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A Cloud Adoption Readiness Model for The Case of The National Data Center of Ethiopia with Mixed Approaches

By

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DECLARATION

I, the undersigned, hereby declare that this thesis entitled – A Cloud Adoption Readiness Model for The Case of The National Data Center of Ethiopia with Mixed Approaches – is my original work carried out under the supervision of Mesfin Kifle (PhD). It has not been submitted in this and any other university and all sources of the materials used for this thesis are acknowledged accordingly.

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Candidate Signature Date

This is to certify that the above declaration made by the candidate is correct to the best of my knowledge.

Mesfin Kifle (PhD) _____ _____

Advisor Signature Date

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Abstract

The deployment of the right innovative technologies to government organizations can provide competitive advantages to the citizens. Cloud computing (CC) is an emerging and transformative technology that offers IT services as utility online. Collaborating to its vital features total cost reduction, increase of productivity and scalability are the top motivators to adopt CC. Prior research works show that before rushing to adoption, organizations must assess their readiness at least once. But as studies show many, including Ethiopia, adopt technologies without considering readiness study – the key step. Readiness study is a must to reduce or avoid risk of wastage and/or failure. Moreover, several research works are more focusing on an individual or a firm level theoretical model using either quantitative or qualitative approach. However, research works on cloud readiness assessment model for e-government (e-gov) services are insufficient, particularly for developing countries. In Ethiopia there is not a cloud readiness study on e-gov services.

The purpose of this study is to design a cloud adoption readiness assessment model (CARAM) that fits to the context of the National Data Center of Ethiopia (NDCE) based on the empirical study of factors affecting adoption of CC to e-gov services with mixed methods. The mixed approaches increase the reliability of the result of the study. A total of 78 respondents from seven government organizations responded for the questionnaires and the collected data was analyzed with SPSS tool. Furthermore, the data collected from interview of twelve senior IT experts of the Ministry of Innovation and Technology (MInT) and document analysis were analyzed using thematic technique. Besides, the performance of Internet and the IT infrastructure of the NDCE were observed. The status of NDCE to adopt CC to e-gov services is low. Moreover, poor connectivity, inconsistency of power supply and lack of CC knowledge to users are identified as barriers though some enabler factors. Accordingly, the CARAM has proposed as a solution to help assessing readiness of NDCE to adopt CC to its e-gov services, since there is nothing earlier.

Subsequently, the proposed model was evaluated twice: firstly, it was evaluated by senior IT experts of the NDCE for refinement and it was improved according to the comments provided. Secondly, the improved model was evaluated for confirmation, and it is highly (90%) accepted.

Keywords: cloud adoption, e-gov services, mixed approaches, national data center, readiness assessment model

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List of Acronyms

AMOS	Analysis of Moments Structure
BB	Broadband
CARAF	Cloud Adoption Readiness Assessment Framework
CARAM	Cloud Adoption Readiness Assessment Model
CC	Cloud Computing
CCARAM	Cloud Computing Adoption Readiness Assessment Model
CSP	Cloud Service Provider
CCS	Consumer of Cloud Service
DMs	Decision Makers
DOI	Diffusion of Innovation
EC^2	Elastic Compute Cloud
ER	Evidential Reasoning
FDRE	Federal Democratic Republic of Ethiopia
FGD	Focus Group Discussion
FVM	Fit Viable Model
IaaS	Infrastructure as a Service
IOS	Inter Organizational Systems
MInT	Ministry of Innovation and Technology

NDC	National Data Center
NDCE	National Data Center Ethiopia
NDCE/MA	National Data Center of Ethiopia with Mixed Approach
NIST	National Institute of Standards and Technology
PaaS	Platform as a Service
PLS	Partial Least Square
PPP	Public Private Partnership
ROI	Return on Investment
SaaS	Software as a Service
SEM	Standard Error of the Mean
SMEs	Small and Medium Enterprises
SME/DE	Small and Medium Enterprises in Developing Economies
SPSS	Statistical Package for Social Science
TAM	Technology Acceptance Model
TCO	Total Cost of Ownership
TOE	Technology, Organization and Environment
TPB	Theory of Planned Behavior
UN	United Nations
UTAUT	Unified Theory of Acceptance and Use of Technology

CHAPTER ONE: Introduction

1.1.1. A Brief History of the Cloud Computing

Cloud computing (CC) is a paradigm which offers computing resources as a utility over the Internet peruse of service(s), as noted in [1]. It is composed of five essential characteristics: On demand self-service, Broad network access, Resource pooling, Rapid elasticity, and Measured service; three key service models: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS); and the four deployment models: private, public, community, and hybrid clouds [2]. A Cloud adoption readiness assessment (CARA) can be defined as the ability of an organization to successfully identify and adopt, use, and benefit from cloud computing; and it is the first step in migrating toward cloud computing. It gives a clear picture of what to migrate, a business case for migration and total cost of ownership (TCO) analysis for migration. The study also provides understanding of; how long the organization is lasting in the cloud service, current strengths, and weaknesses in relation to a cloud-ready organization, and an action plan to resolve identified gaps, [3]. However, the purpose of this research is to perform investigation on factors influencing adoption of cloud computing to e-gov services of the NDC of Ethiopia, particularly the study intended to barrier factors.

Although the concept of cloud computing is among emerging paradigms, it was appeared in 1960s with notions such as the *intergalactic computer network* introduced *by Licklider,* [4]. Then after, in 1961, John McCarthy proposed that *Computing may someday be organized as a public utility just as the telephone system is a public utility.* Although the cloud concept did not exist during that time, John M. expressed most of the current features of cloud computing paradigm during the time, such as, *each subscriber needs to pay only for the capacity s/he uses, certain subscribers might offer service to other subscribers, the computer utility could become the bases of a new and important industry.* Whereas no cloud computing practically, until it became conventional when companies such as Salesforce.com founded the delivery of enterprise systems and their software to customers using a new monthly subscription approach model. This, the per month subscription model, approach was clearly paved the way for Software-as-a-Service (SaaS) service of the cloud computing.

However, the advancement of cloud computing comprises of the key indicators: the emergence of dotcom bubble (2000-2005), entrance of Amazon to cloud (EC2) in 2006, Open-Source Cloud movement from 2009 to 2010, launching of Microsoft Azure in 2010, and beginning of Google Compute Engine in the year 2012. The Elastic Compute Cloud developed and launched by Amazon Web Services was the most important milestone for modern cloud computing, [4].

1.1.2. Background of The National Data Center of Ethiopia

The National Data Center (NDC) of Ethiopia is under administration and management of the Ministry of Innovation and Technology (MInT), currently. It provides different e-gov services that can mainly be categorized into two, as: WoredaNet services and other digital services.

The WoredaNet is the e-government project financed and introduced by the government and administrated by the then Ministry of Capacity Building and then implemented by Ethiopian ICT Development Agency (EICTDA), which was progressed to Ministry of Communications and Information Technology. However, after the reform of 2018 in the country it is the mandate of the MInT to handover all the responsibilities and obligations of the NDCE. The NDC is the headquarters for the WoredaNet where it centrally managing the WoredaNet services, monitoring and supporting the WoredaNet infrastructure, coordinate the activities of the regional and Woreda data-centers, and provides maintenance and supports for more than 5000 Woredas (Districts with an average population number of approximately 100,000), regional states and 2 administrative towns, [5] [6].

Additionally, the NDC delivers other services, for instance, reliable ICT Infrastructure and storage facilities to almost all government ministries and departments, and to some private firms and industries by hosting required hardware, software, and applications in a centralized and secure environment. It also provides service delivery gateway, and citizen information/services portal, government email services and remote management and service integration facility. Moreover, the NDC is equipped to host colocation service, [7] [8]. Huge backup and technology convergence services are among the currently deployed services.

The government organizations those get services from the NDC and the MInT are the population of the title under the study, whereas the e-gov services of the NDC of Ethiopia is the system being

studied, on which the investigation of enabler and barrier factors for adoption of cloud computing to e-gov services is carried out on it. The study is chiefly focused on identifying barrier factors and then developed a cloud adoption readiness assessment model for the NDCE.

1.2. Statement of the Problem

Nowadays, migration to cloud services become a familiar and fastest growing transformative model across all industries, including governmental organizations, in many countries. IT cost reduction, speed of deployment and increase of productivity, and scalability are among top motivators to invest on cloud adoption, as indicated in [9] [10]. The studies show that to enhance the cloud adoption and migration, organizations must first assess and evaluate their readiness. Then, based on a result of an investigation, they can rush into cloud adoption and establish a foundation for migration, [3]. However, several earlier research works are more focusing on enabler factors for the adoption of cloud computing paradigm for a firm with single theoretical model and approach.

For instance, as noted in [11], the USA Federal Government responds firmly to operational demands of the organizations such as evolving requirements: optimizing, operating, sustaining, and replacing outdated and costly IT – while addressing increasing security and privacy threats – during transition of IT operations to a more efficient infrastructure by leveraging technology advancements to cloud services.

Whereas, when considering the case of Ethiopia, there are few research in cloud computing adoption readiness in which most of them investigate the banking sector. There are also very few researchers conducted their studies on other sectors. Each researcher recommended the study of cloud adoption readiness for other organizations and industries. Besides the organizations on which they were carried out their research do not have direct similarity in context with the services the NDC provides [12] [13]. Particularly, the service on which this study focuses, e-government service, is different to the services studied so far domestically. Furthermore, like the investigations that were done on cloud computing adoption readiness abroad, these researchers were highly focused on cloud computing adoption enabler factors. Furthermore, many organizations, including

those in Ethiopia, have been adopting the innovative technologies without considering their readiness as indicated in the literatures.

Additionally, the NDC delivers several services to large numbers of public organizations, and to some private firms and industries countrywide. Although, it offers various services to the citizens, the NDC does not have a disaster recovery data center and some services are running below their requirement and some other services entirely not available. Simultaneously, according to the evidence collected during the preliminary survey via interview to four senior IT experts of the MInT, there is not any previous study neither on cloud computing adoption readiness nor on factors influencing cloud computing adoption to the NDC of Ethiopia, including to the e-gov services. Another arguing indication is that the requirement for innovative technology such as realizing digital transformation in Ethiopia and reducing cost of the NDC. Consequently, there is a strong sign for the adoption of cloud computing services at the NDC of Ethiopia to its e-gov services. However, in a way to cloud computing, the key concern to note is that before starting a journey toward migrating to or adopting cloud computing services; conducting a readiness study is very important and an initial phase.

In recognition to the specified facts, this study deeply investigated factors affecting the adoption of cloud computing to the e-government services of the NDC of Ethiopia particularly focusing on barrier factors to cloud computing adoption, primarily; in order to come up with the solution that helps to decide the implementation of cloud computing based on a sound information and to minimize or avoid risks and unnecessary costs, and failures that occur when running into adoption of cloud without performing readiness inquiry to cloud adoption and implementation .

Based on the gaps identified in the literature; prior studies' recommendations; and the gaps recognized during the preliminary investigation to the NDC (where signs for the need of adopting cloud computing services were obviously observed); there is a motivation to perform investigation that helps to identify factors affecting the adoption of cloud computing to e-government services of the NDC, by giving special attention to barrier factors in cloud computing adoption for the datacenter, mainly. Hence, this study plans to answer the following key research questions:

1. What is the readiness level of the NDCE to implement cloud computing to e-gov services?
2. What are the major barriers to adopt cloud computing to e-gov services of the NDCE?
3. How cloud adoption readiness model helps the NDCE for the adoption of cloud computing

1.3. Objectives of the Study

1.3.1. General Objective

The main objective of this thesis is to design a cloud adoption readiness assessment model that can fit to the context of the e-gov services of the NDC of Ethiopia; chiefly by thoroughly investigating the barrier factors to adopt cloud computing to e-government services with both quantitative and qualitative approaches.

1.3.2. Specific Objective

To achieve the general objective of the study, the following specific objectives are recognized and stated:

- To review the state-of-the art in cloud adoption.
- To evaluate cloud computing adoption readiness status of the NDC of Ethiopia.
- To identify primarily barrier factors for cloud computing adoption for the NDCE
- To Develop a cloud adoption readiness assessment model fit to the NDCE
- To Evaluate the proposed model

1.4. Significance of the Study

This study aims mainly to adapt cloud computing readiness assessment model to the e-government services of the NDC of Ethiopia based on investigation of factors influencing cloud computing paradigm, principally by focusing on identification of barrier factors to adoption. Focusing on barriers will help to understand clearly hindering factors which helps to incorporate the invisible factors to a model from the context of the e-gov services of the NDCE.

The outputs and results of this research will have substantial value to the MInT as well as public organizations principally in understanding the primary barriers of cloud computing readiness for the e-gov services of the NDCE.

The ministry and public sectors those get electronic government services could use the findings of this research to improve their attitude and understanding that would help in updating their strategy to update their knowledge of cloud computing adoption. The research community will also be benefited from this research since the study will contribute to the existing body of knowledge by adding new understanding related to cloud computing adoption to the NDC of Ethiopia, especially about barrier factors to the adoption.

1.5. Scope of the Study

The purpose of this study is to adapt cloud adoption readiness assessment model to the NDCE after examining the status of the NDC in the viewpoint of cloud computing adoption readiness to e-government services. The study chiefly identifying hindering factors to cloud adoption and then incorporating them to a model to adapt to the NDCE in the way it fits to e-gov services of the datacenter.

Therefore, due to the complexity of the system being studied, the constraints of the scarce resources such as time and budget and other constraints (like pandemic COVID 19) this study mainly focused on barriers to cloud computing adoption study for the e-gov services of the NDC of Ethiopia, though the study covers the enabler factors.

1.6. Methodology

Although the details of the methodology part are discussed in Chapter Three of this study, the main methods, tools, data sources, ethical issues and general strategy followed in this research work to achieve the objectives of the research, successfully – are the following:

1.6.1. Literature Review

Materials relevant to cloud computing adoption readiness and its barrier factors, such as journal article, books, thesis and dissertation, conference proceedings and other important resources are searched to understand the theoretical background and the previous empirical works of the area.

The relevant materials that were searched in Google, Google Scholar, Emerald Insight, research gates and IEEE using various keywords and other materials related to factors affecting cloud computing adoption including barriers or hinders of cloud adoption to e-gov services and public organizations are collected.

1.6.2. Data Source

IT professionals of the MInT and the NDC of Ethiopia were candidates for the primary source of data that obtained from the questionnaire and the semi-structured interview from the side of e-gov service provider. Besides, the questionnaires are distributed to six additional government sectors' IT departments, namely, Ethiopian Ministry of Foreign Affairs, House of The Federation, Ethiopian Federal Police Commission, Ministry of Culture and Tourism, Ministry of Finance and Economic Cooperation and Public Procurement and Property Administration Agency. The feedback was collected from all these government departments according to the plan.

For this research purposive sampling technique was applied to formulate the sample in which decisive questions can be asked, and simultaneously to get the appropriate and relevant data for the study.

1.6.3. Methods

As noted in [14], mixed research approaches unlock gate to diverse methods of data collection and helps to generate the results to a population and develop a detailed view of an event being studied. Simultaneously, using multiple approach is used to neutralize the biases that are arisen by implementing any of a single approach and it helps to counterbalance the weaknesses characterized in a single method with the strengths of the other method. To accomplish the objective of this study and answer the research questions; the researchers implemented mixed research approaches, qualitative and quantitative methods, primarily to evaluate and analyze cloud computing adoption

barriers of the NDC of Ethiopia. The existing IT infrastructure of the NDC and internet performance is also detected.

1.6.4. Tools and Techniques

The data that were collected through quantitative approach using questionnaire is statistically analyzed using statistical software: Statistical Package for Social Science (SPSS). Whereas the qualitative data is analyzed with thematic analysis. Thematic analysis is the process of identifying patterns or themes within qualitative data, [15].

Information system artefacts can be evaluated by observational, analytical, experimental, testing, expert validation, and descriptive techniques, [16]. For this study, the expected result – cloud adoption readiness assessment model – will be evaluated through expert validation and descriptive methods.

1.6.5. Ethics Issues

Considering the ethical issues during the entire research process is highly important; particularly when the study is carried out with in a real organization [6]. Therefore, this study assured that not any impairment on the organization from which the information was gathered, and to the respondents of the research questions. Additionally, resources from other authors' work are acknowledged explicitly. As proposed in [17] the ethical issues such as consent, confidentiality and privacy should be considered from the planning stage to final word in the conclusion.

1.7. Thesis Organization

This research is organized into six chapters and Chapter Two discusses fundamental concepts of cloud computing (CC). Moreover, it represents the theoretical and empirical technology adoption models, and related works. Chapter Three deals with the overall methodology, which encompasses quantitative and qualitative data collection methods . Chapter Four describes quantitative and qualitative data presentations, analyses, and discussions. Chapter Five deals with the designed model and its evaluation, and Chapter Six, the last chapter, presents conclusion, recommendations of practical implementation and future works.

CHAPTER TWO: Literature Review

2.1. Introduction

This chapter presents a collection of topics related with this study. It focuses on the theoretical background of cloud computing. It starts by describing the concept of cloud computing paradigm. Then, discusses the vital characteristics of cloud computing, deployment models, delivery models, cloud architecture and e-government concept. In addition, the researchers point out the noticeable advantages and disadvantages of cloud computing and elaborate about cloud security. The chapter also deals with the theoretical and empirical models for the adoption of technology. Concepts of technology adoption models including both individual and firm level technology adoption models are discussed. Finally, the summary of related work done concerning cloud computing readiness studies are presented.

2.2. Cloud Computing Concept

As presented in [18], Cloud Computing is the paradigm that was evolved from the physical data center technology to virtual. Although there are various definitions to cloud computing by different scholars from different perspective, the American National Institute of Standard and Technology (NIST) defined Cloud Computing as a model for enabling global, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly supplied and set free with insignificant management effort or interaction. The computing resources can be networks, servers, storage media, applications, and services [2].

When considering the evolution of cloud computing paradigm, there are very important events as described in the last paragraph of section 1.1.1 of Chapter One of the study. Although no cloud computing practically until it became conventional when companies such as Salesforce.com founded the delivery of enterprise systems and software delivery to their customers by using a new monthly subscription approach model. The delivery of software to customers on the monthly subscription approach was clearly set the way for Software-as-a-Service (SaaS). This firm had become mediator of cloud computing to the customers, without offering actual infrastructure for a common purpose. However, the advance of cloud computing comprises of the next key indicators:

emergence of dotcom bubble (2000-2005), entrance of Amazon to cloud (EC2) in 2006, movement of Open-Source Cloud (Cloudstack, Openstack) from 2009-2010, launching of Azure by Microsoft in 2010, and launching of Compute Engine by Google in the year 2012. The Elastic Compute Cloud developed and launched by Amazon Web Services was the most important milestone for modern cloud computing [4].

The following diagram indicates the milestones in the evolution of cloud computing technology.

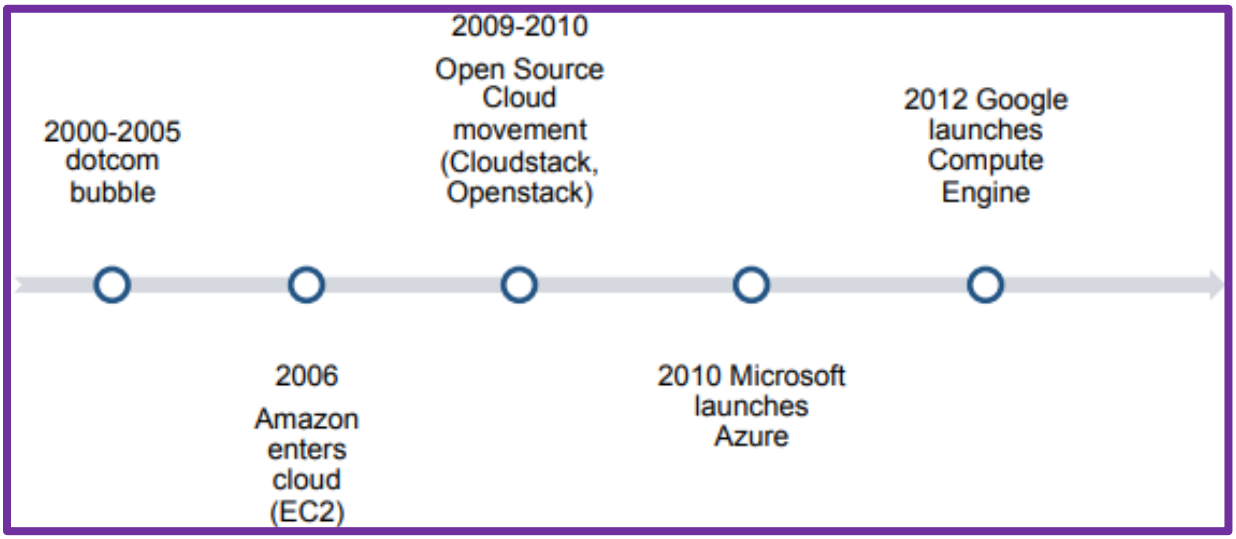

Figure 2.01 Cloud Computing Milestone [4]

2.2.1. Cloud Computing Characteristics

As discussed in [12] [19], according to the NIST definition there are five essential characteristics of cloud computing: measured service, rapid elasticity, resource pooling, on demand self-service and broad network access.

- Measured service: the service usage can be metered, controlled, and reported, providing transparency for both the cloud service provider (CSP) and consumer of cloud service (CCS).
- Rapid Elasticity: refers to the automated process that enables the services to be expanded and contracted to serve the required needs of the customer by instantly provided if the demand rises and released if the demand drops.
- Resource Pooling: refers to the characteristic that the CSP can use a multi-tenant model to pool physical and virtual resources to meet the need of multiple cloud users simultaneously by using

a method called virtualization. The geographical locations of the resources are hidden from the user, generally.

- On-Demand Self-Service: The capability of the user to solely control the service model to get and release services as required without any human supervision, greatly improves the cost efficiency of the services by reducing the number of workforces desired.

- Broad Network Access: refers to the availability of the resources to a wide range of computing devices such as computers, cell phones, and tablets regardless of their platform through standardized network interfaces.

2.2.2. Cloud Computing Deployment Models

As presented in [20], there are four Cloud Deployment Models known as *PPCH model* i.e., public, private, community and hybrid as cloud deployment models.

- Public Cloud: the deployment model where a cloud infrastructure is open to the public.

- Private Cloud: the cloud deployment model where a cloud service is accessible for a single institution.

- Community Cloud: the cloud deployment model where the infrastructure of the cloud is shared among multiple organizations and supports a particular community with shared concerns' service.

- Hybrid Cloud: the cloud deployment model where the setting out of the model is a composition of two or more deployment models of the cloud computing.

2.2.3. Cloud Computing Service Delivery Models

As discussed in [19] [20]**,** there are three major Cloud Service Delivery Models referred to as *SPI model* i.e., software, platform, or infrastructure as a service. To encompass these three and other sub cloud service delivery models, it can also be shortened as XaaS in which X stands for *anything as a service*.

- Cloud Software as a Service: a capability in which the consumer can use the provider's applications running on the cloud.

- Cloud Platform as a Service: the model in which the consumer can install their created or acquired application by using programming languages or tools provided by CSP on the cloud infrastructure.

- Cloud Infrastructure as a Service: a capability of the CC paradigm that can deliver processing, storage, networks, and other essential computing resources where the users can install and run the operating systems and applications software on it.

2.2.4. Layers of Cloud Computing Architecture

The term CC architecture can be defined as the art or practice of designing and configuring CC functionality based on some standards. If one of the components is not working properly along the access chain, the cloud implementation will fail, [19]. Below are the layers of cloud computing implementation architecture.

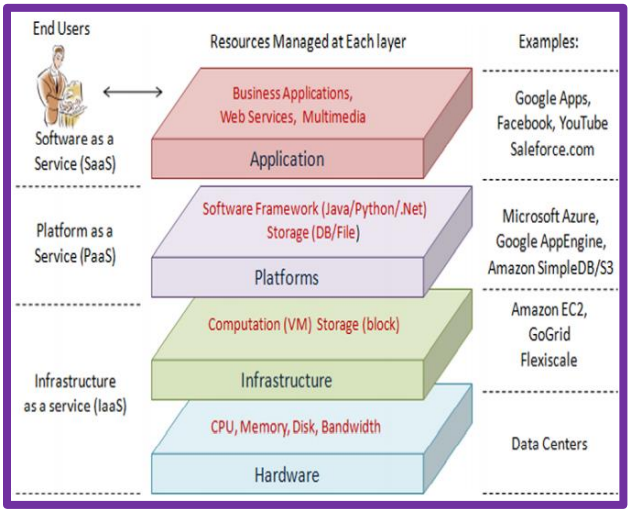

Figure 2.02 Layers of cloud computing architecture [19]

This cloud computing architecture is described as stated below from the bottom layer to the top layer of the architecture.

- Hardware Layer: the first layer that is dedicated to the accommodation of physical resources such as, physical servers and networking hardware devices that are in data centers.

- The Infrastructure Layer: the second layer, which also known as virtualization, enables resource pooling by applying virtualization techniques.

- The Platform Layer: the third layer is comprising of platforms and operating systems and is built on top of the infrastructure layer.

- The Application Layer: the top and the fourth layer is lodging all applications that are provided through cloud computing; and it is the most visited layer to the user.

2.3.E-Government Concept

E-Government is an information technology that uses the Internet and World Wide Web to facilitate interaction between citizens, business, and government. E-government improves/enables interactions with industry, access of government's services by citizens, citizens to get the information they want and efficient management of government [21].

2.3.1. Types of E-Government

Types of e-government services can be classified into 5 categories: citizen to government, business to government, government to employee, government to government, non-profit to government and vice versa for each category, as stated in the article.

- Citizen to Government & Government to Citizen (C2G & G2C): Services provided to citizens via Internet or electronically which facilitates the exchange of information and communication.
- Business to Government & Government to Business (B2G & G2B): The use of electronic means to implement tenders and government purchases
- Government – to – Employee (G2E): Submission of jobs and appointments through the Internet or electronically
- Government – to – Government (G2G): Providing cooperation and communication with the various government departments
- Non-profit to Government & Government to Non-profit (N2G & G2N): Cooperation between government sectors and non-profit private sectors

2.4.Benefits and Challenges of Adopting CC to E-Government

There are a couple of challenges of adopting cloud computing to e-government systems. Similarly, there are also promising advantages of adopting cloud computing paradigm to e-government services. Both the challenges and the advantages of adopting cloud computing are discussed below in the subtitle.

2.4.1. Challenges of Adopting CC in E-Government

As noted in [19] [22], government organizations have employed cloud computing paradigm to improve their communication and delivery of services. With the advancement of technology, the government organizations are proceeded to invest in cloud computing in e-government systems, whereas the adoption of cloud computing in e-government has confronted with several challenges. These challenges may include privacy risk, technology readiness, reliability, security concerns, trusts in internet, legal issue, data transfer and dependency on specific provider.

- Privacy Risk: Cloud computing stores and processes information at different locations by a third party where confidential information can be accessed to unauthorized and unwanted users. The susceptibility of cloud computing to malicious entity compromises the rights of people to maintain the privacy of their sensitive information used in e-government systems.

- Technology Readiness: In the scenario of government organizations cloud computing is readily available to be integrated into e-government. However, CSP must lease cloud services to governments. If the provider fails to form a contract with a government in adopting the cloud services to use in e-government systems, then the government may not get access for cloud computing services.

- Reliability: Governments should be worried for a dependable e-government-based cloud technology and services to finance in. The cloud depends on a high-quality successful e-government portal and applications in government tasks. A system failure based on cloud services may result in the stoppage of numerous services, which may lead to huge loss of financial transactions and system failure enforces mistrust by the users in the e-government systems integrated with cloud computing services.

- Security Concerns: Security is an important factor for establishing cloud-based e-government systems. Lack of Security in cloud computing paradigm discloses e-government to confidentiality and integrity risks of sensitive information. Consequently, CSPs who have reputable high-security features must be selected to adopt their services for e-government.

- Trust on the Internet: Governments have less trust in the networks to store confidential and classified information on it and they should protect their citizen's sensitive information. Nevertheless, CSP hinders the government from controlling their sensitive information. Hence, most governments tend to have little reliance on storage of data via Internet tools.

- Legal Issue: is among key discouraging factors for adopting clouds. The defined rules and regulations in cloud computing mainly stress on different approaches in access control. Cloud computing may store data and information on virtual data centers that can be in distributed locations globally. Whereas disagreements may arise as there are no globally accepted set of rules and regulations.

- Data Transfer: In cloud computing, since all the data are stored in a remote server in cloud computing remotely, the file transferring time for big payloads of data may become inconvenient for the users.

- Dependency on the specified cloud provider: dependency may cause high cost in the long run effect, technical knowledge inefficiency of IT staff, learning how to use a particular cloud configuration and specific applications only, workflow and business processes of an organization is often adapted to a particular software system, interfacing, or linking to ICT infrastructure and applications of the specific cloud provider.

2.4.2. Benefits of Adopting CC in E-Government

Cloud computing has currently been combined with e-government system of many countries [19]. This innovative paradigm of CC has a significant number of benefits that make it crucial asset to the delivery of information and services to citizens. The benefits gained from adopting cloud computing might include scalability, flexibility, cost reduction, pay as you use, ease of administration, time and location independent, disaster recovery, increased collaboration and better security of a system [19] [20] [23] [24].

- Scalability of Cloud computing: CC has great scalability features that make it easily incorporated into the e-government systems. The cloud computing services is easily scalable to existing ICT resources; therefore, it is suitable to incorporate it into e-government systems in government department.

- Flexibility of services: The embracing of cloud computing in government departments for implementing it in e-government services makes it flexible so that cloud-based e-government can be utilized at different levels of government sectors.

- Cost reduction: establishing and maintaining of e-government requires a great quantity of money for the investment of the system. It includes the procurement of ICT equipment and software necessary for the proper provision of services to citizens, periodically. Furthermore, government needs to employ highly qualified professionals to administer, maintain and control running of e-government system. Thus, integration of cloud computing into e-government system has positive contribution by cutting total cost of investment.

- Pay as you go: the use of Pay as you use pricing in utilizing cloud computing technology permits public organizations to save a great quantity of money. Moreover, the cloud computing cuts other costs related to e-government systems including operational cost.

- Ease of administration: The integration of cloud computing with e-government eases the administration of the system, and the CC eliminates the requirement for rigorous management in e-government portal and applications. Cloud computing has the feature of self-service

demand via a plenty of secure interface that authorizing entities to get access of e-government services.

- Time and Location Independency: among the primary advantages of cloud computing, constantly availability of information and services from anywhere through the Internet is the first. As a result, it increases the productivity and initiation of employees.

- Disaster Recovery: Cloud computing can offer tools for automated and scheduled network wide backup system of data in off-site data centers.

- Increased Collaboration: implementing cloud computing to e-gov services increases the collaboration of government agencies to share data and information, consistently.

- Better security: from the perspective of placing the cloud services redundantly at multiple secure and reliable sites provide greater security which is ideal for disaster recovery and business continuity.

2.5. Adoption Models in Information System

As noted in [25], these days, information technology (IT) is globally accepted as an obligatory tool in boosting the growth of the economy of a nation. There is consent that IT has substantial impacts on the productivity of organizations. The results will only be appreciated after IT is regularly and smoothly spread to user and then used. Knowing the determinants of IT adoption is very important. Therefore, it is crucial to understand the theoretical models. There are few literatures about the IT adoption models at the individual and firm levels. There is even a fewer literature about adoption of technology models for implementation to e-government services. In this study, theories for adoption models at the individual and firm levels in information systems are discussed.

There are several theories used in information system research, but this study is interested only in theories about technology adoption. The widely used individual level technology adoption theories discussed here include the technology acceptance model (TAM), theory of planned behavior (TPB), unified theory of acceptance and use of technology (UTAUT), and among the firm level technology adoption models the diffusion of innovation (DOI), the Iacovou model, the technology, organization, environment (TOE) framework, fit-viable model (FVM) and cloud readiness assessment framework to organization are presented in this study [30] [31] [23] [26].

2.5.1. Individual Level Technology Adoption Models

As presented in the articles, the individual level technology adoption models to discuss here include TAM, TPB and UTAUT.

As noted in [26] technology acceptance model (TAM), is among one of the theory most implemented at individual level. The model offers that two independent constructs: perceived ease of use and perceived usefulness that have an influence on a dependent construct called intention to use and ultimately the usage behavior. Perceived Usefulness is how a user feels that the innovation contributes to make the work more effective and improves the results. Perceived Ease of Use measures the effort the user must exert to use the system.

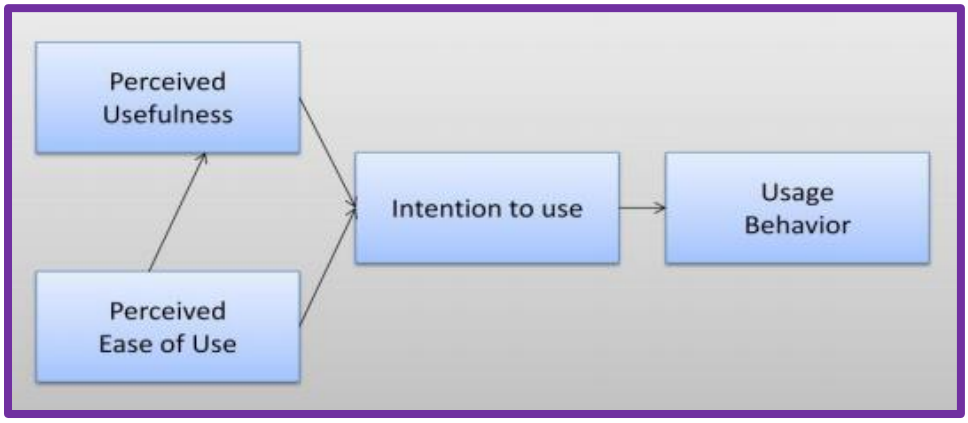

Figure 2.03 Technology Adoption Model (TAM) [26]

As presented in [26], the theory of planned behavior (TPB) attempts to resolve the inadequacy of freedom that act in the adoption model known as Theory of Reasoned Action. As indicated in the article it was originally postulated for individual behavior driven by behavioral intentions as a function of an individual's attitude toward the behavior, the subjective norms surrounding the performance of the behavior, and the individual's perception of the ease with which the behavior can be performed (behavioral control). The attitude towards behavior, subjective norm, and perceived behavioral control are independent constructs, whereas, behavioral intention, and behavior are dependent constructs.

Attitude toward behavior, like in the theory of reasoned action, is an individual's own assessment on consequences and desirability of performing a particular behavior, while subjective norm is the

perception the individual has on people who are important to him/her on whether the behavior should be performed. The perceived difficulty of performing a behavior is defined as behavioral control. Although it has originally suggested that the link between behavior and behavioral control outlined in the model should be between behavior and actual behavioral control rather than perceived behavioral control, the difficulty of assessing actual control has led to the use of perceived control in a substitution as presented in the article.

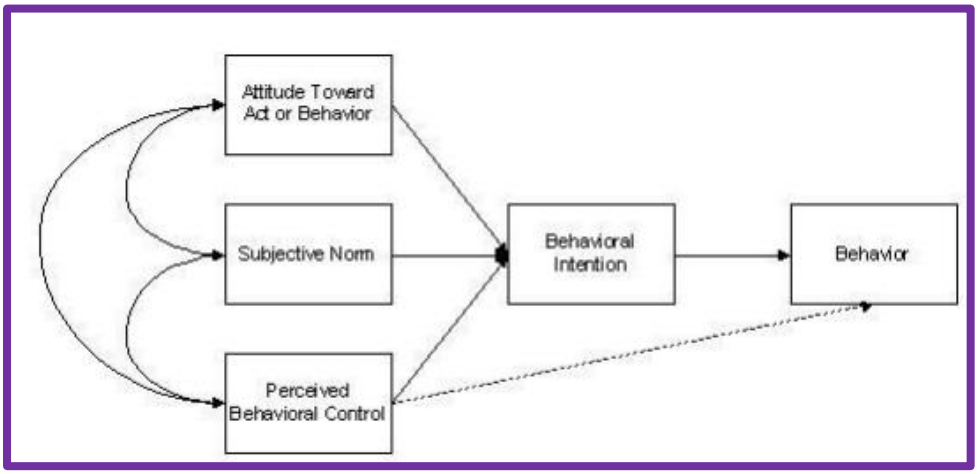

Figure 2.04 Theory of Planned Behavior (TPB) [26]

As proposed in [26] [27], the unified theory of acceptance and use of technology (UTAUT) which compared and combined eight prior adoption theories through empirical studies: the theory of reasoned action, technology acceptance model (TAM1 and TAM2), motivational model, theory of planned behavior, combined TAM and TPB, model of PC utilization, innovation diffusion theory, and social cognitive theory. In the UTAUT model the independent constructs are performance expectancy, effort expectancy, social influence which have a direct influence on behavioral intention while the other independent construct facilitating conditions has direct influence on the actual use behavior of the system. Behavioral intention and use behavior are dependent constructs, whereas gender, age, experience, and voluntariness of use are moderating variables.

As defined in [27], performance expectancy is a perception that an individual has the system will improve job performance, which was argued for, and it is the most influential construct on behavioral intention. Effort expectancy reflects the amount of time and degree of effort individuals think will be spent using the system. Social influence is what the user considers others to think of

a system while facilitating conditions includes the equipment and other infrastructure that are necessary to use the system.

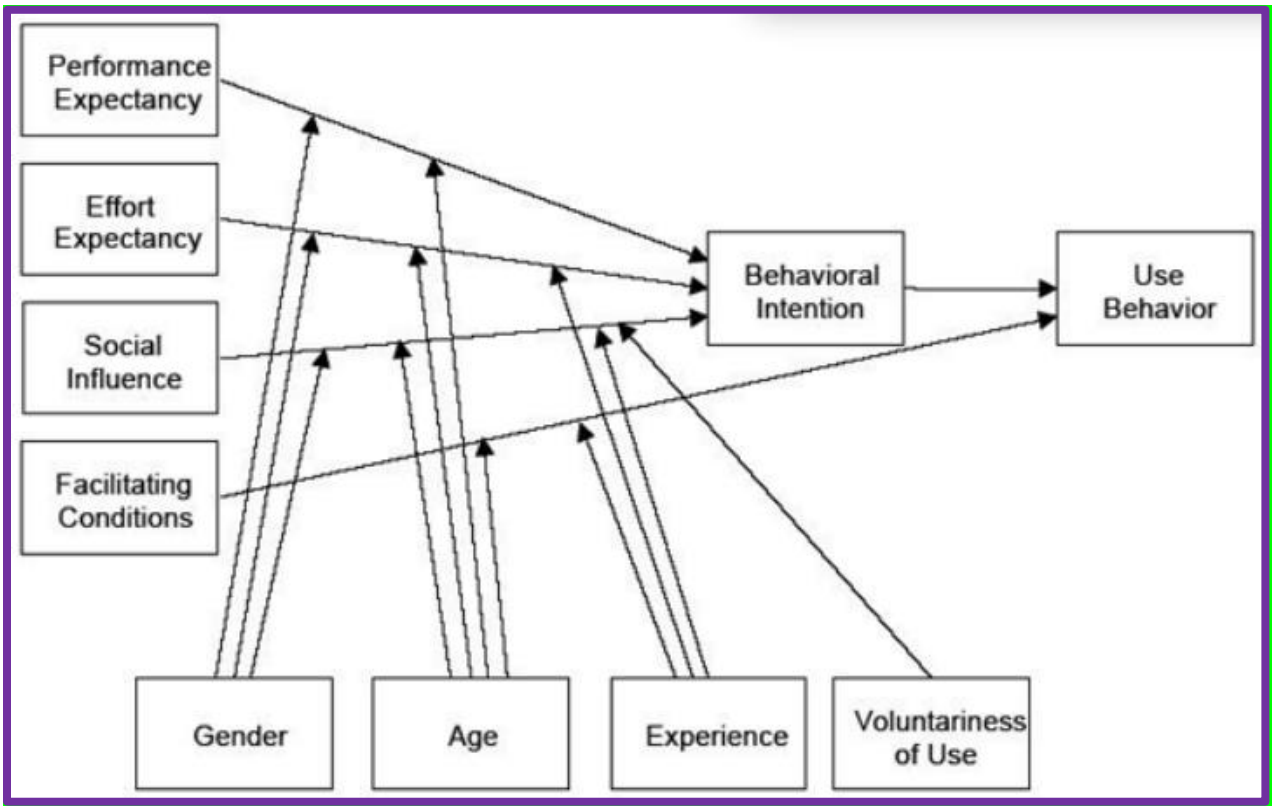

Figure 2.05 UTAUT Model [27]

2.5.2. Firm Level Technology Adoption Models

As noted in [25], DOI is a theory of how, why, and at what rate new ideas and technology spread through cultures, operating at the individual and firm level. *DOI* theory *sees* innovations as *being* communicated through *certain channels* over *time* and within a *particular social system*.

Individuals are *possessing* different *degrees* of *willingness* to *adopt* innovations, and thus it is generally observed that the portion of the population adopting an innovation is approximately normally distributed over time.

Breaking the normal distribution of innovation separates individuals into the following five categories of individual innovativeness, from earliest to latest adopters: innovators, early adopters,

early majority, late majority, laggards. The innovation process in organizations is much more complex. It generally involves several individuals, maybe including both supporters and opponents of the new idea in the innovation-decision.

According to [28], firm level innovativeness is related to such independent variables as individual characteristics, internal organizational structural characteristics, and external characteristics of the organization. Individual characteristics describes the leader attitude toward change. Internal characteristics of organizational structure includes observations according to the author whereby: *centralization is dominating power and control in a system with few individuals*; *complexity is owning high level of knowledge and skill by employees of organization; formalization is the extent of implementing rules and procedures; interconnectedness is the linkage of units in a social system through communication; organizational slack is the extent of availability of unused resources in organization; size is the number of employees.* External characteristics of organizational refers to system openness.

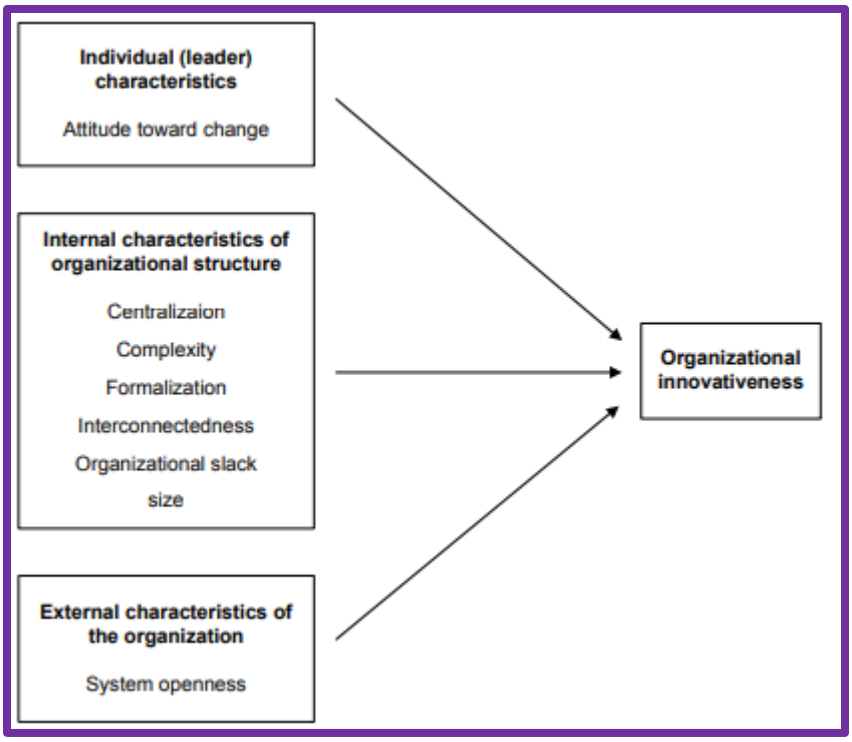

Figure 2.06 Diffusion of Innovations [28]

As specified in [25], the Iacovou model is used to analyze inter organizational systems (IOSs) features that influence organizations to adopt IT innovations in the setting of electronic data

interchange (EDI) adoption. The model is appropriate for explaining the adoption of an IOS. It is based on three factors: perceived benefits, organizational readiness, and external pressure. Perceived benefits are a different construct from the TOE framework, whereas organizational readiness is a mixture of the technology and organization context of the TOE. Thus, IT resources and financial resources are comparable with the technology and organizational contexts of TOE, respectively. The external pressure in this model adds the trading partners to the external task environment of the TOE framework. The following figure demonstrates the Iacovou model.

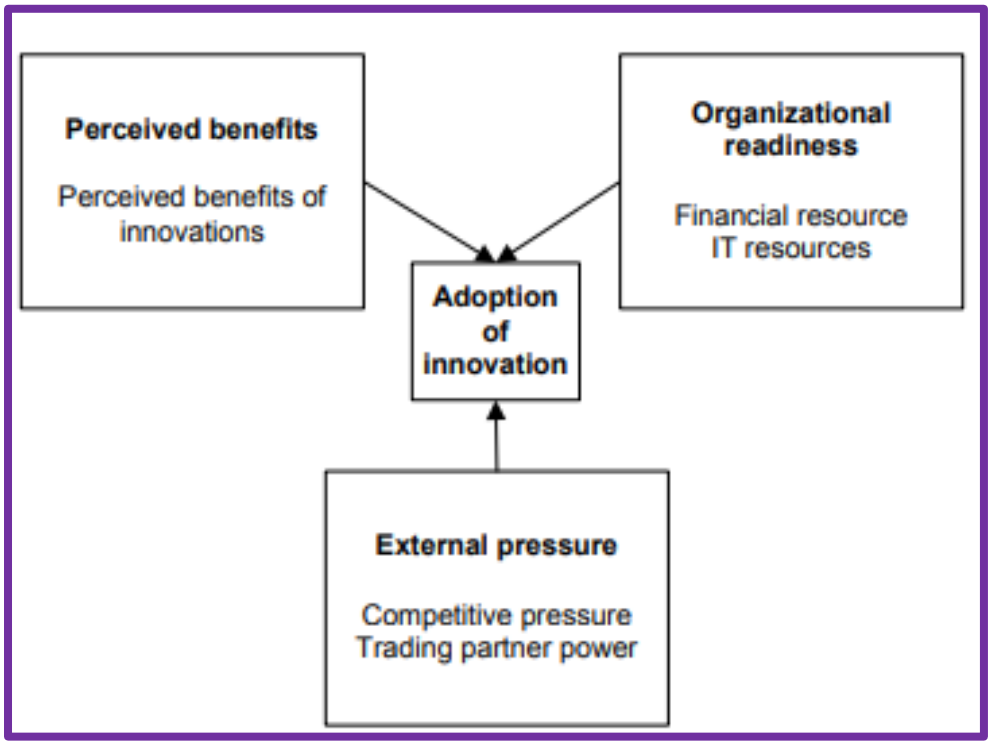

Figure 2.07 Iacovou et al. (1995) model [25]

2.6.Empirical Technology Adoption Models

The following three models are the empirical theories on which this study is grounded. These adoption models are the technology, organization, environment (TOE) framework, fit viable model (FVM) technology adoption model and cloud readiness assessment framework. The detail of each of the model is discussed below under subtitle for each of them.

2.6.1. Technology Organization Environment (TOE) model

As indicated in [29], the TOE framework identifies three aspects of an organization's context that influence the process of adoption and implementation of a technological innovation: technological context, organizational context, and environmental context. Technological context encompasses the internal and external technologies relevant to the organization. It includes existing practices and technological equipment internal to the organization, additionally, available technologies external to the firm. Organizational context deals with the organizational features, such as scope, size, and managerial structure. Environmental context is the arena in which an organization executes its mission—its industry, competitors, and dealings with the government.

As described in the same article, the TOE framework is providing a useful analytical model for studying the adoption and assimilation of different types of IT innovation. This framework has a concrete theoretical basis, dependable empirical support, and the possible of application to IS innovation domains with perhaps varying factors in the three contexts across different studies. This framework is consistent with the DOI theory, in which it was originally emphasized individual characteristics, and both the internal and external characteristics of the organization, as motivators for organizational innovativeness. These are identical to the technology and organization context of the TOE framework, but the TOE framework also includes a new and important component, environment context. The environment context presents both constraints and opportunities for technological innovation. The TOE framework is illustrated hereunder.

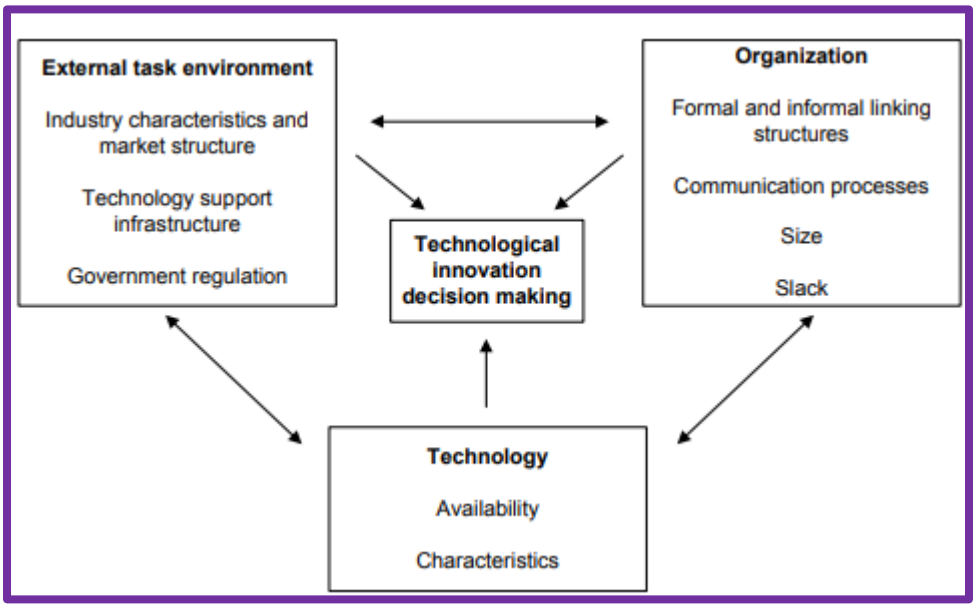

Figure 2.08 Technology, Organization, and Environment Framework [29]

2.6.2. Fit-Viability Model (FVM)

As indicated in [30], the FVM model has been used specifically to address the adoption of a new technology. First, it was proposed by Tjan (2001) for evaluating organizational adoption of internet initiatives. It expands on the task–technology fit model to include two dimensions, fit and viability.

As discussed in the article, the FVM integrates task–technology fit with the general belief of organizational viability of information technology. For fit criteria measurement are identified based on task–technology fit theory, while for viability; financial, managerial, and technological readiness criteria are identified.

In the context of cloud computing, fit is defined as the degree to which cloud computing is consistent with the needs for application in e-government systems. Task refers to the task requirements within the organization. On the other hand, as presented in the literature Technology Features reflect the technological aspects influencing cloud computing adoption, which include relative advantage, compatibility, complexity, trialability and security issues. The details of this factors discussed in the proposed model section, Chapter Five of the study.

Similarly, as indicated in [30], for the purpose of cloud computing, the literature discusses viability measures as the extent to which the public sector organizational environment is ready for cloud computing and the extent of the value-added potential of using cloud computing in e-government services. This research probes the viability of cloud computing in the NDCE along with MInT and other six selected public organizations by investigating economic feasibility, organization, and technological readiness. Besides, the study considers the viability from the perspective of power distribution and broad network connectivity outreach nationwide to all the regional state and at their Woreda level.

Economic feasibility refers to the degree to which the economic benefits of something to be made, done, or achieved are greater than the economic costs. It determines whether a particular technology or application is cost-effective. In the sense of cloud computing adoption and implementation to e-government services, economic feasibility is the determination of cost-effectiveness of adopting and implementing cloud computing to e-gov services. Until now, the NDC provides its services freely to government sectors and to some private institutions and industries. On the other hand, if transaction cost reduces, the willingness to use a technology can increase. Although Factors influencing transaction cost may differ from one technology to another technology adoption for cloud computing adoption, asset specificity and uncertainty have been identified as influencing factors [30].

In addition, as indicated in the article, the study of the readiness of an organization to implement cloud computing, the investigators had considered the top management support, and cloud knowledge as factors that help to examine the viability of cloud computing for e-government implementation. Besides, Technological Readiness describes the organizational resources that influence the organization viability in decision to adopt a new technology, such as, IT infrastructure, IT staff and standards as described in the article. The following diagram is the representation of fit viable model.

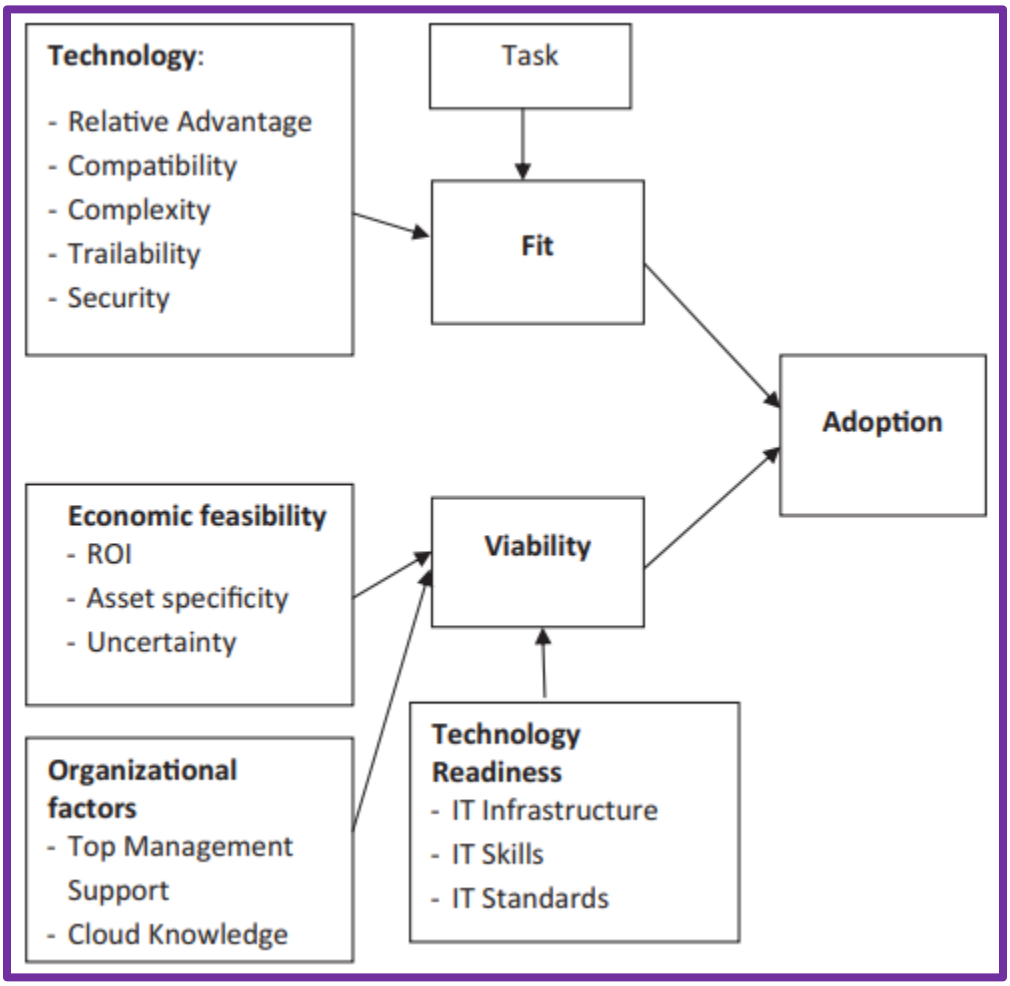

Figure 2.09 Fit-Viable-Model [30]

2.6.3. Cloud Readiness Assessment Framework

As noted in [36], cloud readiness assessment is required before starting a journey toward adopting it. Accordingly, the researchers proposed cloud readiness assessment framework (CARAF) based on three theoretical foundations of technology adoption models: TAM, TOE and DOI. The framework they proposed combines the advantages of the three theoretical models and the unit of analysis used in this study were chiefly organizations and individuals within them.

The proposed framework has three layers; each layer represents one of the mentioned theoretical foundations. The bottom layer of the framework relies on TAM, particularly on its two known constructs perceived usefulness and perceived ease of use.

The middle layer of the proposed framework depends on DOI model. As described in the study, although there are five variables identifying DOI theory in adoption of new technology, relative advantage, compatibility with existing values and practices, simplicity, and ease of use, trialability and observable result, only three of them were adopted for the proposed framework. Perceived ease of use is omitted, and observable result is fused within trial-ability.

The top layer of the proposed framework relies on the three contexts of the TOE framework: organizational context, technological context, and environmental context. In the technological context of the layer hardware and software readiness/Technological readiness, and Network Connectivity have considered as influencing factors. Additionally, in the organizational context Executive support and Business case and budget have considered as the influencing factors. Finally, in the environmental context competitive pressure has taken as the influencing factor.

The cloud readiness assessment model proposed by the authors is demonstrated below.

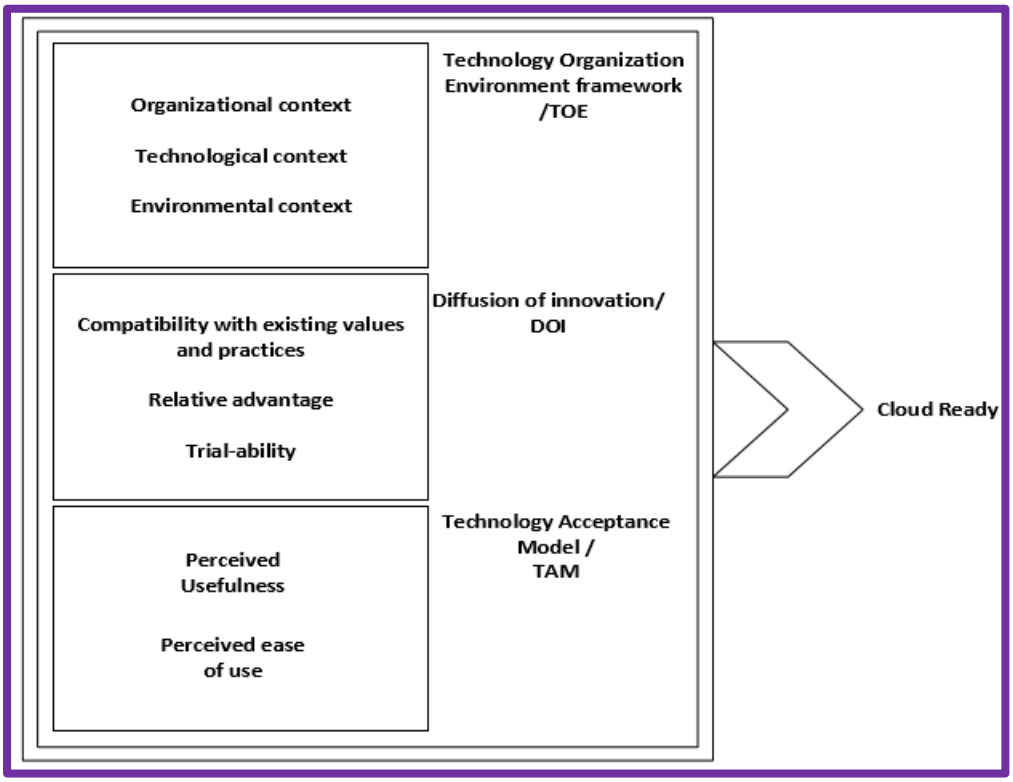

Figure 2.10 Cloud Readiness Assessment Framework for Organizations [36]

The three models combined in the above framework, in Figure 2.10, are the foundational theories for their research. The first two models are firm level technology adoption models, whereas the third one is the framework among the individual level technology adoption models. Therefore, their study is based on the DOI, TOE, and TAM models.

The TAM and DOI models, the bottom and the middle layers of this framework, are almost integrated into the FVM model.

2.7.Related Works

There are several scientific research and studies across the world related to cloud computing adoption readiness, and a few strengthening works in the country. The studies in Ethiopia are highly focused on financial sectors and the enabler factors to cloud adoption readiness of these institutions. When considering the case of most of the cloud computing readiness investigations that are related to the banking sector of Ethiopia, they were conducted by implementing single research approach. The other very few cloud computing readiness assessments to extra institutions; including ethio telecom, higher education institutions, and other government organizations were also undertaken using single research methods. Although, the cloud computing readiness conducted by Lensa B. [13] on banking sector of Ethiopia, and the cloud computing readiness and implementation carried out by Ruth L. [12] on ethio telecom both during the same period, 2017, were trying to implement mixed research approach, they were highly focused on enabler factors to adopt CC and the models they were based on to perform their study varies with the models used for this research and the context of their studies differ with the context of the research being studied. Until present day, there is not any study related to cloud computing on the National Data Center of Ethiopia to the knowledge of the researchers. This study used quantitative and qualitative approaches including observation to the existing infrastructure of the NDCE and document analysis. The context of this study is also highly varying from the other studies mentioned above; it is investigating factors influencing adoption of CC to e-gov and in parallel to identify a status of the NDC of Ethiopia to adopt and implement cloud computing paradigm to e-government services. Moreover, this research is grounded on firm level adoption models which is appropriate to study cloud computing readiness for e-government services, the TOE and FV models; Since the scope of the study is restricted to identifying factors affecting adoption of cloud computing to e-

government services of NDCE and e-government is an information technology that uses the Internet and World Wide Web to facilitate interaction between citizens, business, and government [21]. That means the e-gov services interactions are widely facilitated among organizations, i.e., it is not about adoption of innovative technologies at individual level.

Consequently, none of the researchers of these related works in Ethiopia did not design or adapt cloud computing adoption readiness assessment models for e-government services. Some of them proposed hybrid CC deployment models, some others proposed CC readiness assessment models for a firm, some others only proposed the solution for their studies and there are also some other researchers designed strategic guideline for their works.

The following literatures, from abroad and the inland, are closely related to content of the title of the study.

As indicated in [12], the researchers examined the existing and the required cloud computing capability of ethio telecom. They used semi structured interview and close ended questionnaire as primary data collection methods. Whereas document analysis as secondary data sources. The finding indicates that readiness level of ethio telecom in the perspective of strategy, technology and environment is good, but more work is expected to make organization and employees ready. The result of the study is only about CC readiness of ethio telecom during the period. Thus, the finding is not generalizable. In order to make the findings of the factors influencing the readiness of cloud adoption generalizable the study should be carried out at the national level by involving all the stakeholders. Though this study has limited due to several constraints as indicated in section 4.5 of Chapter Four, it is among the research to come up with generalizable result.

The work in [13], examines cloud computing readiness assessment for banking sector in Ethiopia. The researchers were made use of both quantitative and qualitative methods of data collection and analysis. Their findings confirmed that cloud computing readiness level of Ethiopian banking sector was low. Additionally, security and privacy were among the biggest concerns, no adequate infrastructure, and support from the government wing. Since, the study focused only on banking sector, its result cannot be generalized. To come up with generalizable results, researches the same

to this one should be conducted at the national level as specified in the previous paragraph, in order to generalize the result of work [12].

A cloud adoption readiness framework for small and medium enterprises in developing economies (SME/DE) *evidential reasoning (ER) approach assessment* article is aimed to develop cloud computing adoption readiness assessment framework for small and medium enterprises (SMEs) in developing nations, as an alternate technological solution to eliminate the complexities occurring during adoption [1]. The study was based on literature review.

As specified in [30], the authors aimed to develop a model and measurement to investigate the factors influencing cloud computing adoption as a part of developing countries' alternatives to implement e-government services. They proposed the theoretical model based on fit viable model (FVM) and verified the scale measurements met the conventional criteria of reliability and validity.

As remarked in [31], the authors aimed to investigate whether public agencies should decide to adopt cloud computing, and the strategies they should deploy to overcome the inhibitors of cloud computing. The study is grounded on the theory of technology, organization, and environment (TOE) framework. The key inhibiting factors identified include lack of basic infrastructure for cloud take-off, data security, unreliable internet connectivity, and general lack of institutional readiness. As the investigators indication organizations do not require to spend resources needlessly; in cloud computing project and for embarking cloud strategies just to have a cloud. It is critical to understand the driving factors behind it. Agencies must assess and re-assess themselves if they are cloud ready. The result is specific for the government sectors in Ghana.

As revealed in [32], the study aims to investigate factors influencing cloud computing adoption in organizations embracing Cooperative Insurance Company of Kenya, as a case study. Quantitative approach was used for data collection and analysis. Its result shows that technological factors are the most influential factors in adoption of cloud computing services or paradigm.

As noted in [33], the study aims to conduct a Survey on Cloud Computing Adoption in Kenya's Banking Industry to find out whether commercial banking industry in Kenya is aware of cloud computing, ready to adopt it and its attitude towards cloud computing.

The work in [34] aims to examine ICT utilization strategy in Ethiopian Higher Education Institution and to analyze Cloud Computing model that helps to enhance ICT utilization mechanism for educational institutions teaching, learning and service delivery requirements, concisely. The researchers implemented qualitative research approach. Based on the finding of the study, the hybrid cloud computing model was proposed as a solution to solve the limited utilization of ICT in the system.

According to [35], the study aimed to investigate readiness of banking sector of Ethiopia from the perspective of providing IT support to their stakeholders anytime on their preferred device via optimum channel. Qualitative research method was applied in this study. Centered on the results of the study, the authors proposed Hybrid Cloud Computing model as a solution.

As specified in [36], the authors aimed to propose a theoretical cloud readiness assessment framework and an expert system that assesses cloud readiness and to recommend which cloud deployment and service model to adopt. Their study was grounded on Technology Organization Environment framework (TOE), Diffusion of Innovation (DOI) and Technology Acceptance Model (TAM) as a conceptual framework. The researchers proposed a cloud readiness assessment framework and an expert system.

Work of [37] explores the cloud computing readiness of four selected private and public sectors of Ethiopia and proposes a strategic guideline that could be used by Ethiopian organizations for adoption of cloud computing. The authors made use of qualitative research to undertake their research.

The study in [38] explores the internal and external factors that have influenced IT executives and expert's decision on the adoption of cloud computing focusing on the Ethiopian banking sector. The paper focuses only on the factors that affect cloud computing and it does not assess the banks readiness level.

Thus, when we consider the previous research works on cloud computing readiness study to e-government services, it is very minimum; particularly, no cloud computing related study on the NDCE. This needs serious consideration because readiness is a phase before adoption and undertaking readiness assessment to implement cloud computing to e-government services

reduces or mitigates wastage of government resources and it is an essential feature in determining the success of cloud computing adoption. Moreover, several organizations adopt technologies without considering their level of readiness, which mostly results into failure. In the case of cloud computing, adopting it without studying its level of readiness is resulted from lack of awareness and lack of a regulatory framework for computing implementation as indicated in, [32] [34]. Hence, to reduce unnecessary wastage and to mitigate the chance of failure, adequate readiness investigation is very important before implementing cloud computing paradigm to e-government services of NDCE.

Here is the summary of related works to cloud computing readiness exploration illustrated in the following table.

Author	Objective	Method	Finding	Limitation
Ruth L., [12]	To assess the readiness level of ethio telecom to implement CC services	Mixed research approach	ethio telecom viable financially, but communication & infrastructure gap	Focused on ethio telecom only, so not generalizable
Lensa B., [13]	To identify barriers and enablers of CC readiness (CCR) of Banking Sector of Ethiopia & propose solutions	Mixed research approach	CCR level of Ethiopian banking sector is low – in its early stage	The research was dedicated to banking sector of Ethiopia at the time, not generalizable
Fathey M., et al. [30]	To develop integrated model & instrument to examine factors influence CC adoption for e-gov implementation in developing countries	Literature review	The pilot study has provided initial support for the model constructs and instrument in the assessment of CC adoption for e-gov implementation.	It is grounded on the literatures only
Samuel T., et al. [31]	To identify possible challenges & strategies to be followed for CC adoption by government agencies	Semi-structured interview	Major inhibitors, lack of infrastructure, data security, institutional readiness & unreliable internet connectivity	The investigation was focused to the Ghanaian public agencies, only.
Workineh, M., et al. [1]	To develop CCR assessment framework for SME/DE	Literature review	framework to make informed decision	The proposed framework is for SMEs & criteria for hierarchical

				assessment model identified only from literatures
David K., [32]	To investigate factors influencing cloud computing adoption.	Quantitative	Found technological factors as the most significant factor influencing adoption of CC in Cooperative Insurance Company of Kenya	Applied single approach to identify factors influence CC adoption to the most for Kenyan at a time
Elizabeth W., [33]	To find out the CC awareness of commercial banking industry in Kenya, its readiness and attitude towards CC adoption	Quantitative	Shown that CC concept is known to most IT managers/CIOs and majority of commercial banks were not willing to adopt the technology	Single approach, unwillingness of commercial banks in Kenya to adopt CC, time & contextual variation
Fasil A. et al. [36]	To provide a cloud readiness assessment framework (FW) and an expert system	Quantitative	Proposed theoretical CCR assessment FW, developed expert system predicts cloud readiness, recommends deployment and service models	Single approach, proposed theoretical CCR assessment FW for organization, time & contextual variation
Alemayehu A., [35]	To develop integrated CC FW for Ethiopian banking sector	Qualitative	The study proposed Hybrid Cloud Computing model	Single approach, proposed hybrid deployment model for banking sector
Selamawit B., [38]	To explore the internal and external factors that have influenced IT executives and experts' decision on the adoption of CC	Qualitative & Quantitative	indicated the internal factors: complexity, compatibility, employee skills, risk of failure and external factors: customer demand, pressure, cost, and consistency of CC have a positive influence on adoption	mixed approach, based on TOE to identify internal & external factors affecting CC adoption, time variance, specific to banking sector in Ethiopia

Sewale B., [34]	To examine ICT utilization strategy in Ethiopian Higher Education Institutions (EHEIs), analyze CC concepts for EHEIs and to design a prototype of CC FW	Qualitative	Shown CC is better ICT utilization mechanism for educational institutions teaching learning and design a prototype cloud computing framework. Proposed hybrid deployment model.	Single approach, the result of the study specifically related to higher education institutions, context & time difference
Alemayehu E., [37]	To examine the CCR of four selected sectors in Ethiopia and to produce a Strategic guideline	Qualitative	Produced a Strategic guideline to be used by Ethiopian organizations for the successful adoption of CC	Single approach, identified CC adoption strategic guideline based only on four firms, vary contextually

Table 2.01 Summery of Related Works

As it can be observed from the summary of the related work in Table 2.01, nearly all the research works were used a single research approach either quantitative or qualitative approach. There are also a few works totally based on literature review only. Additionally, some of the studies relied on individual level technology adoption theoretical models. Some other studies those centered on the firm level technology adoption models are also undertaken their research for a firm. However, this study implements mixed research methods, both quantitative and qualitative research methods to come up with more reliable result. Additionally, this study represents the government organizations of the country since the e-gov services facilitates interaction between firms. Furthermore, since cloud adoption readiness

assessment is extremely dependent on the context and cannot be separated from its practical applications, adopting the model as-is is not sufficient. The CCARAM that fits to the context of the e-gov services of the NDC of Ethiopia, must be based on the results of the empirical study related to the context of the NDC of the country in addition to the results of previous works.

2.8. Summary of the Chapter

In this chapter the concepts and the evolution of cloud computing, the essential characteristics of cloud computing, the service delivery and deployment models of the cloud computing, the layers of cloud computing architecture, the concepts and the types of e-government services, the benefits, and drawbacks of adopting cloud computing paradigm to e-government services are discussed. Additionally, in the chapter the individual and firm level technology adoption models in information system comprising of cloud computing are presented. In addition to theoretical models, empirical models of technology adoption in information system are also discussed. In the subsequent chapter the research methodology is discussed in detail.

CHAPTER THREE: Research Methodology

3.1. Introduction

This chapter discusses the research design, population of the study, sampling for the study including selection technique and size, data collection methods, data analysis and presentation methods. As indicated in the prior section, Section 1.3.1 of the study, the ultimate objective of this research is to adapt cloud adoption readiness assessment model that suits to e-gov services of the NDC of Ethiopia based on the empirical study identifying factors affecting adoption of cloud computing to e-gov services of the country.

3.2. Research Design

A research design is a logical approach that uses to link the research question and research process or procedure to address the research question. It consists of research methods, data collection activities and data analysis method. Methodology refers to the designing of the methods used to achieve understanding via the entire research process [39]. It is used to explore different types of methods or procedures and to find out the research assumptions. A research methodology addresses the question of how, the study is conducted, and it is normally governed by the research questions [40]. The methodology used for this study is to assess the factors affecting the adoption of cloud computing to the NDC of Ethiopia based on the instruments designed from the angle of technology, organization, and Environment (TOE) and fit-viable (FV) innovative technology adoption models. Both the technology adoption models are at firm level. The FV model is the cloud computing adoption model for the implementation of cloud as alternative to e-government services in developing countries, [30]. Besides to the instruments adopted and adapted from the two models the influence of power and internet connectivity in the adoption of cloud computing for e-government services of Ethiopia is deeply explored depending on the instruments designed for them to clearly distinguish primarily the barrier factors of an adoption. The whole procedures or processes followed in this research is as depicted below, in Figure 3.01.

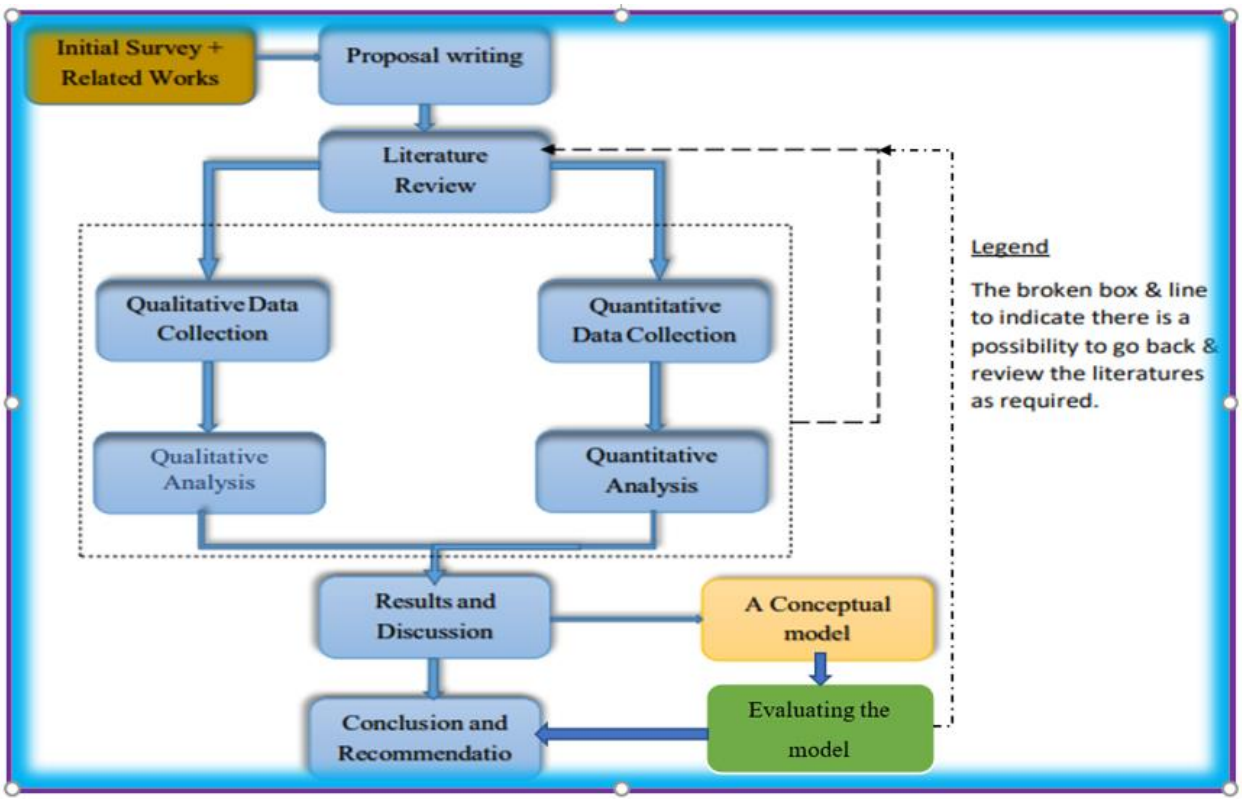

Figure 3.01 Procedures Followed in Conducting Cloud Computing Readiness for NDC

The above diagram, Figure 3.01, illustrates the overall processes used from the conception of this study to its completion.

As indicated in [30], establishing online government services requires implementing and upgrading the e-government system to match task requirements that would otherwise be performed offline in accordance with the reports of the United Nations, Department of Economic and Social Affairs, Division for Public Administration and Development Management, 2010. Business continuity and service availability is a big concern in adopting cloud computing. The potential of cloud computing system availability to the customer for 100% non-interrupted makes it a key selling point. Most essential government services and large vendors may require sustaining their power 365/24/7 up time to businesses and to the citizens in general, to get support to their mission-critical efforts. If there will be power outages do occur unexpected cost can be resulted [31]. It is the concern to identify that whether CSPs have acceptable capabilities and effective business continuity plans (BCP) to handle emergencies and disaster situations. This is also working for the

case of the national data center of Ethiopia, whether it can be outreached to the citizens with the existing power or energy supply. When we are debating about availability it is not only about power or energy requirement, but also concerns of internet connectivity. Therefore, this study deeply explored the status of power and internet connectivity (Powercon) of the country to offer cloud implemented e-government services nationwide.

3.3. Research Methods

This research uses mixed research approaches – both qualitative and quantitative methods – for data collection and analysis in the study. The researchers applied the mixed methods together with observation and document analysis. The combination of pluralistic methods could be used to neutralize the biases that are arisen by implementing any of a single approach and it helps to lessen the weaknesses characterized in a single method with the strengths of the other method as noticed in [14]. That means using mixed research methods increase trustworthiness of the study.

3.4. Target Population and Sampling Methods

The entire Ministry of Innovation and Technology, and its representative institutions and agencies are the population of this study directly or indirectly, when we are considering from e-gov services administration and provision side. However, when we are bearing in mind all the customers of the national data center of Ethiopia, they can be thought as the population of this study as service consumer.

This study generally focuses on the national data center of Ethiopia. The MInT has a mandate to administer and manage all the activities and the services of the NDC, including technical and operational issues of the datacenter. The services of the national data center of Ethiopia are delivered nationwide to government sectors ranging from federal organizations to regional state and Woreda level organizations. The NDC also provides its services to some private sectors and industries.

Therefore, population of the study = MInT + all customers of the e-gov services of the NDCE.

Whereas the sample of the title being studied are the government sectors selected for this study by purposive sampling.

Thus, sample of the study = IT sector of the MInT + IT department of Selected government sectors for this study.

However, concerning target respondents purposive sampling, precisely expert sampling, was used to select IT staff to participate in the study. The purposive sampling was used because participants were selected based on their understanding or special perspective and experience on the issue under investigation.

Therefore, though purposive sampling technique used to formulate the sample in which decisive questions can be asked, and simultaneously to get the appropriate and relevant data for the study, the random sampling technique or the Slovin formula is used to estimate sampling size of the ICT sector employees of the MInT. Whereas all the IT department workers of the other six selected government sectors existing on their job during data collection are directly used as the sample size of the participants, but some of them were not on their job due to COVID 19.

To compute the sample size for ICT sector of the MInT the following random sampling formula was used:

$n= N/(1+Ne^2)$, where: n = number of samples

N = total number of populations (I)

e = error margin / margin of error confidence level of 95% (e=0.05)

Total number of ICT sector employees of MInT = N = 70, from formula above

$n= 70/(1+70x0.05x0.05) = 70/1.175 = 59.57 \approx 60$

Therefore, the sample size (n) of ICT sector employees of the MInT is 60

Thus, this study encompasses all government departments those are getting services from the national data center of Ethiopia. Therefore, the questionnaires of the research are distributed to seven government sectors: namely, Ministry of Innovation and Technology (MInT), Ministry of Foreign Affairs (MFA), Ministry of Culture and Tourism, Ministry of Finance and Economic

Cooperation, House of Federation, Ethiopian Federal Police Commission, and Public Procurement and Property Administration Agency depending on purposive sampling to get the appropriate and relevant data for the study.

3.5.Ethics Issues

Respecting the ethical issues during the entire research process is highly recommended; particularly when the study is carried out with in a real organization as indicated in [6]. Therefore, this study assured that for there is not any impairment on the organization from which the information was gathered, and to the respondents of the research questions. Additionally, resources from other works are acknowledged explicitly. As proposed in [17] the ethical issues such as consent, confidentiality and privacy should be considered from the planning stage to final word in the conclusion. Correspondingly, the ethical issues considered from the beginning of this study up to its completion. Therefore, in accordance with the consent made the participants of the study kept anonymous.

3.6.Method of Data Collection

This research study used primary and secondary data. The primary data was collected through semi structured interviews and questionnaire. Primary data is recognized as an original data that is gathered for specific research in response to a particular problem through interviews and questionnaires. Additionally, secondary data were obtained by examining various documents including annual and semiannual reports, digital Ethiopia – 2025 strategy, research reports, world bank reports and journal articles related with issues of cloud computing.

The instruments for primary data collection are to the majority adopted from cloud computing readiness related literatures with some modification to some of them. The amendment was made to the instruments to meet the purpose of this investigation.

3.7. Data Collection Instruments

As stated in Section 3.6, the instruments that were used to collect the required data consists of survey questionnaire, semi-interview guide, document analysis and observation to the existing IT infrastructure of the NDC and its internet performance.

3.7.1. Survey Questionnaire

The questionnaires used for this research were adopted from the previous related studies [12] [13] [41] [30] with some modification together with selected senior ICT experts of the NDCE and the knowledge management department of the MInT and reviewed by them after update to meet the required standards to gather the relevant and representative information from samples of the study without bias.

Preparing some questionnaires, together with ICT experts of the MInT, that is used to obtain primary data about factors affecting the adoption of cloud computing to the e-gov services of the NDCE was among the important events in this research.

Thus, certain of the questionnaires used in this research are adopted from the prior studies of related works about cloud computing readiness status of the organization that the validity and reliability tests have been performed on the questionnaires and met the conventional standards. Therefore, performing validity testing was not required for some of the questionnaires. Rather, the modified and the prepared questionnaires had been validated by the selected ICT experts of the MInT. The adopted and customized questionnaires were those designed based on the technology, organization, environment (TOE) and fit viable model (FVM) technology adoption models' theories. As described in Chapter Two of this study; both the models are among the empirical models implemented at the firm level for the adoption of innovative technologies. The FVM model is the model proposed for the implementation of cloud computing services for e-government services in developing countries. However, in this study it is uncertain per literature to understand factors that influence the cloud adoption to the national data center of Ethiopia; especially from the perspective of hinder factors to successfully adopting cloud computing in the Ethiopian context to e-gov services. Consequently, it is unwise to spend national resources needlessly, in cloud computing services for embarking cloud strategies just to have a cloud. It is critical to understand

the factors affecting the cloud adoption both negatively and positively by assessing and re-assessing for the NDC of Ethiopia alike as indicated in [31]. The questionnaires of this study have three parts: Part I, consists of personal profile and 'Yes – No' questions, part II questionnaires grounded on TOE model and part III questionnaires are based on FVM model. Part II and part III questionnaires are Likert scale questions ranging from strongly agree to strongly disagree, by encompassing agree, uncertain and disagree in-between.

Likert Scale questionnaire derived data are likely to be nonparametric. It represents nominal and ordinal variables. Nominal scale is the lowest level of measurement and involves simply categorizing the variable to be measured into one of several discrete categories (gender, ethnic group). Ordinal scale involves ordering or ranking the variable to be measured (Likert scale). Ordinal variables have an implied order to the response choices such as, 1= strongly agree, 2= agree, 3= neutral etc. Typically, these variables – nominal and ordinal – use the median and mode, frequency tables, bar charts, and crosstabulations. The ordinal variables mostly use a frequency distribution or charts, [42].

A non-parametric test makes no assumptions about the parameters such as the mean and variance of a distribution. The non-parametric correlation uses only the ordinal position of pairs of scores. It is based on a model that specifies very general conditions. No specific form of the distribution from which the sample was drawn. Hence nonparametric tests are also known as distribution free tests. When there is not the normal distribution of the ratio and interval scale data population (parametric data), a nonparametric method should an alternative to be used when observations are difficult or impossible to implement parametric numerical values to them [43].

Most of the researchers are confused to distinguish between ordinal and interval scale in data analysis. The wrong identification of data can cause misinterpretation finding. Ranking technique require the respondents to order the multiple choices of Likert scale questionnaire with respect to some selected property of interest. For instances, the researchers would classify for each 5-point Likert scales in their questionnaire design as presented in [44] [45]

Therefore, the tool used for analysis of quantitative data collected by using the Likert scale questionnaire is SPSS and since the Likert scale questionnaire derived data is ordinal

nonparametric data type as evidenced by several researchers, the frequency table, the reliability test, and the charts are the algorithms applied to analyze the quantitative data of this study.

Additionally, the qualitative data collection and analysis approach is also applied in the study and some of its instruments discussed below.

3.7.2. Interview

The second instrument used to collect primary data from the purposefully selected respondents is semi structured interview. There are different types of interviews: Structured, semi-structured and unstructured interviews. The aim of structured interview is that it provides the same context of questioning for all respondents so that their replies can be aggregated. Structured interviews make probing a problem area difficult because they introduce some rigidity to the interview, [12] [35].

Semi-structured interview, on the other hand, is non-standardized and is frequently used in qualitative analysis. A list of key themes, issues, and questions to be covered in semi structured interview gives the researcher flexibility to establish his/her own style of conversation depending on the direction of the interview. This flexibility enables probing, which is a way for the interview to explore new path which are not initially considered, [35].

As the authors described, the unstructured interview or in-depth interview takes a further step towards a more open discussion where no predetermined question is needed. The interviewee is encouraged to speak freely about events, behavior, and beliefs, with reference to the subject. In this type of the interview respondents may talk about irrelevant and unimportant issues and it may be difficult to code and analyze the data.

As presented in the same section above, semi-structured interview approach was selected in accordance with the nature of the subject. The flexibility of this type of interview helps to obtain rich information systematically from the interview about the phenomena being studied. The interview guide question was adopted from [34] and modified to the context of the NDCE. The modified interview guide questions were also validated by key ICT experts of the MInT.

Not only the semi-structured interview was implemented as qualitative data collection and analysis technique, but also the document analysis and observation of internet quality and IT infrastructure.

The questionnaires and face-to-face semistructured interview guides for this research work are positioned in Annex I and Annex II of the document, respectively.

3.8.Data Analysis and Presentation

3.8.1. Common Statistical Software for Quantitative Data Analysis

There are Several statistical software available for statistical analysis, namely Statistical Package for Social Sciences (SPSS), Minitab, SAS, R-programming, STATA, SEM-AMOS, SEM-SmartPLS, and WarpPLS. The most popular software for SEM (Standard Error of the Mean) is analysis of moments structure (AMOS), partial least square (PLS), LISREL, SEPATH, PRELIS, SIMPLIS, MPLUS, EQS and SAS, and categorized into two types: Variance-based SEM, such as PLS and Co-variance based SEM, such as AMOS, Lisrel, EQS, Mplus. That means, the software under both categories of the SEM is parametric test technique [46].

Beneath is the comparison of the three widely known statistical analysis software: SPSS, SmartPLS, and AMOS [46]..

SPSS is statistical package that is very user friendly and various statistical tests could be conducted using this software. This statistical software undertakes both comparison and correlational statistical tests in the context of univariate, bivariate and multivariate analysis for both the parametric and non-parametric statistical techniques

SmartPLS is a statistical package primarily designed by a team of software developers from the academia in Germany as indicated in the article cited in the preceding paragraph. This statistical software undertakes SEM analysis using the Ordinary Least Square estimation techniques and is widely used by researchers exploring the theories.

AMOS is a statistical package also designed by the team at IBM Corporation. AMOS software is widely used to confirm a theory, since it uses the ML estimation techniques in the SEM analysis. Besides that, AMOS software is automatically available when the SPSS software version 20.0 and above are installed as stated in the article.

3.8.2. Choosing the Right Software for Data Analysis

In choosing the right statistical software for the statistical data analysis, researchers usually consider a research objective, first. If the research objective is comparison analysis, usually SPSS statistical software is the preferred statistical package compared to other statistical packages such as MINITAB, STATA, and R-Programming statistical software as presented in [46]. This is because the SPSS statistical software is easily able to perform both parametric and non-parametric comparison analysis. It also permits the researcher to check the assumptions of the tests, such as the normality test and outlier's test. Besides that, this statistical package enables a frequency analysis to be perfectly conducted.

Therefore, the SPSS statistical software is preferable for this study since it is easily able to perform non-parametric test analysis when compared to the above discussed statistical tools under Section 3.8.1.

Thus, the data that was collected through quantitative approach using Likert questionnaire was statistically analyzed using statistical software: Statistical Package for Social Science (SPSS). Whereas the qualitative data is analyzed with thematic analysis. Thematic analysis is the process of identifying patterns or themes within qualitative data, [15].

3.9.Model Evaluation Approach

Evaluation of an artifact, through well-executed method, is considered as an important element of IS research process to determine the utility, quality, and efficacy of the design artifact. An IT artifact requires rigorous evaluation with respect to functionality, completeness, reliability, usability, fit to the organization, and other relevant quality attributes prior to using it to the intended goal, [16]. According to the authors, an IT artifact can be evaluated by observational, analytical, experimental, testing, expert validation, and descriptive methods. These evaluation methods can be applicable depending on the type of the study at hand. In this study, expert validation and descriptive methods are used to evaluate the proposed model. The expert validations were executed using focus group discussion twice; during the first phase for refinement of the first draft of the adapted and proposed model and secondly, the finalized proposed model was evaluated for

completeness, correctness, and clarity. Moreover, descriptive method is used to illustrate the utility of the proposed model by building a convincing argument for the artifact's helpfulness.

3.10. Chapter Summary

In the chapter the overall design of the research is clearly discussed. The chapter attempted to present the methodology or the procedures that range and flow from the conception of the study problem to the completion of the study in detail. The implemented methods for data collection, sampling technique and sample size, data collection instruments, data analysis and presentation, tools and techniques for empirical data analysis, and procedures for evaluation of the adapted model has discussed. The proceeding chapter is concerned with data analysis, discussion, and the findings of the study.

CHAPTER FOUR: Data Analysis, Discussion and Findings

4.1. Introduction

This chapter presents data analysis and discusses the data obtained from multiple sources based on the specific objectives of the study and the findings and the theories related to the study. The report of the findings of the study is based on the quantitative analysis: questionnaires, and qualitative analysis: semi structured interview, document analysis, and observation. The discussion is to interpret and describe the significance of the findings against research questions [47]. The description and interpretation of participants' perspectives are also featuring of all qualitative approaches as described in [15] [48]. As specified in Chapter Three, it has been agreed up on to present the analysis of the study in a way it covers as much as possible the identities of the individuals. Therefore, the individual participants were kept anonymous.

All the data collected are agreeing to the consent made between the researchers and the selected data provider organizations based on the cooperation letter written to each organization by AAiT.

4.2. Quantitative Data Presentation, Analysis, and Discussion

The quantitative data was collected with Likert questionnaires from seven government organizations: Ministry of Innovation and Technology and other six purposely sampled government organizations. As described in [45], the responses of Likert scale questionnaire are nonparametric ordinal data type and must be analyzed using descriptive frequency tests and other nonparametric tests. Although the difference between each value is not known the order is very important and noteworthy in ordinal data analysis.

Therefore, since the quantitative data collected for this study is based on Likert scale questionnaires the reliability test of Cronbach's coefficient value, descriptive frequency test and analysis, and the charts were implemented. The quantitative data was collected based on the technological context, organization context and the environmental context of the TOE technology adoption model and the fit-task and viability of the FVM model for adoption of cloud computing paradigm to e-gov services in the developing countries.

According to the analysis of the data collected depending on the two theoretical models many of the responses indicated that the existing status of the NDC of Ethiopia is suitable to adopt and implement cloud computing for startup. But when considering the connectivity and power related readiness of the NDC to adopt CC to e-gov services nationwide, the result of the analysis shows that there is a demand to both which requires improvement in quality and distribution.

4.2.1. Reliability and Validity Test

Validity and reliability are the attributes that measure quality of a research. They address issues regarding the quality of data and the appropriateness of method used [30].

4.2.1.1. Validity Test

Validity indicates the degree to which an instrument measures what it is supposed to measure. Some of the instruments were adopted from previous works, some others were modified, and additionally, the others were designed for the study and then validated in accordance with the context of e-government services of the NDCE as presented in sections 3.7.1 and 3.7.2. The verification of the modified questionnaires was done using pilot test on eight IT experts of the MInT before the main data collection took place. The pilot study is a small version of the final real data collection process in which the data are collected from several respondents of the real sample to assess the reliability of an instrument as reported by Robson 2002 and cited in [30]. The reliability of the pilot study is .837, the acceptable coefficient of alpha.

4.2.1.2. Reliability

A reliability test helps to ensure consistency results of the internal measures. As indicated in this article, reliability is a consistency which a measuring instrument yields a certain result when the entity being measured has not changed. The Cronbach's coefficient alpha is the most common index of reliability [49]. As presented in this article, the weakest value of alpha is less than .6 and Alpha values more than .7 is acceptable. To investigate reliability of this study, Cronbach's coefficient alpha was computed using SPSS 25.0. The overall score of alpha value for the questionnaire distributed to the MInT IT staff is .880, similarly the alpha value for the responses of the questionnaire disseminated to the selected six customer organizations of the NDC is .895.

Both the alpha values are greater than .7, therefore, the reliability of the questionnaire is at acceptable level. The reliability test conducted for MInT and the other six selected government organizations are indicated below.

Reliability Statistics		
Source of Data	Cronbach's Alpha	No of items
MInT Respondent	**.880**	**55**
Other Organizations	**.895**	**23**

Table 4.01 Reliability Test for Data collected from MInT and other selected organizations

4.2.2. Description of Quantitative Data

The survey questionnaires were created in two formats: in paper form for the participants of the selected six government organizations – Ministry of Foreign Affairs, House of The Federation, Ministry of Finance and Economic Cooperation, Ministry of Culture and Tourism, Ethiopian Federal Police Commission and Public Procurement and Property Administration – and in google form for the respondents of the MInT. The survey questionnaire in the paper form were distributed to 24 participants of the selected government organizations. One IT staff of each selected organization was cautiously selected to follow up and collects the responses of the questionnaires. Almost all the designated staff were from the IT management professionals. Accordingly, 23 questionnaires were appropriately responded and then handed in to the researchers, i.e., 96% of paper-based questionnaires were properly responded. On the other hand, among the questionnaires disseminated to 60 participants of the MInT, 55 of them accurately responded. That means, 92% of the participants provided their response, suitably. Cumulatively, 93% of the survey participants responded for the questionnaires distributed to them appropriately.

As stated in section 3.4 of this research, although the sampled organizations are selected purposely, the minimum number of the participants of the ICT sector of the MInT were randomly calculated by using Slovin formula or random formula. Whereas the number of all employees of the IT department of the selected public organizations exist on their job during data collection were all used as the participants of the quantitative data collection. But not all the IT department workers

of the other sampled organizations were on their job; some of them were at leaving because of COVID 19. The data of the respondents can be summarized according to the following table 4.02.

S/N	Name of Organization	Expected Participants	Number of Respondents	Difference
1	Ministry of Innovation and Technology	60	55	5
2	Ministry of Foreign Affairs	5	4	1
3	House of Federation	2	2	-
4	Ministry of Finance and Economic Cooperation	6	6	-
5	Ministry of Culture and Tourism	5	5	-
6	Ethiopian Federal Police Commission	2	2	-
7	Public Procurement Agency	4	4	-
Total		**84**	**78**	**6**

Table 4.02 Number of Respondents Respective to Their Organization

4.2.3. Respondent's Demographic Characteristics

This section introduces the descriptive statistics of the characteristics of the respondents of the study. The demographic characteristics consist of gender, level of education, role of respondents, and work experience. This descriptive statistical analysis was done using the data collected about individual respondents, on the first page of the questionnaire and the demographic data collected during semi structured interview. This personal data encompasses all the ICT professionals and managers participated in this study from Ministry of Innovation and Technology, and other six selected government organizations. The demographic information of the respondents summarized, and it is shown below in table 4.03.

Variable	Classification	Frequency	Percentage
Gender	Male	58	74.4%
	Female	20	25.6%
	Cumulative	**78**	100%
Educational Level	BSC	46	59.0%
	MSC	32	41.0%
	Cumulative	**78**	
Work Experience	Below 5 years	31	39.7%
	5 – 10 years	27	34.6%
	11 – 15 years	17	21.8%
	Above 15 years	3	3.8%
	Cumulative	**78**	**100%**
Role of Respondent	Application Administration	3	3.8%
	IT team leader	3	3.8%
	IT Director	3	3.8%
	IT security professional	11	14.1%
	system administration	12	15.4%
	IT project manager	2	3.6%
	Middle IT Manager	6	7.7%
	Network Administration	17	21.8%
	Software Developer	11	14.1%
	Top IT Manager	6	7.7%
	User Support and Help Desk	3	3.8%
	Database administration	1	1.3%
	Cumulative	**78**	100.0%

Table 4.03 Demographic Information of the Respondents

The educational level of qualification of the respondents participated in the interview shows 59.0% of the respondents are having the bachelor's degree, and 41.0% of the remaining respondents having the master's degree. From the result the respondents are educated and having bachelor and master's degree.

The description of respondents from the perspective of work experience is indicated in table 4.03 above. This experience does not indicate the total years of services of the professionals, rather their work experience in their organization.

Therefore, 39.7% of the respondents have experience less than 5 years, however respondents of the MInT have experience of >=3years in their organization, 34.6% of the respondents have the experience between 5 and 10 years, 21.8% of the respondents have the experience between 11 and

15 years and 3.8% of the respondents have the experience greater than 15years. The analysis clarifies that more than 50% of the respondents have experience greater than or equal to 10 years. Simultaneously, the IT professionals of MInT categorized under the age group of less than 5 years have work experience greater than 3 years and the experience of those sampled from the six customer organizations of the NDC also does not represent the total years of services of the professionals, rather their work experience in their current organization. Thus, the respondents have a good experience in their working field to express the status of their organization in the viewpoint of cloud computing adoption readiness.

The distribution of the respondents in relation to their roles in the organization they have sampled from are also presented in table 4.03 above. The respondents with the role of network administration represents 21.8%; the participants with system administration denotes 15.4%; 14.1 % of the respondents role is represented by software developers and IT security professional; both top IT managers and middle IT managers constitute 7.7% of the role; the ICT support and help desk, application administration, IT team leader and IT director roles have the share of 3.8%; the IT project manager role has 2.6 % and database administration role constitutes the share of 1.3%.

4.2.4. Respondents' Knowledge of Cloud Computing

According to the survey questionnaire to understand the knowledge of the participants on cloud computing; among 55 participants of the MInT who responded for the questionnaire, 54 (98%) and all the respondents of the selected government organizations, i.e., 23 (100%) of them replied as they have good understanding of Cloud Computing. This shows that nearly all the respondents of this study have knowledge of Cloud Computing and were able to give responses to the questionnaire questions of this study based on their experience.

4.2.5. Analysis of quantitative data (Likert scale questionnaire)

Therefore, in accordance with the analysis of this study as discussed in section 4.2 of the third paragraph, most of the respondents of both the ministry of innovation and technology as the e-government services provider and those of the others which sampled from the selected six government organizations as the representative of consumers of e-government services provided their responses that is supporting the readiness of the NDCE to adopt CC as startup. However,

there were also few respondents who gave their responses which refute the readiness of NDC of Ethiopia to adopt CC. Additionally, there were also some respondents who provided the neutral response “uncertain”. But the total of agreed and strongly agreed respondents were over the average, almost for all the questionnaire questions grounded on the TOE and FVM models. For instance, when the responses for broad internet access, quality of internet in the sampled organization, impacts of power inconsistency in the sampled organization to adopt CC, inconsistency of power and communication network impacts to outreach with CC to the regional state and their woreda level, the awareness of CC & its implementation exists among top managers and the professional staffs and the adequacy of ICT training involving CC are considered from the analysis of quantitative data they can be concluded in the following table, Table 4.04 with the description succeeding it.

S/N	Factors to understand levels of user view	Organization			
		MInT		Others	
		Strongly agree and agree		Strongly agree and agree	
		Frequency (55)	Percent (%)	Frequency (23)	Percent (%)
1	There is BB connectivity in your organization	49	89.1	18	78.3
2	Quality internet connection in your organization	41	74.5	17	73.9
3	Inconsistency of power affects adoption of CC	34	61.8	14	60.9
4	Inconsistency of power & network disturbs CC to outreach regional states and woreda level	46	83.6	18	78.3
5	Awareness of CC & its implementation exists among top managers and professional staffs of your organization	29	52.7	7	30.4
6	There is adequate ICT training including CC in your organization	19	34.5	9	39.4
7	The policies are in place to promote and manage use of CC in your organization for e-government services	18	32.7	6	26.1
8	The IT infrastructure of the NDC can support CC	30	54.5	11	47.8
9	There is adequate budget for adopting and maintaining CC	20	36.4	12	52.2
10	There is an established policies on data management and security in your organization	32	58.2	23	100
11	Support of top management is essential to invest in CC services	40	72.2	21	91.3
12	Strong IS security option in your organization	13	23.6	8	34.8
13	Users of CC require adequate IT and cloud technology knowledge	39	70.9	19	82.6

Table 4.04 Frequency Distribution of Quantitative Data

According to table 4.04 above the analysis of the first tuple indicates for the questionnaire question concerned to the existence of broad band network 89.1% of the respondents of the MInT responded strongly agree and agree; and 78.3% of the respondents from the other sampled government organizations – the customers of the e-government services of the NDC of Ethiopia – responded strongly agree and agree. For the questionnaire question based on the quality of the internet as it can be observed in the second tuple of the above table 4.04, 74.5% of the respondents of the MInT responded strongly agree and agree. Similarly, 73.9% of the respondents sampled from the customers of the e-government services of the NDCE replied strongly agree and agree. Quality can be defined as a set of specific requirements provided by a network to users, which are necessary to achieve the required functionality of an application or service. General QoS parameters in packet switched networks are summarized as: delay, jitter, packet loss, throughput, and SLA [50].

The analysis of each tuple of the table 4.04 above can be represented in terms of graphs to add clarity of the document to the audience through visualization. Consequently, the analysis results of the quantitative data can be illustrated by using pie chart as indicated below for some selected parameters.

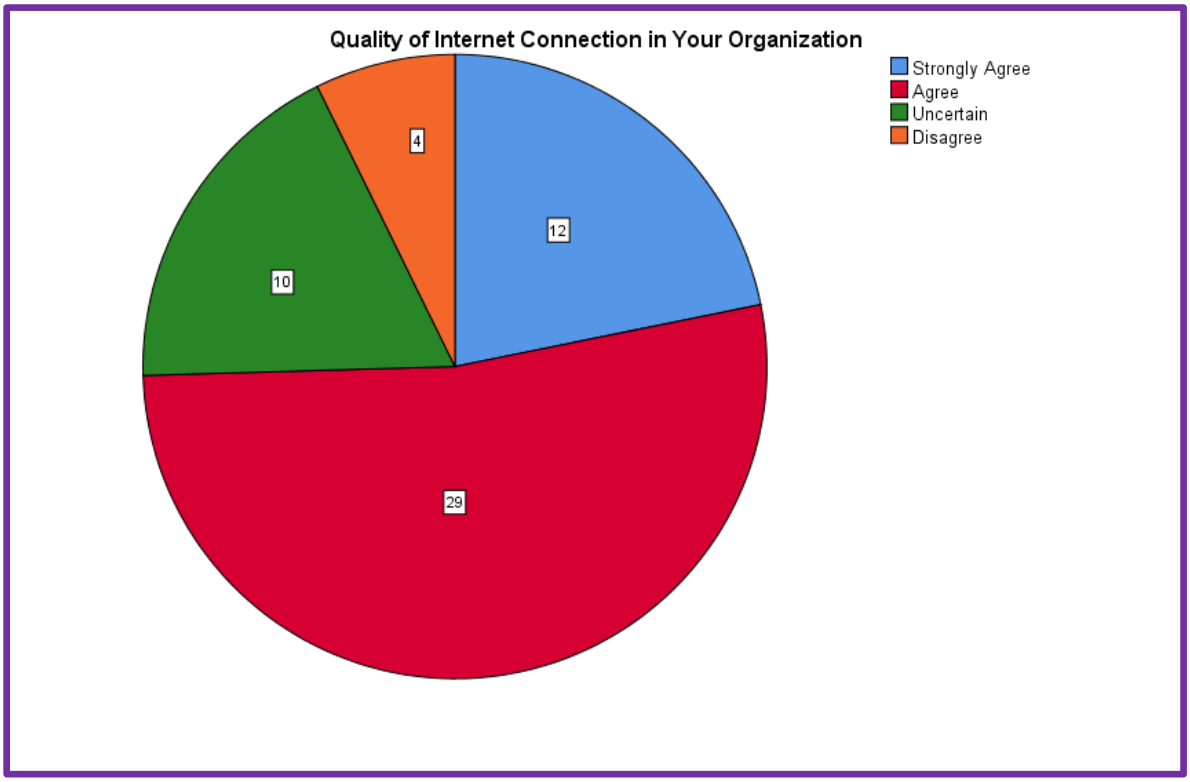

Figure 4. 01 Internet Quality for Respondents of MInT

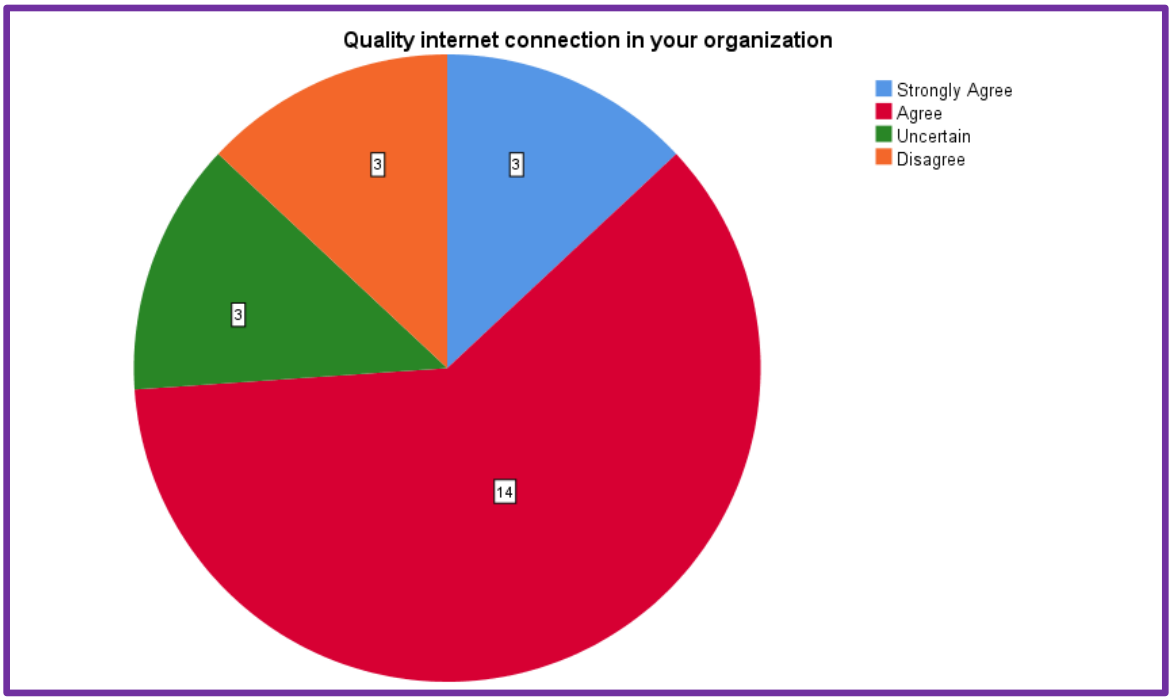

Figure 4. 02 Internet Quality for Other Respondents

According to the first and the second tuples of table 4.04 above and figure 4.01 and 4.02, all the respondents agree that there is a BB network connectivity and the quality internet access in their organization.

However, when considering the impact of the inconsistency of the internet connectivity and the availability of the power supply on the adoption of CC: the respondents of both the MInT and the sampled government organizations from the customers of the NDC of Ethiopia, 61.8% and 60.9% of them respectively responded strongly agree and agree for the questionnaire question that says inconsistency of power supply can affect adoption and implementation of CC to the e-gov services of the NDCE. Likewise for the question about inconsistency of power and communication network in the country hinders to outreach the regional state and woreda levels' organization with CC adoption 83.7 % of the respondents from the MInT and 78.3% of the respondents from the selected government organizations responded strongly agree and agree.

In comparison to table 4.04 above if considering the graph of the impact of inconsistency of power and communication network to outreach organizations at least in settlement parts of the country with CC, the analysis result represented as shown below.

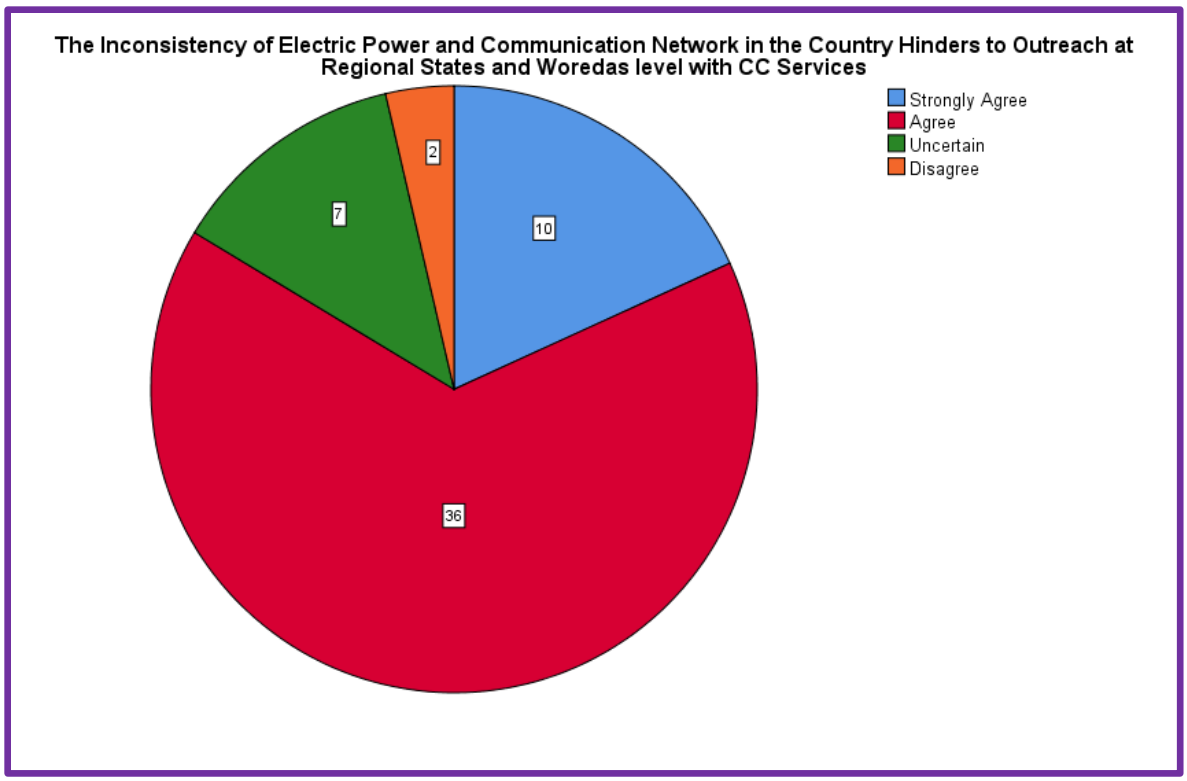

Figure 4. 03 Effect of Inconsistency of Powercon on CC Adoption as MInT Respondents

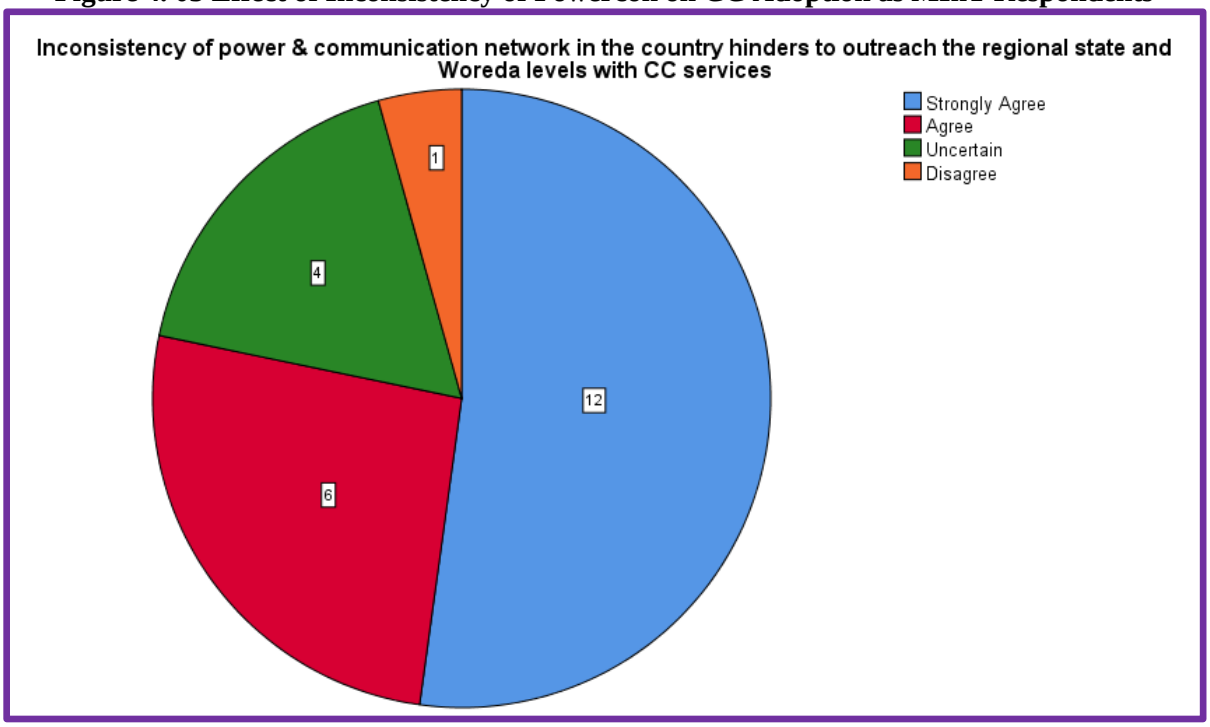

Figure 4. 04 Effect of Inconsistency of Powercon on CC Adoption as other Respondents

As it can be observed from the analysis results of figures 4.03 and 4.04 and the 3rd and 4th tuples of table 4.04, the inconsistency of power and network connectivity in the country negatively affect the adoption of CC at the sampled organizations level and the regional states and their Woreda levels.

Furthermore, as shown in table 4.04 the result of the quantitative descriptive frequency analysis is also showing that above average (52.7%) of the respondents provided their response by agreeing to the presence of awareness of cloud computing and its implementation across the MInT staffs including the top managers and the professional staffs. whereas, when viewing for the existence of quality and adequate ICT training and education in the MInT only 34.4% of the respondents gave their response as strongly agree and agree. This indicates that there is a need of training and adequate ICT education, together with cloud computing, to the staffs. Moreover, the frequency analysis of the quantitative data collected from the sampled customers of the e-government services of the NDC shows that below the average (30.4%) of the respondents strongly agreed and agreed as there is awareness of cloud computing and its implementation for top managers and other professional staffs of their organization. Similarly, below the average (39.1%) of the respondents responded strongly agree and agree for the provision of quality and adequate ICT training in their organization, currently. Tuples 5 and 6 of table 4.04 show the analysis of awareness of CC for top managers and the professionals and the ICT training requirement based on the quantitative data collected from the sampled organizations.

Additionally, the result of the analysis regarding the existence of adequate ICT training which involves CC denoted in graph as illustrated below.

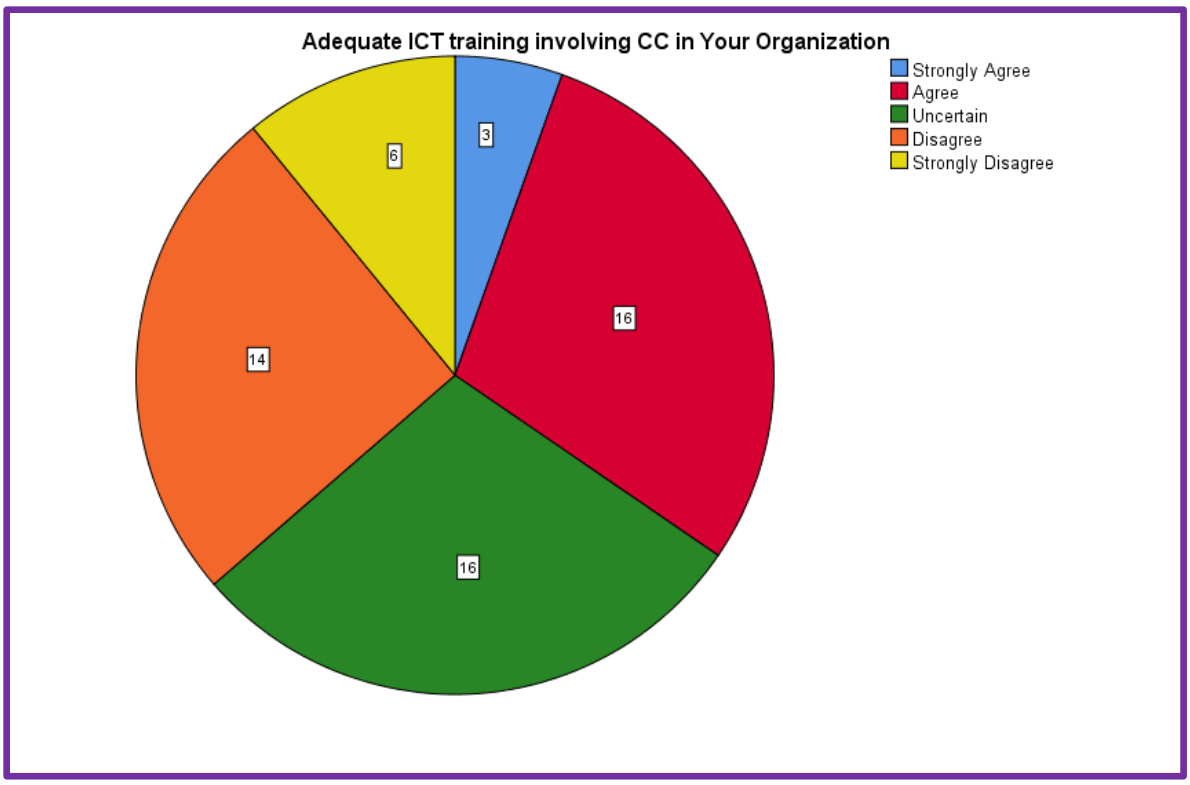

Figure 4.05 Adequacy of ICT Training Involving CC to MInT Staff

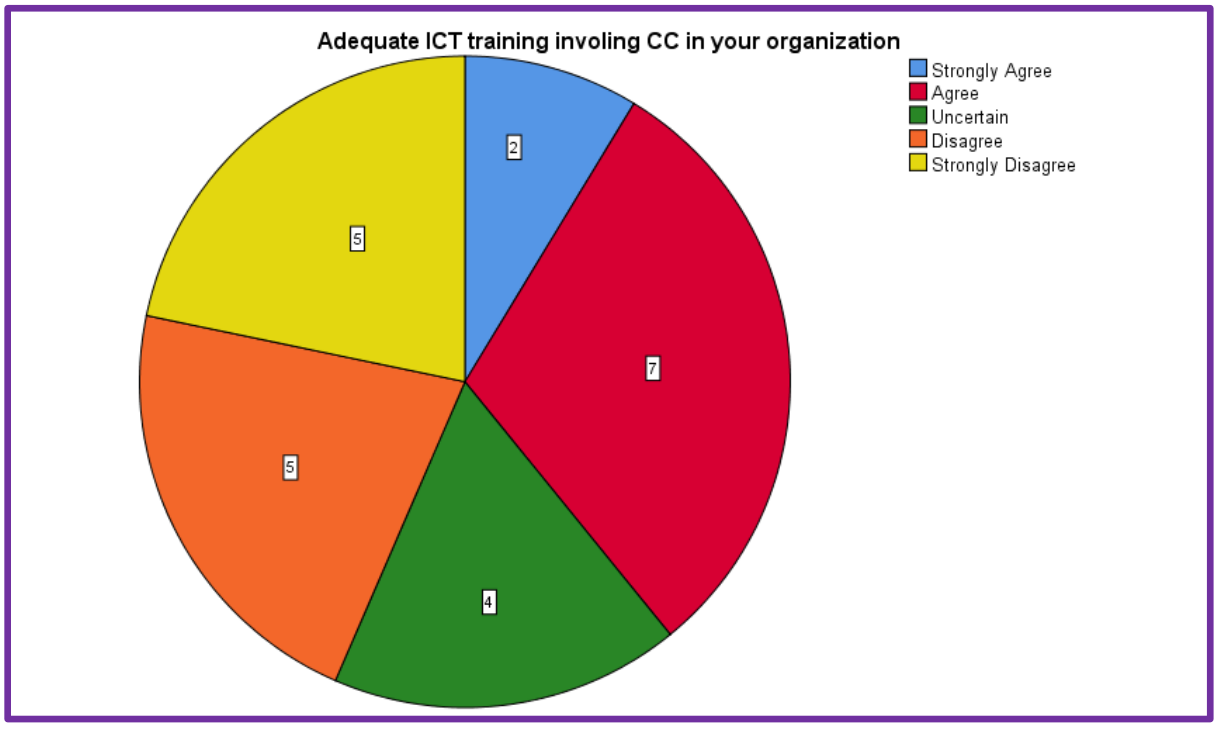

Figure 4.06 Adequacy of ICT Training Involving CC to other organizations' Staff

Although there is awareness of cloud computing and its implementation for top managers and other staffs according to responses of the respondents; the results indicated in the 6th tuple of table 4.04 and figures 4.05 and 4.06 clearly show that the gap in providing adequate ICT training that involves CC to the concerned staffs of the public organizations.

Finally, there are also remarks to be revealed here. As the results recorded in the tuples 8 to 10 shows currently there is not cloud computing policy related to the NDCE, but when the collected data is analyzed since the MInT went more than half the way to design the cloud computing policy and awarded the project to AAU; and additionally, as the result of quantitative approach shows though no involvement of stakeholders when designing innovative e-gov services but during implementation; whereas currently the ministry started involving all the concerned bodies from inception to execution of new projects. Therefore, the researchers concluded that no need to discuss them here.

4.2.6. Discussion of the Quantitative Findings

In this research – the research questions: What is the readiness level of the NDCE to implement cloud computing to e-gov services? What are the major barriers to adopt cloud computing to e-gov services of the NDCE? And how cloud adoption readiness model helps the NDCE for the adoption of cloud computing? – are addressed. These questions are appropriately addressed in this study in one or another way. According to the quantitative data analysis of the study the descriptive frequency and percentage results of the study show that the existence of poor internet connectivity and the inconsistence of power hinders the NDCE to outreach the nation with cloud computing service through e-gov services. The problem of internet connectivity agrees with the findings of previous researchers to some extent such as [13] [31]. To the contrary, nearly about ¾ of the respondents of the questionnaire responded that a quality internet exists in their organization at the head office, i.e., in Addis Ababa. When considering the inconsistency of power supply and its irregular distribution's impact on the adoption of cloud computing to e-gov services nationwide, not much was said in earlier works. However, it is stated that most government organizations require nearly 100% uptime and if the desired consideration is not given to the power and connectivity during readiness assessment phase the adopted CC system will be performing at the status of offline [30] [31].

When considering the existence of adequate ICT training including cloud computing in public sector and the prepared policy concerning cloud computing adoption promotion and management only less than 40% of the respondents confirmed for the existence of adequate ICT training and cloud computing policy in their organization. The result concerning to training coincides with the findings of the previous research works of [12] [13] [31]. Whereas the result regarding to the existence of cloud computing awareness which promotes its adoption to e-government services agrees with findings of the previous studies in [12] [31]. Additionally, the result of this study on the requirement of cloud computing knowledge to its users indicates that over 70% of the respondents responded for the need of cloud knowledge to the users. This result is consistent with the results of the previous studies of [12] [13] [30] [31].

From the perspective of the existence of information system security in public organization, only less than 35% of the respondents responded for the presence of sound security in their organization. Thus, the result indicates to do more on security in which it corresponds almost with all the findings of the prior works.

When the presence of adequate budget for the adoption of cloud computing to the e-gov services of the NDCE is considered only 36.4% of the respondents of the MInT and 52.2% of the respondents of the other six selected government organizations are confirmed for the existence of appropriate budget. Therefore, this result indicates for the deficiency of budget for the adoption of cloud computing technology to e-gov services of the NDCE comparable to the study conducted in Ghana on barrier factors to adopt cloud computing to large government organizations. Like our country, public sectors of the Ghanaian government organizations earn a budget for projects from the Ministry of Finance of their country [31].

Thus, the readiness level of the NDCE to adopt the cloud computing to e-government services is concluded to low. Additionally, the power and internet connectivity problems, poor ICT training involving CC, cloud computing knowledge requirement to users, security issues and budget constraints can be considered as some barrier factors to adopt cloud computing to the NDCE.

4.3. Qualitative Data Presentation, Analysis, and Discussion

In this section, the qualitative data collected via face-to-face interview (from the IT professionals of the NDC and the MInT), document analysis and the observation will be analyzed. The analysis of the qualitative data increases the trustworthiness of the research.

Thematic analysis is frequently employed in qualitative research because themes are patterns of significant interest across data sets that play a vital role in describing phenomena under investigation [15]. According to these authors, themes or patterns within the targeted data can be explained and identified either inductively or deductively. Curiously, if the interviews address the same research question, a collective thematic analysis can be used; but if each interview belongs to a different research question, a separate thematic analysis for each related data set will be implemented. Since, the researchers have used the same interview guide questions for all the respondents; the collective thematic analysis method was applied for this research.

4.3.1. Data from Face-to-Face Interview

The teams participated in the interview are comprised of System Admin Team, Network and Infrastructure Admin Team, IT Security Specialist Team, ICT Support Desk Team and Knowledge Management Team. Based on the consent made with participants of the study, the responses were collected using note taking approach from all the twelve (12) respondents of the semi-structured interview. To come up with the clustered patterns of the following themes: the transcript of the interview was repeatedly and thoroughly read to be more familiar with it and condensed many times.

All the respondents of the semi structured interview of this study have theoretical understandings of cloud computing, but they lack practical or implementation knowledge. Most of the respondents expressed that the NDC of Ethiopia has a plan to build its own CC data center to shift current e-government services to it and to launch other more e-services on the CC.

According to the responses collected from the participants of the interview, migrating to the CC enhances the delivery of e-government services except may be facing with infrastructure and knowledge gaps.

Some of the respondents of the interview also responded that CC is trusted; when migrating e-government services to it, since it is simply the shifting of the e-services to cloud. As the responses of these participants the NDC is at the stage of toward hyper-convergence. Currently, the NDC is implementing both converged and hyper converged technologies. Therefore, as their response the NDC is compatible and interoperable with when migrating e-government service to the cloud.

According to the respondents, the e-services are already there at the NDC of Ethiopia, therefore, the main concern during signing the service level agreement should be confidentiality, integrity and availability of services and the duration of the agreement. As the duration of the agreement remains longer the cloud computing would become costly.

According to other responses of the participants of the semi-structured interview, the power distribution and capacity may vary from place to place in the country. However, it is on right status at the NDC or at the MInT, though its availability is not as typical as conventional standards of the availability for the power.

As the responses of another interview question the implementation of the cloud computing to the e-government services is not the only solution to accomplish the mission and the vision of the NDC, but there are also other several conditions to be fulfilled, such as, awareness creation and digitizing the manual works. Whereas, as the view of some other interviewees, the status of NDCE is adequate to startup the adoption and implementation of CC for the existing e-services, although some others strongly oppose this view.

According to most of the respondents the NDC or the ministry does not involve the stakeholders during planning for new technologies including CC. This is because it is expected that there is a trust in government services with the stakeholders. The government sectors or the stakeholders are involved during the implementation. Whereas there is a plan that involves the stakeholders in awareness creation on new technologies to digitalize Ethiopia in the future.

Related to the alignment of cloud computing to the goals of the e-government services, most of the interviewees were responded that the CC is highly aligns with objectives and the goals of the e-government services. As their responses the CC has better security and flexibility over the current e-government services. Therefore, based on their expectation the respondents stated the

technical advantages of the CC, such as better availability of services, strong security issues, transferring of administrative and management of resources to a third party. Whereas they raised unemployment and loosing of acquiring advanced IT skills and training as the technical disadvantages of adopting cloud computing services.

According to the respondents of the interview of this study, the major barriers to CC adoption (CCA) for the case of the NDC of Ethiopia are summarized as newness to this technology or knowledge and skill gap to the customer staff and the service provider staff side, that means there is digital illiteracy including to top management and IT staff. Some participants also expressed their opinion to show the existing difficulty in creating awareness on CC adoption and convincing the top managements. They also revealed other problems existing currently, such as, budget constraints like the study undertaken in Ghana [31], oldness and incompatibility of the IT infrastructure of the NDC, licenses of some software outdated; and absence of policy, standards, strategies, and guidelines related to cloud computing readiness assessment, adoption, and implementation. Their responses also show higher degree of inconsistency to power and internet connectivity, particularly at regional states and Woreda levels. Both power and internet connectivity (Powercon) availability and quality are better at the capital of the country. The IT infrastructure is also the problem across the country. Besides, in accordance with several previous studies the privacy and security issues are also raised as the barrier factors to the adoption of CC. But few professionals stated that flexibility and security as strong features of CC.

In contrary, some other respondents replied that there are appropriate understandings of the emerging technologies including CC with top managements of the MInT, appropriate leadership opportunities from both the MInT and the government, and the IT staff of the MInT are better knowledgeable to align themselves with cloud computing technology.

The concepts of the semi-structured interview of this research can be summarized into three themes: the basic theme integrating the codes of the thematic analyses, the major barrier factors to cloud adoption as organizing theme, the main perceived enabler factors to cloud adoption is also organizing theme and the global theme that combines the organizing themes of barrier and enabler factors to cloud computing adoption and implementation. The thematic diagrams of each of the

three themes is illustrated below respectively. The structure or the frame and the headers of the thematic diagrams has been adopted from [6] [61].

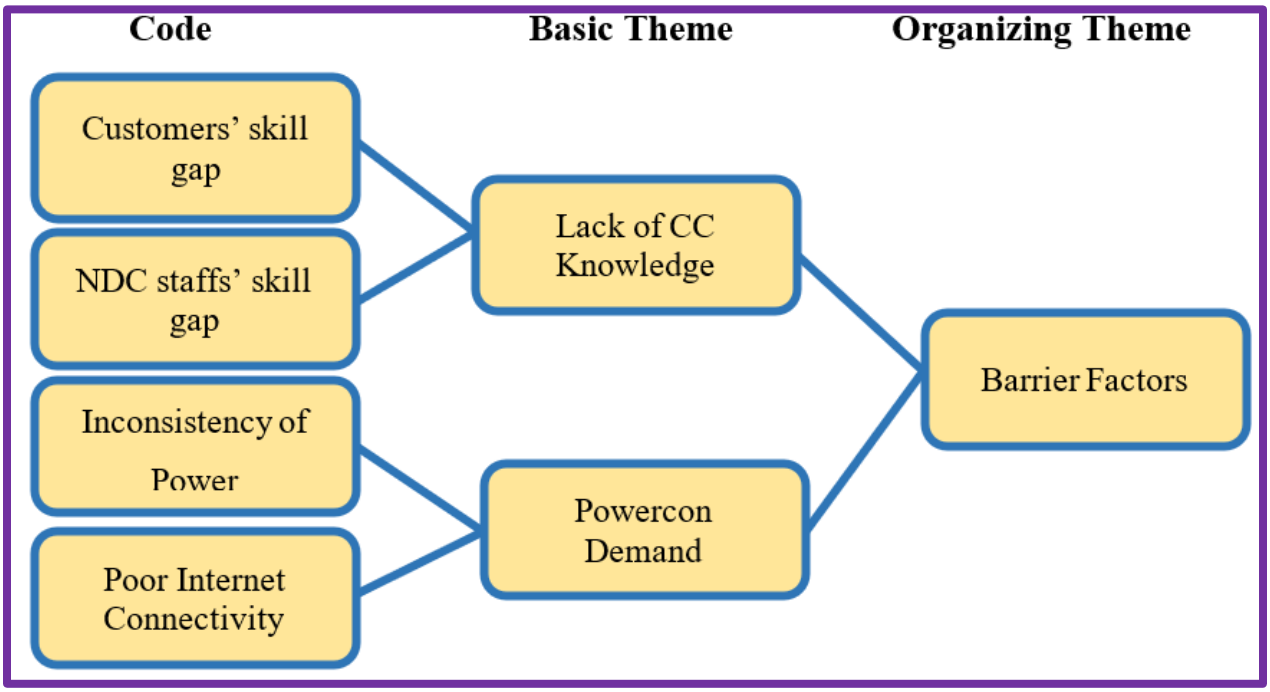

Figure 4.07 Major Barriers to Cloud Adoption

As illustrated in Figure 4.07, the primary barrier factors in the adoption and implementation of cloud computing to the NDC of Ethiopia are identified as inconsistency of power supply in the country including the capital of the country, Addis Ababa, although it is better in comparison to regional states and the Woreda level towns of the country. The other barrier factor is poor internet connectivity. The two barrier factors termed as Powercon under basic level of the diagram by truncating these two coded concepts. The *power* is derived from the inconsistency of power code and the *con* is taken from the poor internet connectivity, and then merged as Powercon demand. The term Powercon is also used in adaption of cloud adoption readiness assessment model for the NDC of Ethiopia as new construct. The term was never used in any previous studies up to the knowledge of the researchers. The other barriers revealed by all the respondents of the semi structured interview are the skill gaps to the staffs of both the MInT or the NDC and the customers of the NDC of Ethiopia. These the coded skill gaps based on the concepts of the respondents are termed as lack of CC knowledge under the basic theme that representing the two codes. Finally,

the two basic themes termed as Powercon, and lack of CC knowledge are come under the organizing theme as barrier factors of CC adoption for the case of the NDC of Ethiopia.

On the other hand, there are many perceived benefits of cloud computing as the responses of the participants that correspond with results of the previously studied related and theoretical technology adoption assessment models or frameworks. Among these benefits, reduction of CAPEX and OPEX cost to the data center, ease of scalability, and increase of production are the main benefits of cloud computing in accordance with the responses of the interviewees. These, the primary benefits of the CC, are illustrated diagrammatically in the following theme.

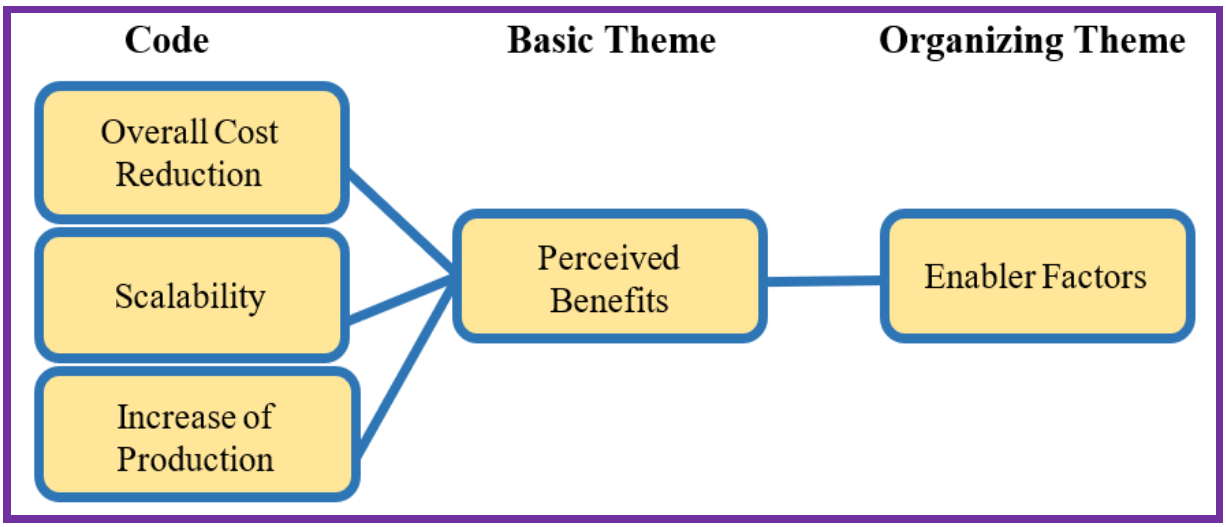

Figure 4.08 Major Benefits of Cloud Computing to Public Sectors

As indicated in Figure 4.08, the three primary benefits of cloud computing are overall cost reduction, ease of scalability and increase of production. Overall cost reduction enables government sectors to minimize costs of resources acquisition to build or upgrade or maintain their own data center, and additionally, the operational performances of the government services can be maximized due to the advanced characteristics of the cloud. Ease of Scalability is another core facility of CC to consumers of cloud services to quickly and easily increase or decrease their services based on their requirement on demand. The scalability also includes request to adopt other services when the customer is the consumer of one service. That means, if the customer is consumer of PaaS; it is possible to request for IaaS or SaaS as required. When considering the increase of productivity by implementing the cloud services to meet the growing demands of the

citizen and the government organization to government services, the CC enhances government services to be accessed anytime anywhere. As indicated in [31], with the use of cloud applications, citizens can access government services such as, taxes, pensions, medical records, transport information, and other services anywhere anytime if they have internet access. This enables public sectors to deliver effectively and efficiently, making them more productive, and leading to improve services and overall satisfaction to the citizens and any user.

The organizing themes that were discussed in the preceding section can also be condensed into the global theme based on the summary of the enabler and barrier factors to cloud adoption in combination. The following thematic diagram illustrates this by using the pattern from code to global theme, in the diagram given on next page.

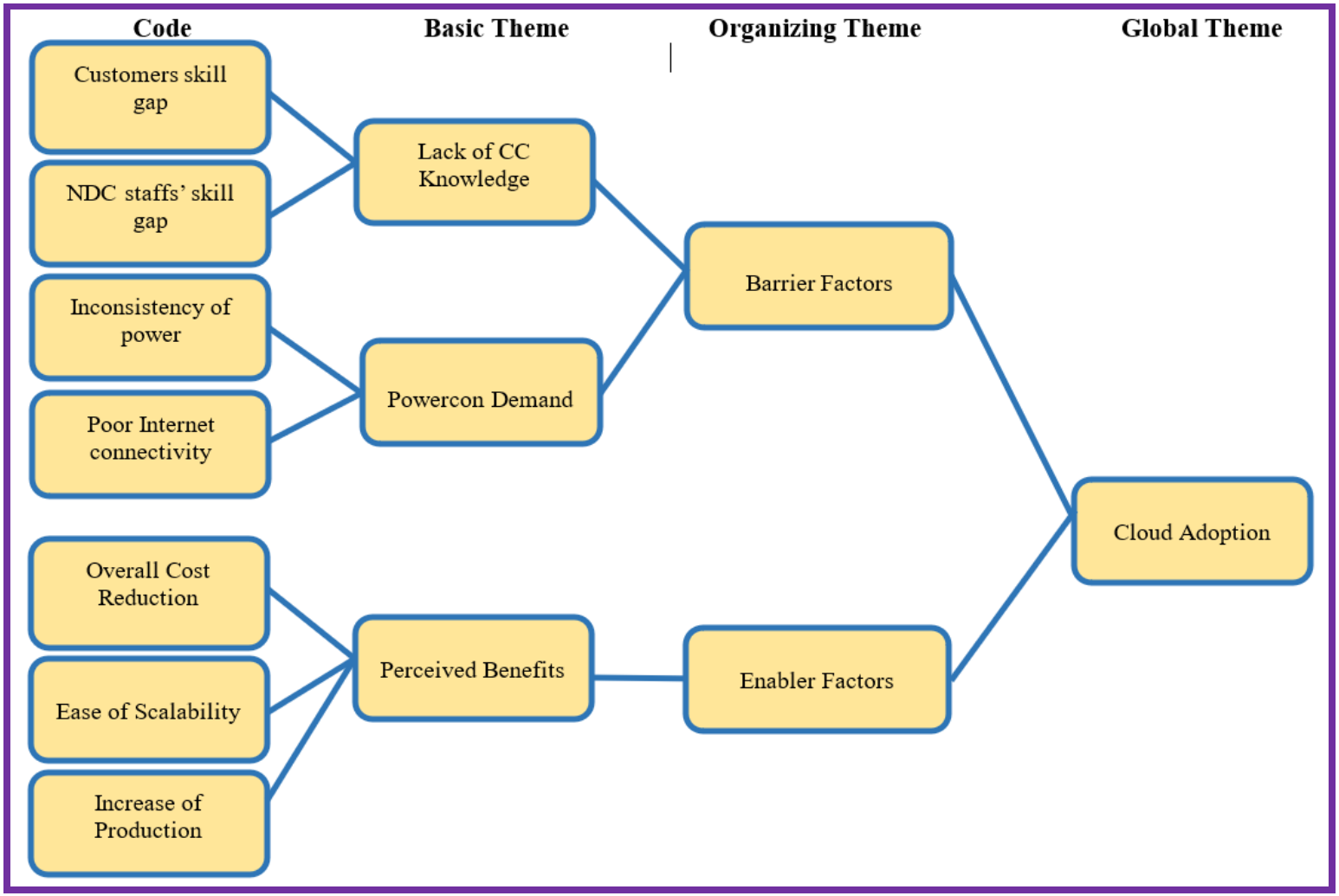

Figure 4.09 Major Factors Affecting Adoption of Cloud Computing to e-government Services of the NDCE

4.3.2. Document Analysis

As noted in [51], regardless of the kind of data being collected, a study's conclusions should be drawn about those data. If there are multiple perspectives, the analysis may mean making sense from each perspective and testing the evidence for consistency across different sources strengthen the findings more. The use of interviews and observations and even the inspection of documents and artifacts from different sources are likely based on triangulating the data, which adds credibility and trustworthiness of the study.

Document analysis is a form of qualitative research in which documents are interpreted to give voice and meaning around a title being studied. Analyzing documents incorporates coding content into themes like focus group or interview transcripts. Thus, document analysis is important research tool and is an invaluable part of most schemes of triangulation; the combination of methodologies in the study of the same phenomenon as analyzed in [52]. There are three main types of documents [53]:

- Public Records: The official, ongoing records of an organization's activities, which include student transcripts, mission statements, annual reports, policy manuals, student handbooks, strategic plans, and syllabi.
- Personal Documents: an individual's actions, experiences, and beliefs. They include calendars, e-mails, scrapbooks, blogs, Facebook posts, duty logs, reports, reflections/journals, and newspapers.
- Physical Evidence: Physical objects found within the study setting, often called artifacts. They include flyers, posters, agendas, handbooks, and training materials.

Accordingly, document analysis is among instruments applied in this study. The two major documents selected for analysis in this study are Digital-Ethiopia-2025-Strategy and United Nations E-Government Survey 2020, both are public records document type.

As presented in [54], *Lack of effective technical roadmaps including for WoredaNet, the network designed to create connectivity across public institutions and become the central tool for E-Governance projects (including Ed-Tech and E-Health initiatives), have led to slow pace of*

infrastructure creation. WoredaNet is facing congestion, decrease of speed and degradation in its services. The main challenges are the limited bandwidth capacity and the lack of tools for monitoring its use that could inform a more effective distribution plan. Currently, WoredaNet's capacity allocated to each Woreda is irrespective of demand or usage.

On the other hand, currently, as stated in the article the MInT has taken mandate and working on initiatives to improve bandwidth capacity within the national backbone roadmap. Hunting for a new approach of rolling out connections to government institutions. Engagement of private sector through public private partnership (PPP) are being considered for project finance and development. The series of bold reforms to accelerate development in the sector consists of sector liberalization, infrastructure, and service separation for ethio telecom, and WoredaNet upgrade and modernization.

When considering the power distribution of the country, electricity access to households is on equivalence with Sub-Saharan Africa but over 50% connecting informally. Electricity service in the country is currently accessible to only 44% of the population. This data indicates that Ethiopia is on par with the Sub-Saharan average (44.5%), but lower than leaders like Nigeria (54.5%) or neighboring Kenya (64%). The last available national statistics show that around 33% of Ethiopians benefit from an on-grid electricity access, while 11% access to electricity through some forms of off-grid systems, such as generators, solar home systems (SHS) and mini-grids [54].

In accordance with the article, unreliability of power is a key bottleneck in Ethiopia. Due to its high dependence on hydro resources for electricity generation, together with failures and maintenance problems on transmission and distribution networks; system losses are estimated at around 22%. Therefore, on global reliability and quality indices, Ethiopia scores 0.00, on a scale from 0.00 – 8.00, in contrast to neighboring Kenya and Rwanda, scoring 4.00 and 5.00, respectively.

As stated in the article there are initiatives to minimize the problems related to the power in the country. Conscious of the current challenges and the threats that unreliable power supply poses to development of the national economy, the government is developing a roadmap to reform the sector to address access, technical and financial performance, and private sector engagement. In

addition, the initiatives underway are PPP proclamation and reform of power generation procurement, Utility restructuring and corporatization, national electrification plan (NEP) 2.0 and network expansion. The electric power network expansion consists of Access: Investing in last mile connection upgrade, Inclusivity: Diversification of energy sources and off-grid solutions should be boosted, and Poor reliability: facilitate follow up and maintenance through measurement and monitoring systems

Secondly, when considering the United Nations E-government Survey of the year 2020, our country, Ethiopia is among the countries those have made strides in online services delivery despite low levels of infrastructure and human capital development. The rank of Ethiopia with e-government development index (EGDI) is 178 with middle e-government development index from the e-government rankings of 193 United Nations Member States and their placement and relative position: as the report of the United Nations survey of the year 2020, [55].

Annex Table 2. E-Government Development Index (EGDI)

Country	EGDI Level	Rating Class	Rank	EGDI	Online Service Index	Telecommunications Infrastructure Index	Human Capital Index
Estonia	Very High EGDI	VH	3	0.9473	0.9941	0.9212	0.9266
Eswatini	Middle EGDI	MH	128	0.4938	0.4882	0.3539	0.6392
Ethiopia	Middle EGDI	M1	178	0.274	0.3647	0.1194	0.3378
Fiji	High EGDI	H3	90	0.6585	0.5059	0.6468	0.8227

Table 4.05 E-Government Development Index of Countries of the World, [55]

Annex Table 10. E-Government Development Index EGDI of Landlocked Developing Counties(LLDCs)

Rank	Country	Sub-Region	EGDI	Online Service Index	Telecommunications Infrastructure Index	Human Capital Index
169	Afghanistan	Southern Asia	0.3203	0.4118	0.1762	0.3728
68	Armenia	Western Asia	0.7136	0.7	0.6536	0.7872
70	Azerbaijan	Western Asia	0.71	0.7059	0.6528	0.7713
103	Bhutan	Southern Asia	0.5777	0.6824	0.5367	0.5139
97	Bolivia (Plurinational State of)	South America	0.6129	0.5824	0.5184	0.7379
115	Botswana	Southern Africa	0.5383	0.3647	0.5591	0.6911
164	Burkina Faso	Western Africa	0.3558	0.4647	0.3117	0.2911
168	Burundi	Eastern Africa	0.3227	0.3529	0.126	0.4891
190	Central African Republic	Middle Africa	0.1404	0.1294	0.038	0.2539
189	Chad	Middle Africa	0.1557	0.2	0.089	0.1782
128	Eswatini	Southern Africa	0.4938	0.4882	0.3539	0.6392
178	Ethiopia	Eastern Africa	0.274	0.3647	0.1194	0.3378
29	Kazakhstan	Central Asia	0.8375	0.9235	0.7024	0.8866
83	Kyrgyzstan	Central Asia	0.6749	0.6471	0.5902	0.7873

Table 4.06 E-government Development Index of land locked Countries of The World, [55]

Based on the analysis of these two documents the following themes are organized as illustrated below.

- Poor connectivity
- Low power or electricity supply in the country
- Low level infrastructure and human capital
- Initiatives to solve both power and connectivity problem

Using thematic diagram, the summary of document analysis can be summarized as established below.

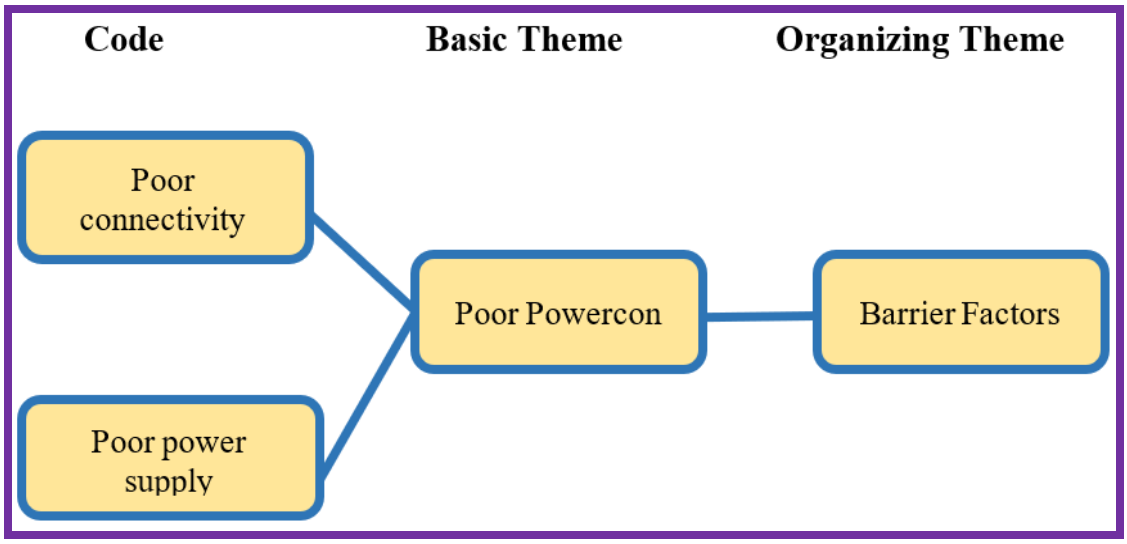

Figure 4.10 Major Barrier Factors of Cloud Computing to Public Sectors

According to this diagram, the documents used for analysis are clearly shown the poorness and the low levelness of electricity or power supply and network connectivity in the country. Particularly the problem exacerbates at the regional states and woreda levels as indicated in the document [54].

In the other hand, there are certain brightness hopes to lessen the problems that may happen in adoption of cloud computing to the NDC of Ethiopia. There are initiatives that are being undertaken to both the sector: power and network connectivity advancement. The thematic diagram that illustrates this part is presented as given underneath.

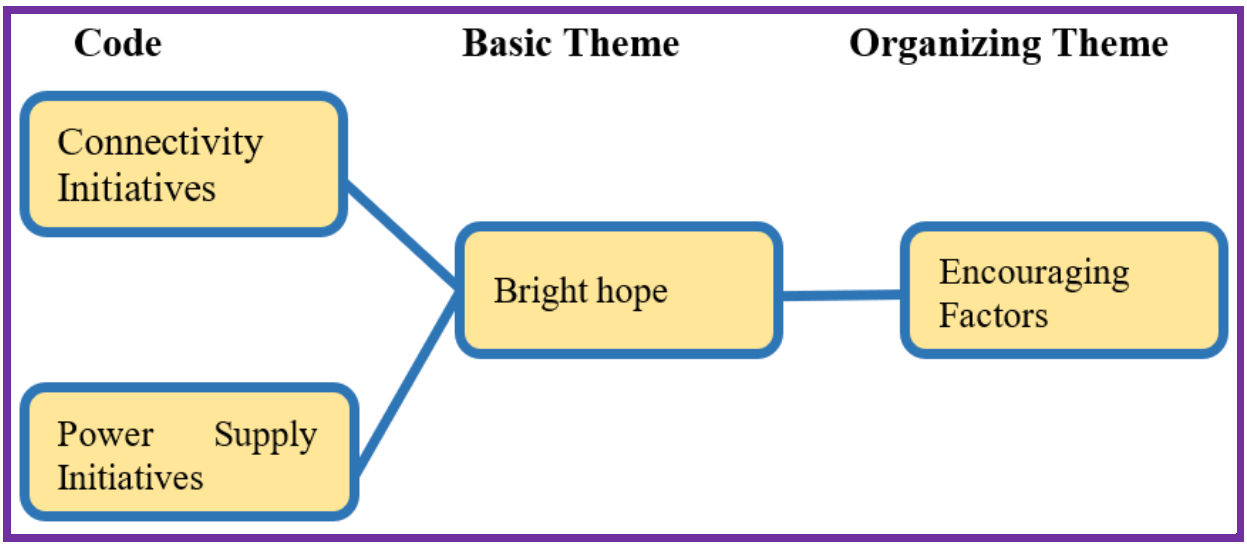

Figure 4.11 Encouraging Factors for adoption Cloud to Public Sectors

As summarized from the documents and indicated in Figure 4.11, there are promising projects initiated to both the sectors to be accomplished within short and middle term plan i.e., in 1 to 5 years period. The guide to document analysis of the study is presented in Annex III.

4.3.3. Observation Data Collection

As defined in [56] observation is watching and recording of behavior or trait or attribute as it occurs in its natural locations. There are many cases where and when interested in a behavior that happening in its natural setting. As indicated in the article the important features of observation study generalized as observation is noninterference, it involves the observation and detection invariants of the phenomenon, it is useful when little or nothing about a certain subject is known and it cannot reveal why the phenomenon occurred.

According to [57], there are two types of observation: participant observation and structured observation. In participant observation the researcher attempts to participate fully in the lives and activities of the research subjects and thus becomes a member of the subjects' group(s), organization(s) or community. In contrast, structured observation is systematic and has a high level of predetermined structure. Structured observation may form only a part of data collection approach because its function is to tell you how but not why often things happen. The observation approach applied in this study is participant observation.

The goals of observational study determine whether researchers search for a comprehensive description of behavior record or a description of only selected behaviors. How the results of a study are eventually summarized, analyzed, and reported depends on how behavioral observations are initially recorded as noticed in [58]. For this study only observation of selected behaviors has been implemented to IT Infrastructure of the datacenter repeatedly at the interval of a week for more than three months.

4.3.3.1. Observation on the Performance of the Internet

Although, there was the broadband internet connection in the NDCE the performance or the quality of the internet connectivity cannot be appreciated based on the observation undertaken repeatedly.

4.3.3.2. Observation of IT Infrastructure of the NDC

The IT infrastructure of the NDC of Ethiopia were thoroughly observed. According to the observation the power distribution unit (PDU) and the air conditioners (AC) of the modules of the data center were functioning in the acceptable conventional standards, (temperature 23^0c to 27^0c, humidity 25% to 65%), The UPS, and the batteries of the NDC and the compressors were also functioning properly.

Accordingly, the IT infrastructure of the NDC of Ethiopia are properly functioning in providing e-government services to most government sectors, and other services too, including to some industries and private sectors. The IT infrastructures are healthy operationally within the required humidity, cooling system and power distribution. The data center is equipped with UPSs and compressors, and other components. There are several unused racks or reserved racks for future use. However, the lifetime of much of the equipment is longer than three years.

Consequently, the IT infrastructure of the NDC is anticipated to serve as beginning the implementation of cloud computing services to the e-gov services of the data center. The guide to the observational method of this study is accessible in Annex IV.

4.3.4. Discussion of the Qualitative Findings

As it can be observed from the details discussed in the face-to-face semi-structured interview, document analysis and observational study of the qualitative data analysis and presentation sections of the study the perceived benefits of cloud computing adoption can be summarized as cutting of the overall cost, increasing of the productivity and the easily scalability of its services, citizens and other users comfortably assessing government services where there is internet access, efficiency and effectiveness delivery of services and the overall satisfaction. These results, the perceived benefits of adopting cloud computing, concurs with the results of the previous studies in one and other ways in [12] [13] [18] [19] [20] [21] [22] [30] [31].

There are also several barrier factors to adopt cloud computing to e-gov services of the NDCE which are emphasized on by individual interviewees. These barrier factors can be concluded as lack of practical cloud computing knowledge to users and IT staffs of public organizations, difficulty to provide awareness to managers and to convince them, poor internet connectivity,

inconsistent power supply and uneven distribution or accessibility of power across the country, budget constraints, lack of disaster recovery data center, security issues and absence of policy, standards, strategies, and guidelines. The findings about internet connectivity, security issues and the budget constraints agree with the findings of the previous works stated in [12] [31]. Lack of cloud computing knowledge and the absence of policy, standards, strategies, and guidelines agree with the results of the preceding studies of [12] [13] [30] [31].

There are some encouraging factors to adopt cloud computing technologies to e-gov services of the NDCE in accordance with responses of some interviewees of the MInT, the document analysis, and the observation of the IT infrastructure of the datacenter. These encouraging factors include there are initiatives to solve the gaps observed from the side of internet connectivity and inconsistency and distribution of power supply [54], there is also a willingness to encourage the emerging technologies from government wing as the responses of these interviewees. Additionally, there is high expectation from the interviewees that the IT sectors of the MInT and other public organizations can be easily aligned themselves with this technology, and transfer the technology to other users, too. Moreover, the IT infrastructure of the NDCE is observed as it can serve for startup of the CC adoption to the e-gov services.

4.4.SWOT Analysis

SWOT analysis is identification of various factors that are analytically used to formulate a company strategy. It is based on a logic that maximize the strengths and opportunities but can minimize the weaknesses and threats at the same time. SWOT analysis is a way to observe situations through internal factors (Strength & Weakness) and external factors (Opportunity & Threat). Strengths including resources, skills, competitive advantage, and market needs, however, Weaknesses including management capabilities, facilities of the company, financial resources, skills from the marketing, and brand image from the side of internal factors. When considering the external factors, Opportunities including changes in technology, changes in competition and regulatory situations, good relationships between buyers-suppliers, etc. whereas, Threats including slower market growth, technological changes, new revisions or regulations, and increased bargaining of key buyers-suppliers [59].

Therefore, the SWOT analysis of this study can be concluded according to the following SWOT analysis matrix quadrant. The contents of each quadrant are summarized from the analysis of both the approaches implemented to this study – quantitative and qualitative approaches.

Strength	**Weakness**
•Many competent IT professionals •Top management support •IT infrastructure for startup	•Little/no knowledge of CC for non-IT staff •Oldness of some IT infrastructure •Some software licenses outdated
Opportunities	**Threat**
•Support from government wing •Initiatives – Powercon – digital transformation project	•Budget constraint •Inconsistency of Powercon

Table 4.07 SWOT Analysis of the Study

4.5.Limitation of the Study

Though, fully involvement of the IT professional staffs from the selected seven government organizations for this research and responding of them without any reluctance during data collection; and applying mixed data collection and analysis approaches; and using of triangulation in qualitative data collection and analysis – interview, documentation, and observation – are strengths of this research; however, this study did not engage in every detail related to cloud computing paradigm: it is regarding to the investigation of the factors influencing the adoption of CC to the e-gov services of the NDCE; particularly focusing on the barrier factors to the adoption at the national level. Additionally, because of resource constraints and other constraints including the pandemic COVID – 19, only seven government organizations were involved as the sample of the population of the study at the national level. The respondents involved in the study were also

the IT professionals of the selected organizations, only. Therefore, this study requires further comprehensive investigation. The duration of data collection for the study also represents January to March 2021.

4.6.Discussion summary

As a conclusion, when comparing the results of the quantitative analysis and qualitative analysis of the study; the results of both approaches almost coincides to the results of one another. However, when the quality of the internet is examined nearly ¾ of the respondents of the MInT and the sampled other government organizations both responded agree and strongly agree, i.e., they were confirmed that as there is a quality internet access in their organization. However, the results of the triangulation (face-to-face interview, document analysis and observation) of the qualitative analysis contradicts the result of the quantitative analysis. They all indicate that the quality of internet connectivity is poor at the NDCE.

On the other hand, the major perceived benefits of adopting cloud computing to e-gov services of the NDCE summarized as overall cost reduction, ease of scalability and the increase of productivity for this study. Concurrently, the major barrier factors to adopt cloud computing to e-gov services of the NDCE according to the findings of this study summarized as lack of cloud knowledge, inconsistency of power supply and internet connectivity (Powercon inconsistency).

4.7.Chapter Summary

The data collected via mixed approaches – quantitative and qualitative methods – were analyzed quantitatively and qualitatively using SPSS and thematic technique, respectively. Additionally, the analysis of document and observation of Internet performance and the IT infrastructure of the NDC are discussed in the chapter. The findings of the study are also presented in this section. The following chapter deals with the proposed cloud adoption assessment model.

CHAPTER FIVE: Proposed Cloud Adoption Readiness Assessment Model

5.1.Introduction

This chapter presents about the adapted cloud adoption readiness assessment model that fits to e-government services of the NDC of Ethiopia. Furthermore, the chapter discusses the evaluation of the adapted model to affirm its clarity, completeness, and correctness. The model is adapted centered on the findings of the study and related literatures to provide an answer to the third research question. Firstly, the proposed model is presented, and then its evaluation is discussed.

5.2. Adapted Cloud Adoption Readiness Assessment Model

Prior to moving into an adoption of cloud computing, the readiness assessment step is a crucial phase to avoid wastage of resources and to reduce risks or failures. Research works on cloud readiness assessment model for e-government services are insufficient, particularly for developing countries. When the case of Ethiopia is considered, entirely there is not cloud readiness assessment study on e-government services of the country, including on the NDC. Concurrently, there is not any model adopted or adapted to the NDCE that can be applied in assessing its readiness to adopt cloud computing. Therefore, the proposed and adapted cloud readiness assessment model for the case of the e-government services of the NDC of Ethiopia by this research is presented below.

Although the study was grounded on the TOE, FVM and CARAF theoretical models chiefly; the model selected for adaption is the FVM. The two more significant reasons to select the FVM model for adaption are discussed here. Firstly, the FVM is the theoretical model that was proposed as suitable model for identifying factors affecting the implementation of cloud computing paradigm to the e-government services in developing countries. Secondly, many of the factors or the indicators those were included in the TOE and CARAF frameworks are to the most incorporated in the FVM model. Whereas the researchers are not confident to accept the FVM model to the e-government services of the NDC as-is based on the literature only; thus, it is believed that the model must be adapted to the context of the country, i.e., to the NDC of Ethiopia. Hybridization or modification of technology adoption models have been exhibited in previous scientific research;

including the literatures reviewed in this study as indicated in the preceding sections; typically, in Chapter Two of the research.

Therefore, the FVM model that was chosen for adaptation among the other models, has customized into the cloud adoption readiness assessment model that fits to the context of the NDC of Ethiopia based on the empirical data collected from the participants and analyzed with quantitative and qualitative data analysis techniques. Consequently, the adapted model is proposed as a solution to apply it in assessing and reassessing readiness status of the NDCE to adopt and implement CC to its e-gov services. The illustration of the adapted and proposed model is represented in figure 5.01 below.

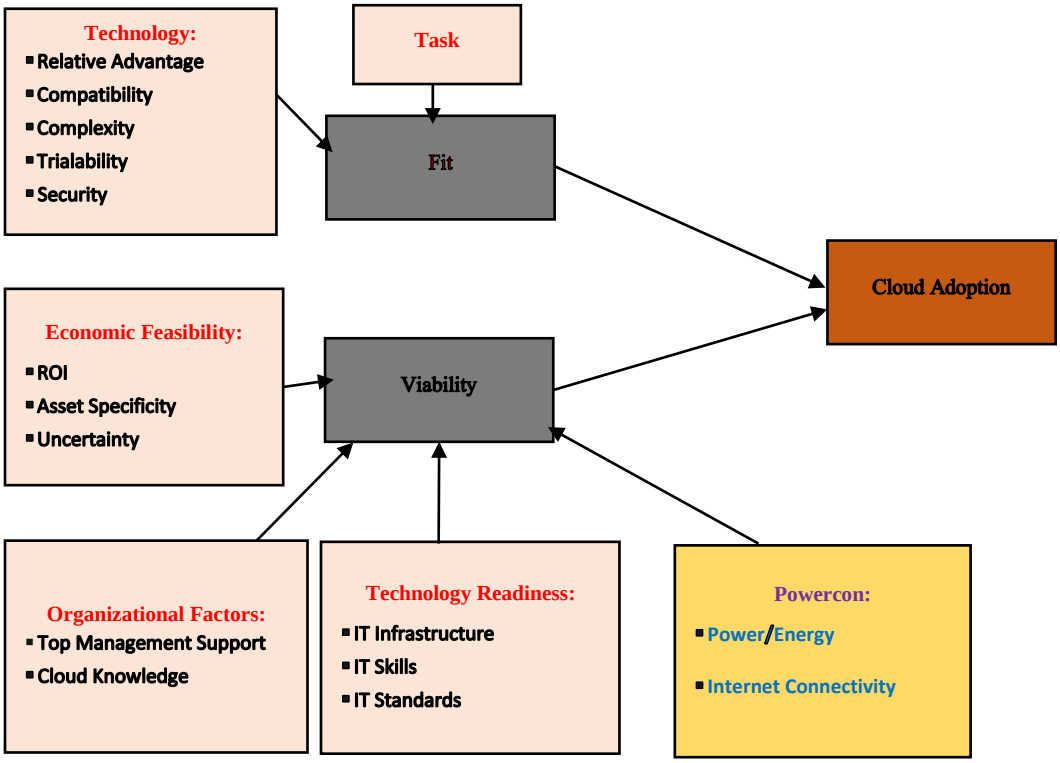

Figure 5.01 Cloud Adoption Readiness Assessment Model for The NDC of Ethiopia

Figure 5.01 represents the adapted and proposed model with its two main dimensions and related factors or indicators including their influencing factors in the adoption and implementation of cloud computing services to the e-gov services of the NDC of Ethiopia. These two dimensions of the proposed model are the fit and viability and their detail description is discussed underneath.

5.2.1. The Fit Dimension

In the CC context, fit is defined as the degree to which cloud computing is consistent with the specific requirement of e-government implementation, [30]. Consequently, fit can be measured by defining the e-government implementation tasks and the technological characteristics of cloud computing required to the NDCE. Task refers to the task requirements within the organization – the existing and the potential e-gov services of the NDCE. In other word related to this study, task refers to government-related requirements and actions that are performed to provide e-services. The study examined computing needs of public organizations to implement e-government services. As indicated in [30], creating online government services are needed to adopt CC; similarly implementing and upgrading the e-government system of the NDCE to CC should match online task requirements that would otherwise be executed offline.

Conversely, Technology characteristics consider the technological factors influencing cloud computing adoption, which include relative advantage, compatibility, complexity, trialability and security as presented in the proposed model. Relative advantage is defined as the degree to which decision-makers perceive cloud computing as being better than other computing paradigms. Compatibility, on the other hand, is defined as the extent to which the cloud computing is perceived as consistent with the existing technology, skills and needs of organizations. Related to cloud computing, complexity refers to the degree to which cloud computing is perceived as being relatively difficult to understand and use. Trialability means that the degree to which the cloud computing can be experimented with on a limited ground. Security can be defined as the ability to prevent unauthorized access or modification to information in storage, processing, or transit. Regarding cloud computing technology, data security and privacy are the major concerns for adopting it to e-gov services of the NDCE consistent to previous studies.

Except the security, the other indicators or factors related to technological characteristics of the proposed model are adopted from DOI framework.

5.2.2. The Viability Dimension

Viability refers to the extent to which the public sector organizational environment and the NDCE are ready for adopting cloud computing and the extent of the value-added potential of using cloud

computing in e-government system. This research appraises the viability of cloud computing in the public sector organization by investigating economic feasibility, organization, technological readiness and Powercon (power and connectivity of the network). Economic feasibility refers to the degree to which the economic benefits or values equivalent to the economic benefits acquired by adopting CC to e-gov services of the NDCE is greater than the economic costs to incorporate the CC to e-gov system and other related costs. It determines whether a CC technology or application is cost-effective. This includes cost reduction and acceptable ROI. Hence, it includes two different aspects: ROI and transaction cost. ROI assesses the cost vs benefit of the CC adoption project to see whether the investment can bring in adequate returns. On the other hand, if transaction cost reduces, the willingness to use a technology can increase. In the essence of this study economic feasibility refers to the extent to which the economic benefits of adopting cloud computing to the NDC of Ethiopia greater than its economic expenses. Factors influencing transaction cost may differ from one technology to another, but for cloud computing adoption, asset specificity and uncertainty have been identified as influencing factors. In this research, corresponding to the article from which this model is adapted, asset specificity can be defined as the cost of physical (hardware, software, licensing and integrating) and human (training and consulting) requirements to successfully implement cloud computing in e-government services. In relation to cloud computing, where data are stored and how they are handled increase the uncertainty. Uncertainty is examined as a negative factor of cloud computing adoption. Subsequently, the uncertainty of cloud computing in the public sector affects the transaction costs which economically influence the viability of this technology in the context of e-government implementation. On the other hand, Top management support, and cloud knowledge are considered as factors that examine the viability of cloud computing for e-government implementation to the NDCE from the perspective of organizational factors.

Technological Readiness describes the organizational resources that influence the organization decision to adopt a CC to the NDCE. Organizational resource includes IT infrastructure and IT staff. However, because there is a lack of standards when using cloud computing, governments need to promote endorsement of open standards for the cloud as presented in [30]. Therefore, the IT infrastructure, IT staff and IT standards are accepted as the influencing factors for technological readiness in adoption of CC to e-gov services of the NDC of Ethiopia.

Powercon is a short form of power and connectivity of the network. The term Powercon represents the power and internet connectivity needs or demands of the NDC to implement the CC to its current and potential e-government services. Both, the consistent need of power or energy to the NDC of Ethiopia and the requirement for quality internet connectivity are beyond the internal feasibility of the organization. Consequently, in accordance with the result of empirical study of the research, it is better to consider the feasibility of Powercon at the national level. Therefore, the researchers are considered the Powercon as additional factor or indicator to the proposed model to fit to the context of the NDC of Ethiopia; otherwise, if the required consideration is not given to the Powercon during the phase of cloud adoption readiness assessment, the adopted CC will be performing at the status of offline [30]. Additionally, as discussed in [31], most essential government services sustaining 365/24/7 for nearly 100% up time is crucial to businesses and the citizens. Whereas when considering the case of the energy or power distribution in Ethiopia, it is reached out only for 44% of the population with its system losses are estimated to 22% and its global Reliability and Quality indices scores 0.00, on a scale from 0.00 – 8.00, as indicated in the document analysis of this study. There is also high internet connectivity and power problem nationwide as observed in both quantitative and qualitive analysis of the study.

5.3.Evaluation of The Adapted Model

5.3.1. Adapted Model Evaluation Approach

A model is among an artifact that needs to be evaluated to prove its quality, utility, and efficacy. The evaluation of the artifact helps to improve the artifact in an iterative manner to ensure the quality of the proposed solution so that it can solve real world problems as proposed in [16]. As presented in the article and the previous section of this study, Chapter Three, an IT artifact can be evaluated in terms of fit with the organization, functionality, completeness, reliability, usability, and other relevant quality attributes. The evaluation of an artifact can be carried out through observational, analytical, experimental, testing, expert validation, and descriptive methods [16]. In this study, as stated in the research methodology section, expert validation and descriptive methods was used to evaluate the proposed model. Expert validation is chosen to gain diverse views of the senior IT professionals of the MInT. The evaluator experts were selected based on their CC knowledge along with their adequate IT experiences, which is anticipated as very important value

to achieve respected results of the evaluation. Moreover, majority of the experts have sufficient years of experience in the NDC of Ethiopia and the MInT. Therefore, it is believed that their experience in the NDC and the knowledge of CC can help them to evaluate the adapted and proposed model whether it fits to assess and reassess the readiness of the NDC to implement the CC technology to its existing and potential e-gov services or not.

According to [16], fit to the organization can be one of the criteria to evaluate an IT artifact. As stated in the article, evaluation and re-construction of the design artifact is required to verify the research contributions. Thus, in this study, the proposed model was evaluated twice. At the first round the evaluation was carried out using focus group discussion (FGD) team of 6 members selected from senior experts of the NDC of Ethiopia for refinement of the model. The aim of this evaluation was to discuss on a CCARAM designed to the NDC of Ethiopia in the perspective of its completeness, correctness, and clarity; and then to come up with credible improvement opportunities. Accordingly, the detailed discussion had been led with the selected senior experts of the NDC to have extra reactions. Then, depending on the feedback of the experts, the proposed model was modified to improve its completeness, clarity, and correctness.

Subsequently, the second-round evaluation of the revised proposed model was conducted by senior experts of the NDC of Ethiopia and other senior IT professionals of the MInT fortnight later to the first evaluation via a FGD to gather in-depth final feedback on the improved CCARAM regarding its completeness, clarity, and correctness.

The content of the FGD guiding questions was derived from the evaluation criteria recommended in [16] which consists of fit to the organization, comprehensiveness, reliability, clarity, correctness, and usability quality attributes. However, the format to summarize the opinions of the discussion of individual member of the team of the first FGD result has adopted from [30] and that of the team of the second FGD has adopted from the article [60].

A focus group discussion is a group interview organized discussion between 6 to 8 people. Focus group discussions provide participants with a freedom to discuss a particular topic, in a context where people can agree or disagree with each other. It allows to explore how a group thinks about an issue, in terms of their beliefs, experiences and practices. The participants of FGD should be

recruited purposefully for whom the issue is relevant [61]. However, it is reported in [62], generally 4 – 12 participants are acceptable. As presented in [60], the four reasons to explain why a focus group is an appropriate technique in evaluating artifacts include that the FGD: tolerates direct interaction with participants, brings flexibility to deal with various design ideas, acclaims rich and different data that allow researchers to obtain a group view of the design, and a good setting to acquire new ideas emerged from comments of participants. Therefore, the FGD in this study tracked the basic process or activities followed in [60]: formulation of research objective, preparation for the focus group (including question and discussion points), identify a moderator, recruiting participants, conduct the focus group, analyze the focus group data, and report findings. Consequently, these steps were implemented in this evaluation and the participants of the FGD for the evaluation of the proposed model for the study – in both sorts of evaluation - were purposefully selected according to their relevance, cautiously.

As presented in [62], regardless of the number of focus group discussion meetings, based on the topic under investigation, the number of questions and the number of participants the duration of the FGD meetings is 1 – 2 hours by the rule of thumb. The focus group discussion sessions are run until a clear pattern emerges and subsequent groups produce no new information. According to the discussion in this article, a focus group discussion, researchers adopt the role of a "facilitator" or a "moderator." In this setting, the researcher facilitates or moderates a group discussion between participants and not between the researcher and the participants.

5.3.2. Evaluation Result of The Proposed Model

As stated in the prior section, Section 5.3.1, of the study the evaluation for the proposed model was conducted twice. During the first phase, the evaluation was conducted by a team of six focus group discussion purposely selected from different teams of the NDCE based on their relevance to the topic under study so that according to their experience and good knowledge with cloud computing. Their profile was thoroughly studied to get the desired staffs for the team to organize. Then, after the kind of team required for the discussion was organized, the researcher assigned as the moderator for the team, and the discussion was conducted for 90 minutes. The desired notes were taken during the discussion by asking clarification where there was ambiguity. Additionally, the summary of each discussion questions was taken according to the following three criteria; the

model: is not representative, needs revision and is representative. The evaluation criteria for the first round were adopted from article [30]. In accordance with this discussion the evaluators of the proposed model during the first phase recommended to replace the “top management support” of the adapted model with ‘executives’ support’, and they also suggested to differentiate the colors of the components of the proposed model based on the discussion. The proposed model was colorless or not color filled when presented to the first evaluation. However, since the top management encompasses the senior executives and the board of directors as indicated in the literatures, the replacement of top management support with executives’ support is not sounding. On the other hand, the proposed model is filled color to distinguish its components. The summary of the analysis of this, the first phase focus group discussion, evaluation result is illustrated below in a table form.

Criteria and FGD participants' opinion										Remark
Criteria	Figures	The model								
		is not representative		needs revision		is representative		Not answered		
		No	%	No	%	No	%	No	%	
Completeness	Of all	0	0	0	0	6 of 6	100	0	0	
	Of replied	0	0	0	0	6 of 6	100	0	0	
Correctness	Of all	0	0	4 of 6	66.67	2 of 6	33.33	0	0	Comment to replace **top** management support with **executives'** support
	Of replied	0	0	4 of 6	66.67	2 of 6	33.33	0	0	
Clarity	Of all	0	0	4 of 6	66.67	1 of 6	16.67	1 of 6	16.67	Comment to **distinguish** the components of the model with **fill** colors
	Of replied	0	0	4 of 5	80.00	1 of 5	20.00	1 of 5	20.00	
Total	Of all	0	0	8 of 12	66.67	9 of 18	50.00			
	Of replied	0	0	8 of 11	72.73	9 of 17	52.94			

Table 5.01 Analysis of First Phase FGD Evaluation for Refinement

Similarly, as specified in the preceding part of the chapter, after the required amendment has been made to the proposed model the second phase evaluation has conducted on the model fortnight later to the first phase evaluation. The required types of participants as the member of a group discussion of the final or the second-round evaluation of the proposed model were purposely selected: six of them were the participants of the first phase evaluation whereas other four IT experts were included to the team from the MInT. According to the second phase evaluation, nearly all the participants of the discussion group have agreed upon the acceptance of the proposed model with confidence. Therefore, the conclusion of the analysis of the transcriptions taken from the focus group discussion can be presented according to tabular form indicated on the following page. Like the first phase, the final opinions of each individual participants were asked to understand their level of acceptance and rejection based on the criteria and the form adopted from the article. The range of opinion collection intervals included in the format with criteria are strongly disagree, disagree, moderate, agree, and strongly agree. The evaluators' satisfaction level collection criteria and the format, too adopted from [60], and the summary of the second evaluation discussion transcript is provided below in the form of the table.

Criteria and FGD participants' opinion											
Criteria	Figures	Strongly disagree		Disagree		Moderate		Agree		Strongly agree	
		No	%	No	%	No	%	No	%	No	%
Completeness	Of all	0	0	0	0	1 of 10	10.00	7 of 10	70.00	2 of 10	20.00
	Of answered	0	0	0	0	1 of 10	10.00	7 of 9	77.78	2 of 9	22.22
Correctness	Of all	0	0	0	0	1 of 10	10.00	6 of 10	60.00	3 of 10	30.00
	Of answered	0	0	0	0	1 of 10	10.00	6 of 9	66.67	3 of 9	33.33
Clarity	Of all	0	0	0	0	0 of 10	0.00	8 of 10	80.00	1 of 10	10.00
	Of answered	0	0	0	0	0 of 10	0.00	8 of 9	88.89	1 of 9	11.11
Total	Of all	0	0	0	0	2 of 20	10.00	21 of 30	70.00	6 of 30	20.00
	Of answered	0	0	0	0	2 of 20	10.00	21 of 27	77.78	6 of 27	22.22

Table 5.02 Second Phase Evaluation Based on The Proposed CCARAM

As it can be observed from the summary of the second FGD result in table 5.02, 90% of the participants were accepted the proposed model by responding agree and strongly agree to the model in the focus group discussion session as overall according to the final questions provided to each individual team member to get the degree of their satisfaction opinion. Thus, the evaluation result indicates that the focus group discussion team has a clear consent on accepting the clarity, completeness, and correctness of the adapted and proposed CCARAM. The guide to the FGD is available in Annex V.

The proposed model is expected to serve in assessing the readiness of the National Data Center of Ethiopia to adopt CC to its e-gov services. As it is identified in the study, the NDCE do not have any model that helps it to investigate its readiness to adopt CC. This model is the only one that is designed to support in studying the readiness of the NDCE to implement CC to e-gov services to the knowledge of the researchers. Therefore, the proposed model is answering the third research question in helping during readiness assessment to adopt CC to e-gov services.

5.4. Chapter Summary

The cloud computing adoption readiness assessment model to e-government services of the NDC of Ethiopia was adapted the FVM model based on the results of the empirical data analysis of the study. Then the adapted proposed model was evaluated twice: firstly, with the FGD team of six members that were selected senior IT professionals of the NDCE and secondly, with the FGD team of ten members purposely selected from the NDC and other IT professionals of the MInT. The results of the evaluation are also discussed in the chapter.

CHAPTER SIX: Conclusion and Recommendations

6.1. Introduction

This, the last chapter of the study, presents an overall conclusion of this research. The chapter emphases on showing how the outcomes of the study relate to the research questions and objectives set out in chapter one of the thesis. It also provides recommendations which have emerged from this study and corresponding research to be carried out to evaluate the consistency and validity of the proposed CCARAM as well as continued research that could produce a better-quality model.

6.2.Conclusion

The overall objective of this study was to adapt a model that fits and will be implemented in assessing and reassessing the readiness status of the NDCE to adopt a cloud computing to its e-government services. To attain the objective of the study, the researchers made a strong effort to answer the three research questions set out in section 1.2 of the study:

1. What is the readiness level of the NDCE to implement cloud computing to e-gov services?
2. What are the major barriers to adopt cloud computing to e-gov services of the NDCE?
3. How cloud adoption readiness model helps the NDCE for the adoption of cloud computing?

6.2.1. The Readiness Level of the NDCE to Adopt CC to E-Gov Services

To provide response to this question, primary data of factors affecting cloud computing adoption of the NDCE to its e-gov services was collected through quantitative and qualitative approaches to identify the status of the NDC to adopt cloud computing technology to its e-gov services, to both existing and potential services. The quantitative data was collected from seven government organizations through Likert scale questionnaire. Additionally, the qualitative data was collected from senior IT experts of the MInT through semi-structured interview, and from document analysis. Besides, observation of the internet performance and IT infrastructure of the NDC of

Ethiopia was conducted. Consequently, the collected data was analyzed using SPSS and thematic techniques respectively and the following are the key findings:

There is not any previous CC adoption readiness study conducted to the e-gov services of the NDC of Ethiopia and additionally there is not any model or framework and policy and standards related to the cloud computing. However, there are multiple promising initiatives, such as digital transformation projects and other internal projects, that will contribute for designing CC policy. There is also encouraging supports from the government to transform the country digitally with the adoption of innovative technologies, which includes cloud computing technology and simultaneously by building the capacity of the country. Although there is not CC policy, CCARAM and CC readiness study for the NDC, there are some appealing results observed during the study. Since most of the professionals of the NDC are qualified with IT, computers and other technology related disciplinary it is expected that they have a potential to easily cope with the technology and even then, provide the required awareness to their users within the desired period. The existing IT infrastructure of the NDC is also good enough for beginning the implementation of the cloud computing as startup. Whereas lack of CC policy, standards, guidelines, and procedures; demand for an improvement of the NDC security and cybersecurity; inadequacy of cloud knowledge for MInT and other users of the e-government services; inconsistent distribution of power and poor connectivity of the communication network are observed as the gaps to adopt and implement the CC to e-gov services. Thus, when summarizing this point the NDC is at its low level or infant stage to implement the desired sorts of CC technology. Additionally, it is revealed that the NDCE does not have any model or framework designed to it, which guides to assess and identify its readiness to adopt and implement cloud computing.

Therefore, the status or the level of the NDCE to adopt cloud computing to its e-gov services is low or at starting level.

6.2.2. Major Barriers to Adopt Cloud Computing to E-Gov Services of the NDCE

In responding to the second research question of the study there are various factors that affect the preparation of the NDC of Ethiopia to adopt and implement CC technology to its existing and potential e-gov services as enablers or barriers. Although both the factors were identified in the

context of the e-gov services of the NDC of Ethiopia, the section highly focuses on the barrier factors to the NDCE in adoption of CC to its e-gov services.

Thus, to answer the second research question of the study, the focus of this section is on barrier factors in the adoption of cloud computing for e-government services in the context of the NDC of Ethiopia. The barrier factors observed from empirical evidence includes data center security and privacy issues, budget constraints, lack of cloud knowledge for users, poor and inconsistent internet connectivity, inconsistent power or energy distribution. However, the later three are identified as the main barriers to adopt and implement cloud computing to the e-gov services of the NDC of Ethiopia.

6.2.3. Cloud Adoption Readiness Assessment Model Fits to the NDC of Ethiopia

Moreover, designing the CCARAM was the primary motive of this study. In order to attain the design objective of the study a review of literature on cloud adoption readiness assessment, particularly those focusing on e-gov services was conducted to develop a conceptual model as a basis for discussion. Furthermore, a review of the selected comprehensive cloud computing readiness assessment models or frameworks were carried out. There are several models, frameworks or theories developed, adopted, or adapted in adoption of innovative technologies including cloud computing. There are several concepts common to multiple artifacts and there is no single definition to the cloud computing and to the CCARAM. The structure of the models or the frameworks, for assessing the readiness of organization to adopt and implement to its services, are also varying. There are little models designed for assessing readiness of organizations to adopt and implement cloud computing technology to e-gov services, especially for developing countries. Hence, it was crucial to identify the existing cloud adoption models or frameworks that can be used as foundation for developing a cloud computing readiness assessment model that fits to the context of the NDC of Ethiopia. Amongst the several models or frameworks exist for adoption of innovative IS including cloud computing, the researchers have analyzed eight of them, whereas only three of them with the empirical background was deeply analyzed comparatively, and the FVM model was selected for adaption as presented in the previous part of the study, in Chapter Five – Section 5.2. However, as discussed in the chapter, since cloud adoption readiness

assessment is extremely reliant on the context and cannot be validated separately from its practical applications, adopting the model as-is is not sufficient. Thus, the ultimate purpose was to adapt CCARAM that fits to the context of the e-gov services of Ethiopia which is based on the results of the empirical study related to the perspective of the NDC of the country in addition to the results of previous works. Accordingly, as mentioned in section 5.2.1, the technological characteristics of the fit dimension of the FVM model was taken from the DOI theory except the security characteristic added on the fit dimension. The task represents the existing and the potential e-gov services of the NDCE.

When considering the second dimension of the FVM model, viability dimension, it encompasses four indicators or factors that indicates the feasibly of the NDC to adopt and implement CC to its e-gov services. The factors or indicators are economic feasibility, organizational viability, technology readiness and Powercon with their respective influencing factors or resources. The first three indicators were directly taken from the FVM model. However, the Powercon indicator of the proposed model to the NDC of Ethiopia is added to the previous version of the model based on the empirical result of the study. The Powercon factor or indicator encompasses two fundamental influencing factors: the power or energy and network connectivity requirements of the NDC to its current and potential e-gov services to be communicated between the government sectors smoothly online with required standards, for 365/24/7 with nearly 100% availability. The researchers consequently designed and proposed the CCARAM that fits to the NDCE in assessing and reassessing its readiness to adopt and implement CC to e-gov services. The adapted model includes the components listed below.

1. Cloud Adoption
2. Fit
   - 2.1. Task
   - 2.2. Technology
3. Viability
   - 3.1. Economic feasibility
   - 3.2. Organizational factors
   - 3.3. Technological readiness
   - 3.4. Powercon

Finally, the CCARAM adapted and proposed to the assessment and reassessments of the e-gov services of the NDC of Ethiopia has been evaluated by key senior IT professionals of the MInT from the perspective of its completeness, correctness, and its clarity criteria. The overall results of the evaluation of the proposed model indicates that the model is valid and acceptable. Therefore, the researchers conclude that the research objective has been met and the research questions are entirely answered.

6.3.Recommendations

In accordance with the findings of the study and the conclusions presented the following recommendations are forwarded for practical application and for future research work.

6.3.1. Recommendation for Practical Implementation

Based on the summary of discussions of this study, the national data center of Ethiopia does not have its own model or framework that can be used to perform the required assessment to identify the readiness of the NDC to implement the CC paradigm to its e-gov services. Therefore, the result of this study is believed to serve as a guidance in assessing and reassessing the status of the NDC/MInT to adopt and implement cloud computing technology to e-gov services nationwide. Thus, the adapted and proposed CCARAM is expected to support the MInT managers, IT professionals of the NDC, and the stakeholders of the National Data Center regarding to e-gov services and directly or indirectly the citizens in reducing the costs and risks that may be happened when the CC technology is implemented to e-gov services without considering readiness assessment. Consequently, for practical implementation the following lists of key points in the bulletin form are recommended.

- The NDC staff in collaboration with the top management of the MInT and critical stakeholders should establish an organized responsible team that coordinate investigation of cloud computing prior to adopting and implementing it to e-government services of the NDCE.
- The NDC must prepare the strategy that guides the overall adoption and implementation of Cloud computing to e-gov services of the NDCE and its management.
- The required awareness of cloud computing should be provided to the users and consumers in quality and quantity.

- The NDCE staff in collaboration with the MInT top management, the government wing and the stakeholders should work diligently to boost consistency of Powercon of the country.
- The NDCE is advised to apply the proposed CCARAM in assessing and reassessing its status to identify if ready to adopt and implement cloud computing to its e-gov services or can update the proposed model and then implement for the investigation of CC readiness to e-gov services.

6.3.2. Recommendations for Future Work

In consent to this study as stated under the limitation subtitle, the study does not include every detail related to cloud computing paradigm. It is regarding only to the investigation of the factors influencing the adoption and implementation of CC particularly by focusing on the factors hindering the CC adoption to e-gov services at the national level. Additionally, on account to resource constraints and other constraints including the pandemic COVID – 19, only seven government organizations from Addis Ababa were involved as the sample population of the study at the national level. This point is also among the points raised as the limitation. Furthermore, the world is changing dynamically from time to time. Especially, when it is thought in terms of technology and energy requirements, in addition to the other factors. Since our country is also parts of the globe and of its changes recommendation for future study is pertinent to the NDCE regarding to adopting cloud computing technology to existing and potential e-gov services. Therefore, to come up with more robust results, to align with the rest of the world and to enhance the utilization of digital resources via e-gov services to our country, the researchers recommend the subsequent focus areas for future studies:

- Further study with the same topic to expand or modify the CCARAM by improving the limitations mentioned in this study work.
- Studying the most important types of cloud computing service and deployment models that fit to the e-gov services of the NDCE.
- Conducting a study on creating a cloud computing policy that fits to the context of the existing and potential e-gov services of NDCE.

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Appendix I: Questionnaire Survey

Addis Ababa University
Addis Ababa Institute of Technology
School of Electrical and Computer Engineering
Telecommunication Engineering graduate programme

Dear respondents:

I kindly request you for cooperation in giving me correct and complete information to this questionnaire that represents genuine finding. Thus, the objective of this questionnaire is to collect data from seven selected government organizations, to investigate factors affecting cloud computing adoption to e-government services of the National Data Center of Ethiopia (NDCE) and then adapting a cloud adoption readiness assessment model that fits to the context of the data center based on the empirical result of the study.

All your responses will be kept strictly confidential and anonymous. Thank you for kind cooperation by dedicating your time.
Best regards,

Habtamu Bekele

Part I: Personal Data of the Respondents

1. **Your age**

   a 20-25 ☐ c 36-45 ☐ e Above 55 ☐

   b 26-35 ☐ d 46-55 ☐

2. **Sex**

   a Male ☐ b Female ☐

3. **Your work experience in your organization**

   a less than 5years ☐ c 11-15 years ☐

   b 5-10 years ☐ d greater than 15 years ☐

4. **Your level of education**

   a Diploma ☐ d Doctorate ☐

   b Bachelor's Degree ☐ e Others (specify) _____

   c Master's Degree ☐ _____

5. **Your Role in organization**

a Top IT Manager ☐
b Middle IT Manager ☐
c Developing Software or Web ☐
d Network Administration ☐
e System Administration ☐
f User Support and Help Desk ☐
g Information Security Operation and Administration ☐
h. Others (Specify) _____

PART II: Questionnaire Grounded on Technology Organization Environment (TOE) Model

1. The feedback scale to collect respondent's satisfaction opinion is arranged in the order of strongly agree, agree, uncertain, disagree and strongly disagree. Please put tick sign (√) in the space provided to your correct answer for Technology Readiness.

	Technology Construct Measure	Feedback				
		Strongly agree	**Agree**	**Do not know**	**Disagree**	**Strongly Disagree**
a	Your organization has broad internet access					
b	There is quality internet connection in your organization					
c	Hardware & Software needed for CC are readily available at your organization					
d	The Hardware and software required for the CC are readily affordable					
e	The NDCE has adequate operation and maintenance process					
f	There is adequate local support to address ICT problems related to proposed services					
g	Current IT security is strong enough to fulfill the required security demand to CC					
h	Your organization accepts cloud computing technology					
i	Your organization has technical and managerial skills to use technological innovation					
j	Top and middle level managers of your organization accept any change that requires the use of technology in routine task					

2. For Organization readiness factors affecting the NDCE to adopt CC to e-government services; please put the tick sign (√) in the appropriate space provided for your answer.

	Organization Construct measures	Feedback				
		Strongly agree	**Agree**	**Uncertain**	**Disagree**	**Strongly Disagree**
a	Your organization has service level agreement with the legal vendors					
b	Cloud computing encourages individuals and investors to participate in demand to e-government services					
c	Policies and strategies are in place to promote and manage use of CC in your organization for e-government services					
d	Your organization's vision of planning in adoption of cloud computing is widely communicated throughout the directorates					
e	Your organization has high bandwidth connectivity to speed up downloading and attaching files					
f	There is support to ICT services with innovative ones in your organization					
g	Your organization involves staff and other stakeholders in planning for new e-gov services					
h	Integrating CC in e-gov services have a great role in digital transformation					
i	Awareness of CC exist for top managers and professional staffs of the organization					
j	The quality of ICT training and education is adequate in your organization					
k	Implementing CC solves the existing problems regarding the NDCE					

3. For environment readiness factors affecting the NDCE to adopt Cloud Computing to its e-gov services; please put the tick sign (√) in the appropriate space provided for your correct answer.

Environment construct measures		Feedback				
		Strongly agree	**Agree**	**Uncertain**	**Disagree**	**Strongly Disagree**
a	Your organization communicates electronically with its stakeholders					
b	The IT infrastructure of the NDCE can support CC					
c	The infrastructure of the NDCE is reliable and efficient					
d	Your organization covers international trainings' expenses					
e	Educational institutions can contribute to the quality of ICT for the e-gov services					
f	Inconsistency of electric power supply affects the use and adoption of CC in your organization					
g	The existing internet connectivity is good enough to implement cloud computing services					
h	The inconsistency of electric power and telecommunication network hinders outreaching regional states and their Woredas with CC services					

PART III: Questionnaire Based on Fit-Viable Model (FVM)

1. To investigate the extent to which the task - technology fit impacts the adoption of Cloud Computing to e-government services of the NDCE; please put the tick sign (√) in the appropriate space provided on the scale ranging strongly agree through Strongly Disagree.

	Questions	Feedback				
		Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
a	Automation of tasks is possible through cloud computing technology					
b	Cloud computing provides remote implementation of tasks					
c	Cloud computing supports multi-tasking					
d	Cloud computing provides sharing of resources to perform tasks					
e	Virtualization is necessary for cloud computing technology					
f	Cloud technology enables provision of scalable resources on demand					
g	Interacting with CC services is not clear and is difficult to understand					
h	It seems that CC fits well with NDC's needs to boost e-government services					
i	Service-oriented architecture is necessary for cloud computing					
j	Customers use CC to better perform with no need of or with little training					
k	CC is compatible with the systems that are already in use by the NDCE					
l	CC can be tested properly before deciding to use any of its services					
m	CC provides sufficient security controls to e-gov services					
n	CC providers protect the privacy and confidentiality of e-gov data					
o	CC technology is more secure than the existing security of the NDCE					

2. To examine the extent to which the viability impacts adoption of Cloud Computing to its e-government services; please put the tick sign (√) in the appropriate space provided for your answer.

	Questions	Feedback				
		Strongly agree	**Agree**	**Uncertain**	**Disagree**	**Strongly Disagree**
a	The adoption of CC requires the hiring of employees with special expertise					
b	Providing e-services over the CC will lower costs					
c	Your organization has adequate budget for adopting and maintaining CC					
d	The CC environment and its process are subject to frequent changes					
e	Your organization has a robust network management system					
f	The NDCE has integrated databases or a data warehouse					
g	Your organization has established policies on data management and security					
h	The cloud project leader must have prior experience in cloud implementation					
i	The use of cloud technology reduces the need for physical asset on hand					
j	The customers must have adequate IT and cloud technology knowledge					
k	Support of top management is essential to invest in CC services					
l	The adoption of cloud computing to NDCE needs special hardware/software					

Appendix II: An Interview Guide for Cloud Adoption Research

The objective of this interview is to investigate deeply factors affecting adoption of cloud computing to e-government services of the NDC of Ethiopia and then based on the empirical results of the study designing cloud adoption readiness assessment model that fit to it. Therefore, I kindly request you for cooperation in giving me correct and complete information to acquire a representative finding. All your responses will be kept strictly confidential and anonymous, and only used for academic purpose.

Thank you in advance for kind cooperation by dedicating your time.

1. What is your understanding on cloud computing?
2. Does the government or MInT have a plan to adopt or build a cloud computing?
3. What is attitude of MInT/NDCE towards cloud-computing adoption in e-government services?
4. Would the current ICT development status have an impact on cloud-computing adoption?
5. What would be your concerns, regarding security issues when migrating e-Government services onto the cloud?
6. Do you trust cloud services, or are you confident in moving government services onto the cloud?
7. In the light of compatibility and interoperability, what would be your areas of concern?
8. What would be your areas of concern when choosing a cloud-service provider?
9. What would be your main concerns when signing a Service-Level Agreement?
10. Would you expect CC be cost-effective? If yes, what if when engaging in the service for a long period of time?
11. What kind of skills or competencies are you expecting from user employees in the cloud-computing environment?
12. How does the current regulation situation impact on cloud-computing adoption and development?
13. Do you expect a reduction of energy consumption when applying CC to e-gov services to the NDCE? Why?

14. What are your ideas regarding CC contributions to “green computing”?
15. In your opinion what are the barrier factors to adopt cloud computing to the NDC?
16. Is the network connectivity of Ethiopia good enough to implement cloud computing to the e-government services?
17. Does the existing power distribution and capacity of the country adequate to adopt CC to the e-gov services? And what is the extent of its impacts on the adoption of cloud, specially, at regional state and Woreda levels?
18. Does your organization have a CC strategy and policy in place? And is there cloud computing regulatory body in Ethiopia?
19. Do you think implementing CC is enough to achieve the mission and vision of the NDCE, and in transforming the ministry as well as the country digitally?
20. Do you think all the user groups among staff and other stakeholders of your organization have been/will be involved in planning for the new cloud computing implementation to e-government services? In what way do they involve?
21. Will your organization involve all the stakeholders in the cloud governance activities?
22. Is there a plan to give training to adopt cloud computing? Is it before or after implementation? To whom it should be provided: to internal workers or external employees of stakeholders or to both?
23. What is the technical advantage of implementing cloud computing?
24. What is the technical disadvantage of adopting cloud computing to the MInT as well as the country in the perspective of IT human resource empowering or in increasing dependency?
25. Is the current infrastructure capable and secure to implement cloud computing?
26. As MInT staff do you think the ministry and the country will benefit from adopting CC to e-gov services of the NDCE?
27. Does e-government goals and cloud computing implementation objectives are aligning?
28. Would you think the service provider’s Terms of Service allow the NDCE to directly audit the implementation and management of the security measures that are in place to protect the service and the data held within it?

Appendix III: Document Analysis checklist adapted from [6]

Document analysis for A CARAM for the Case of the NDCE/MA		
List of question	Description	Remark
Title of the document	Digital Ethiopia 2025 – A Strategy for Ethiopia Inclusive Prosperity, E-Government Survey 2020 Digital Government in the Decade of Action for Sustainable Development	
Content of the document	Strategic plan; annual report	
The aim of the document	Transforming Ethiopia digitally; Reporting annual e-government status of countries of the world	
The audience of the document	Citizens of Ethiopia & other stakeholders; Nations of the world.	
Document preparation year	2020; 2020	
The main topics of the document	The status of Ethiopia digitally including connectivity and power problems & some initiatives to reduce the existing gaps; the e-government status of the countries of the world comparison	
Who prepared the document	FDRE; United Nations	
Relevance of the document	Both the documents are directly or indirectly related to the topic understudy	

Appendix IV: Observation checklist adapted from [6]

Key points to consider when using observation as a method

- Is it compatible with this research aims, questions and paradigmatic approach?
- How will it add value to the research in addition to or in place of other methods?
- Are there any ethical, access or other issues that might make observations difficult?
- How will you collect observational data? Using Structured template, unstructured, or semi-structured?
- How will you organize your field notes, personal notes etc.?
- Do other data collection methods be used? If so, how will they add value? If you are seeking to triangulate, how will this be compatible with epistemology?
- Observing how the systems operating in their natural setting

A few questions considered during conducting observation to this study

- How does the air conditionings of the modules of the NDCE operate?
- How does the power distribution units of the modules of the NDCE operate?
- How does the UPS and the battery room of the NDCE operate?

Appendix V: Focus Group Discussion Guiding Checklist adapted [6] [16]

Steps used in Planning and conducting Focus Group discussion

1) Select the Team: the FGD team of ten members comprised of a:
    a. Facilitator to guide the discussion,
    b. Note taker will make hand-written notes and observations during the discussion
2) Plan to select the participants of the Focus groups: The participants or the members of the FGD team were selected from five directorates of the IT sector of the MInT based on their experience, knowledge, and complexity of different expertise to evaluate the proposed CARAM to e-gov services of the NDCE; the evaluators were anonymous relying on the consent.
3) Plan schedule and decide on location of focus group discussion: the focus group discussion was scheduled for one hour and undertaken at the MInT.
4) Plan to invite the participants: the participants were invited two weeks before the date of the discussion.
5) Plan to prepare the focus group guide: The discussion guide (outline) prepared to the respondents in advance based on the third research question of the study.

Facilitator's Welcome, Introduction, and Instructions to Participants

Welcome: the facilitator welcomed and thanked the members for agreeing to take part in the FGD.

Introduction: This focus group discussion is designed to assess your current thoughts and feelings about the cloud adoption readiness assessment model proposed to e-government services of the National Data Center of Ethiopia.

Anonymity: the discussion will be confidential. The notes of the focus group will contain no information that will allow individual subjects to be linked to specific statements.

Ground Rules

- The cellphones of the discussion group remain silent until the completion of the discussion
- The most important rule is that only one person speaks at a time
- There are no right or wrong answers

- You do not have to speak in any specific order
- The views of each of you obtained as important
- You do not have to agree with the views of other people in the group
- Asking if anyone of the participants have a question, and providing answers, if any.

Warm Up

- First, I would like everyone to introduce himself or herself. Can you tell us your name?

Introductory Question

The objective The FGD guiding questions was distributed to each participant along with the proposed model. Then, ten minutes were given to read and think about the proposed model to e-gov services of the NDCE.

Guiding Questions

  - How do you feel about the proposed model to e-gov services of the NDCE?
  - What do you think are the strengths and weaknesses of the model? What do you like? What do you think could be improved or should remain the same?
- **General**
  - Would you think the proposed model is comprehensive in terms of coverage?
  - How do you feel on the organization & denoting of the proposed model suitability?
  - How are the comprehensibility of the two dimensions of the model?
  - Is the objective of the model comprehensible?
- **Regarding the content of the model**
  - Is the content of the proposed model clear?
  - Is the content of the proposed model, correct?
  - Is the content of the proposed model complete?
- **Regarding the model utility and applicability**
  - Is the proposed model applicable?
  - Would you do think the proposed model fits to the NDCE?
  - How can the applicability of the proposed model improve CC readiness assessment success of the NDC of Ethiopia?

- **Summarizing the discussion**
    - What is the extent of your satisfaction on completeness, correctness, and clarity of the proposed model from the perspective of it is: not representative, needs revision and is representative?
    - What is the extent of your satisfaction on completeness, correctness, and clarity of the refined proposed model from the perspective of strongly disagree, disagree, moderate, agree and strongly agree?

Concluding question

- Of all the points discussed today; how would you express about the most important issue?

Conclusion

- The moderator:
    - Expressed thanks to the participants, and the successfulness of the discussion
    - Conveyed as the opinions of the participants are asset to the study
    - Reminded to the participants that any comments featuring in the report will be anonymous
    - politely Informed the participants to hand in a guideline distributed to them before leaving the session and all the guidelines returned, accordingly.