adopting information systems is useful for any higher learning institution in order to change its industry structure in efforts to increase its relative competitive position in the education industry. As the institution utilizes the cloud computing system, by default, new opportunities will be generated to outperform other higher learning institutions.

- *Changes of the Industry Structure* Cloud computing is maturing in the IT industry as many companies are adopting it into both their existing infrastructure and business processes. A research performed by the International Data Corporation (IDC), a market research, analysis, and advisory firm that specializes in Information Technology, saw that the cloud computing industry has grown from a multimillion to a multibillion dollar industry, and as of 2015, public cloud services accounted for 46% of net new growth in overall IT spending in key areas such as applications, application development and deployment, systems infrastructure software, basic storage, and servers (Gens and Shirer 2015). As more powerful computer hardware and software become available, this industry will continue to grow exponentially, especially in business and academia.
- *Increase in the Relative Competitive Position* Competitive advantage is the leverage that a firm has over its competitors. It refers to the ability gained through strategies and resources to perform at a higher level than others in the same industry or market. When businesses adopt a cloud computing system, their data resources increase significantly thereby facilitating better information provision that adds value to its products. As businesses create more value for their clients by differentiating their product offerings from others in the competitive landscape either through lower costs or better quality, their relative competitive position increases and the target markets recognize these unique products or services resulting in brand loyalty. This is evident in the ranking of top universities around the world.
- *Generation of New Business Opportunities* There are countless reasons why cloud computing will benefit higher learning institutions in the developing world, but perhaps the primary benefit rests in its ability to allow smaller, less renowned schools to compete with their larger counterparts, and even surpass them in some instances. Additionally, the cloud environment enhances an institution's working efficiency, offering seamless collaboration and communication among students and faculty while extending its reach to discover new research and development channels. Because the cloud enables users to utilize computing resources over the Internet without having to invest in the underlying software and hardware infrastructure, the cloud serves as an ideal foundation upon which scholastic entities can build a digital enterprise.

Government Regulation One of the key tasks of an organization is keeping data private and secure. Security and legal issues regarding data jurisdictions, security risks and data confidentiality must be considered when attempting to upload data into the cloud. In fact, with recent breaches of privacy such as the Facebook scandal in the United States and the Google scandal in China, these concerns are more significant than ever. Many times, entities focus so much attention on the technological aspect of incorporating a cloud platform into their management strategy that government regulatory compliance gets overshadowed.

- *Government Incentives* In many developing countries, governments have strived to keep up with the current pace of IT innovation. In 2010, the United States Federal Government created the first cloud strategy, called *Cloud First*, which provided government agencies broad authority to adopt cloud-based solutions for IT modernization. In line with this, the US government stated it would allocate around $80 billion of its information technology resources annually to hybrid (Hiran et al. 2018), public, or private computer clouds (Bhardwaj et al. 2018). As of 2011, the US government's information technology resources were $80 billion, and it anticipated having an annual savings of $5 billion as a result of this move.
- *Law and Policies* Regulatory compliance is when an organization obeys the laws, guidelines, and specifications that pertain to its operations. In a global economy, it is necessary to be aware of the laws that are enforced

not just pertaining to a particular industry but also in the countries where foreign clients/beneficiaries live. In the case of higher learning institutions, they may be subject to both domestic and international laws and policies that affect both their foreign students and staff.

3.4 Socio-cultural factors

Socio-economics Colleges and universities are highly social institutions that are made-up of countless students and faculty from many nationalities and cultures within the academic arena. Moreover, their social interactions and academic efforts are highly dependent on the use of the Internet (García-Sánchez et al. 2017). This vast access to online information and societal communication has the ability to organize individuals and social groups to empower them to influence political and social issues (Hiran et al. 2019). Statistics released by the International Telecommunication Union (ITU) (2013) confirm that earnings from telecommunications contribute 4% of total GDP in Sub-Saharan countries. In many cases, there is a positive relationship between GDP per capita and adoption of an innovation by organizations and individuals. The higher the GDP per capita of a nation, the more likely that innovation adoption increases by organizations and individuals (García-Sánchez et al. 2017).

Polities The decisions made by policy makers plays an integral role in opening up opportunities for technological reform in the ICT sector, especially when introducing transformative platforms such as the cloud computing. If the political structure of a country is susceptible to influences by already established telecommunications operators who have made significant investment in the status quo of information integration, then ICT reform that will lead to the immediate migration to the Cloud may take longer than expected or prove to be an exercise in futility altogether (García-Sánchez et al. 2017).

4 Research methodology

The study examined various works by different industry authorities in the field of cloud computing who had utilized and subsequently endorsed the TOE–DoI integrated framework. As expressed in the literature review, cloud computing adoption in Ethiopia is concentrated on how the adoption technology adoption by higher education institutions can be a catalyst for vast improvement in the education sector. Surely, there are distinct factors influencing the adoption of new technology within academia, which are outlined in this research. Moreover, these determinants can be confirmed in this work when bearing in mind the justification for TOE–DoI technology innovation (Hassan et al. 2017; Alshamaila et al. 2013). The study revealed striking data through a questionnaire inquiry alluding to the usefulness of cloud computing adoption in EHE. Established on the four factors analyzed in the research, a survey for cloud computing adoption was established via models from the literature. The preliminary SPSS Cronbach's Alpha reliability breakdown of the distinct variables were established. Without trying to influence the data results in the Cronbach's Alpha, the mean, variance and standard deviation of the results were further tested and analyzed. Although extensive research is needed to substantiate cloud computing adoption in Ethiopia's higher education, this study should serve as an integral part in the collection of research works in this field.

The research was conducted through a reliability test scale using SPSS Cronbach's Alpha to assess the prospect of the effective realization of cloud computing measures if sufficient preparation was made by the university to adopt it. The study sought to impartially understand educational determinants and sub-determinants related to cloud computing adoption in the EHE. The primary factors and sub-factors identified from the technology adoption works include technological factors, organizational factors, environmental factors and socio-cultural factors (See Fig. 2). The research encompassed survey coupled with a questionnaire to identify key TOE–DoI variables. All responses were documented using five-point rating scales.

4.1 Descriptive data analysis

Table 2 shows the total number of respondents = 500, which includes Male (352) and Female (148) respondents. Sample of 500 respondents comprised students (350), faculty (50) and support staff (100) were drawn from the higher education population in Ethiopia. In all, 431 valid responses obtained from 500 respondents, thus, giving a response rate of 86%. Category of respondents comprised faculty members, staff and Students. The proposed conceptual TOE–DoI framework consists of 4 constructs and a total of 41 questions. All measures were documented on five-point Likert scales affixed by Strongly disagree to Strongly agree. The score of the questionnaire was from 1 to 5. These values range from 1 for Strongly Disagree to 5 for Strongly Agree on the Likert scale.

4.2 Inferential statistics analysis

Reliability Analysis The internal consistency between the constructs in this study was tested using Cronbach's alpha. Reliability measure is concerned with the degree to which an instrument measure is consistent (Hiran et al. 2014). Table 3 shows the Cronbach's alpha (CA) reliability

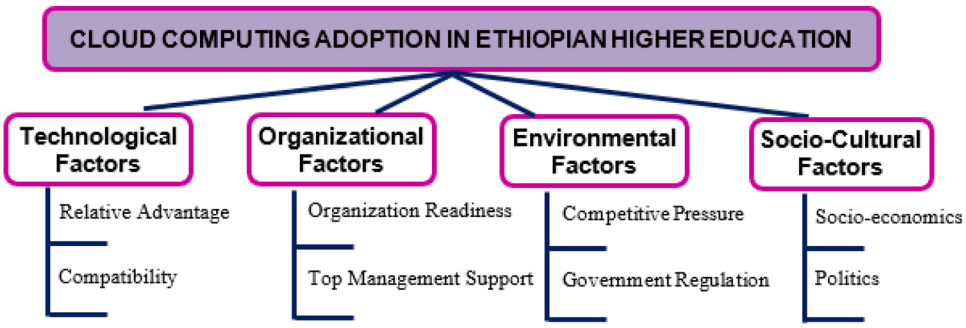

Fig. 2 The Decision-making hierarchy structure to adopt a cloud computing system

Table 2 Number of respondents

Category	No. of respondents
Male	352
Female	148
Total respondents	500

measurement of the study with all of them meeting the minimum acceptable level of Cronbach's alpha criterion of 0.7. According to Hair et al. (2014), Cronbach's Alpha (CA) of composite reliability (CR) values of 0.70 and 0.90 are considered satisfactory.

5 Results and discussion

Based on the information collected from the University actors in Ethiopia, data was compiled on a coding sheet encompassing the four determining factors in the TOE–DoI framework illustrated in Table 3 below. A reliability analysis carried out on the perception of the university actors values scale comprised items of the following: 19 items—Technological factors, 8 items—Organizational factors, 8 items—Environmental Factors, and 6 items—Socio-cultural factors.

Cronbach's Alpha revealed that the questionnaire reached a satisfactory reliability, a = 0.739 for technological factors, 0.712 for organizational factors, 0.761 for environmental factors, and a = 0.841 for socio-cultural factors. Most of the items seemed worthy of retention, which could have resulted in the decrease of Alpha if deflated. Nonetheless, the research did not consider exclusions in the items which could increase Cronbach's Alpha. Yet, the researcher intentionally settled for retention because without influencing the results, the study can more accurately measure the respondents' cloud computing adoption views.

The findings of this study revealed a significant but a weak and positive influence of technology factors on Intention to adopt cloud computing in Ethiopian Higher Education (Coefficient = − 0.162, P (= 0.000) < 0.05). The findings of this study revealed a significant and very strong and positive influence of Organizational factors on Intention to adopt cloud computing in Ethiopian Higher Education (Coefficient = 0.997, P (= 0.000) < 0.05). The findings of this study revealed a significant but a weak and positive influence of environmental factors on Intention to adopt cloud computing in Ethiopian Higher Education (Coefficient = 0.365, P (= 0.020) < 0.05). The findings of this study revealed a significant but a weak and positive influence of Socio-Cultural factors on Intention to adopt cloud computing in Ethiopian Higher Education (Coefficient = 0.694, P (= 0.000) < 0.05).

Hypothesis Testing The following table shows the hypothesis test results for the study (Table 4).

6 Findings and conclusion

In this study, significant factors for cloud computing adoption in EHE sector were identified using the integrated TOE–DoI framework. The study established that the TOE–DoI approach to education in Ethiopia is genuine in respect to the technological, organizational, environmental and socio-cultural factors. Furthermore, the research established that using an integrated TOE–DoI framework to EHE is not only achievable but also practical. Accordingly, the four factor reliability statistics validate this assumption with a Cronbach's Alpha a = 0.739 for technological factors, 0.712 for organizational factors, 0.761 for environmental factors, and a = 0.841 for socio-cultural factors. Accordingly, using the Pearson Correction Coefficient model, the research examined the linear connection among the items, thereby establishing a strong relationship between these determining factors. The P values for technological, organizational, environmental and socio-cultural factors also supported for the cloud computing adoption. Considering the strong relationship between the four factors, the TOE–DoI integration in Ethiopian universities is scientifically acceptable. The findings of this study revealed a significant and positive influence of technology, organizational, environmental, socio-cultural factors on Intention to adopt cloud computing. Therefore, we accept

Table 3 Reliability statistics

TOE–DoI framework factors	Cronbach's Alpha	Cronbach's Alpha based on standardized items	No. of items
Technological factors	0.739	0.740	19
Organizational factors	0.712	0.713	8
Environmental factors	0.761	0.762	8
Socio-cultural factors	0.841	0.842	6

Table 4 Hypothesis testing

Hypothesis	Estimate (β)	SE	CR	*p* value (Sig.)	Results
H1: Technology factors affect the intention to adopt cloud computing	− 0.162	0.034	− 4.761	0.000	Supported
H2: Organizational factors affect the intention to adopt cloud computing	0.997	0.225	4.438	0.000	Supported
H3: Environmental factors affect the intention to adopt cloud computing	0.365	0.157	2.327	0.020	Supported
H4: Socio-Cultural factors affect the intention to adopt cloud computing	0.694	0.161	4.314	0.000	Supported

Estimated Beta (β) = Unstandardized Beta Coefficients, SE = Standard Error, CR = Critical Ratio (t), $P < 0.05$

the hypothesis from H1 to H4 and draw the conclusion that technological, organizational, environmental, socio-cultural factors do influence the intention to adopt cloud computing.

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