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Adama Science & Technology University

SCHOOL OF ELECTRICAL ENGINEERING & COMPUTING

DEPARTMENT OF COMPUTING

A Master's Thesis

An Adoption of Cloud Computing Based Architecture for Agriculture Market Information (CCBAAMI) in case of Ethiopia

BY:

TIZAZU BAYIH

June 24, 2017

Adama, Ethiopia

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE DEGREE OF MASTER OF SCIENCE IN SOFTWARE ENGINEERING

BY:

TIZAZU BAYIH

24 June 2017

DECLARATION

This thesis is my original work, and it has not been presented for a degree in any other university. All sources of materials used for the thesis have been acknowledged.

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Tizazu Bayih

This thesis has been submitted for examination with my approval as university advisor

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Dr. Mesfin Abebe

24 June 2017

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Name and Signature of Members of the Examination Board

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_____ Chairperson's name	_____ Signature

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ABSTRACT

Now a days cloud computing has becomes an adaptable technology in many organization and used in various fields like Educational institutions, Business, Health care center, Weather forecasting systems, Communications etc. But not used vastly in Agriculture sector which is main livelihood for majority of people in rural areas and which also drives economy in developing countries like Ethiopia. Most of the people living in rural areas were depends on agriculture but they does not have facilities or cost may be very high to technology to Agriculture sector to yield good results. The main aim of this research is to design a cloud based architecture to able to share and access agricultural market information for the users which wants to access the information's anywhere, using internet enabled devices.

This study proposes Hybrid cloud platform architecture for sharing and accessing agricultural market information remotely using the independent devices. The study was try to address the limitations of current IT utilization for agriculture and whether Agricultural Groups understand the concept of Cloud computing, its architecture, what it can offer and associated risks challenges agricultural groups might face when migrating their applications to the Cloud. For the designed architecture a prototype system was implemented using Microsoft window azure platform. The prototype is very interactive and user friendly which have resource sharing and accessing portal. The thesis analyze specific cloud platform service and deployment model which agricultural groups can adopt to ensure that migration and integration from traditional on premise systems to the Cloud is seamless.

Keywords: *Cloud computing, Cloud based architecture, Software architecture**,** Agricultural Market information.*

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List of Abbreviations and Acronyms

AWS	……	Amazon Web Service
CCBAAMI	……	Cloud Computing Based Architecture for Agricultural Market Information.
CDN	……	Content Delivery Network
CSC	……	Community Service Centers
CSP	……	Cloud Service Provider
CSS	……	Cascading Style Sheet
DC	……	Data Center
EAI	……	Ethiopian Agricultural Institutions
ECX	……	Ethiopian Commodity Exchange
EIAR	……	Ethiopian Institute of Agricultural Research
GSM	……	Global System for Mobile
GSM	……	Global System for Mobile
GUI	……	Graphical user interface
HTML	……	Hypertext Markup Language
HTTP	……	Hypertext Transfer Protocol
IaaS	……	Infrastructure as a Service
ICT	……	Information Communication Technology
IIS	……	Internet information service
IT	……	Information Technology
MASC	……	Multi-Agent System Cloud
MCIT	……	Ministry of Communication and Information Technology
MoA	……	Ministry of agriculture
MVC	……	Model View Controller
NIST	……	National Institute of standards and Technology

OSS	••••••••••••••	Operational support services
PaaS	••••••••••••••	Platform as a Service
PDA	••••••••••••••	Personal Digital Assistance
RDP	••••••••••••••	Remote Desktop Protocol
RUP	••••••••••••••	Rational Unified Process
SaaS	••••••••••••••	Software as a service
SLA	••••••••••••••	Service Level Agreement
SOA	••••••••••••••	Service Oriented Architecture
SPSS	••••••••••••••	Statical Package for Social Science
SQL	••••••••••••••	Structural Query Language
SSH	••••••••••••••	Secure Shell
TCP/IP	••••••••••••••	Transmission Control Protocol/Internet Protocol
UP	••••••••••••••	Unified Process
VM	••••••••••••••	Virtual Machine
VPC	••••••••••••••	Virtual Private Cloud
VPN	••••••••••••••	Virtual Private Network
WiFi	••••••••••••••	Wireless Fidelity

CHAPTER ONE: INTRODUCTION

1.1. Background of the Study

Now a days Information Communication Technology (ICT) provides powerful tools for spreading valuable agricultural information and thus boost productivity and incomes. Cloud computing is a tool to make information technology (IT) related services available in a simplified manner hiding the complexities of those services. The users do not really need to know who is providing those services and the charm of cloud computing. The services may be availed whenever and wherever needed. It also reduces the cost of availing those services drastically [1] [2].

Agriculture-Cloud [3] is one special type of Cloud, such cloud composed of different services which are based on adapting agricultural-Cloud Architecture. The services are:

- Analyzing of information by the cloud and giving information for agricultural groups.
- Data processing services like data sharing, data computing, data conversion, reporting and security etc.
- Data storage services in the database.
- Abstracted, pooled resources.
- Elasticity (the ability to scale up easily)
- On-demand, self-service provisioning.

Cloud computing has a characteristics of shared/pooled resources, elasticity, scalability etc. It can support different devices types like mobiles, web browsers, Tablets, or any cheaper devices it can be used by consumers of any category from farmers to agriculture experts etc. Cloud computing data centers allows you to store vast historical data securely on which many complex calculations can be done which is required for agricultural scientists for new inventions [3] [4].

Cloud computing concerned with the concept of implementing such an ICT tool which will maintain a huge but well customized, updated and secured database with instantaneous connectivity but with reasonable investment cost. This new application domain of ICT is Cloud Computing. It allows users to make use of services such as real-time computation, data access, and storage to end-users without the need to know the physical location and configuration of the system that delivers the services [5].

This research paper is concerned with the concept of implementing such an ICT tool which will maintain a huge but well customized, updated and secured database with instantaneous connectivity but with reasonable investment cost and why cloud computing technologies cannot be applicable in agricultural organization for the future, and if it needs to apply what are the infrastructure, architecture and other ICT utilization services to be needed and adopt cloud computing Architecture for agricultural service specially for market information as part of Agricultural-cloud Architecture. This new application domain of ICT is Cloud Computing. It allows users to make use of services such as real-time computation, data access, and storage to end-users without the need to know the physical location and configuration of the system that delivers the services. Hence, if we need to improve the economic condition of developing nations then the only way to do that is to improve the agricultural sectors of them. One possible way by which this can be achieved is the successful implementation of the new ICT tool, Cloud Computing. This paper suggests implementation of common cloud computing architecture in Agricultural sector.

1.2. Statement of the Problem

The Cloud Computing Architecture of a cloud solution for the structure of the system, which comprise on premise and cloud resources, services, middleware, and software components, geo-location, the externally visible properties of those, and the relationships between them. The term also refers to documentation of a system's cloud computing architecture. Documenting facilitates communication between stakeholders, documents early decisions about high-level design, and allows reuse of design components and patterns between projects. Agriculture plays vital role in economic point of view [6].

Agricultural organization have different services including weather forecasting, government services, soil conservation farming, and market information and other services. This research is only focuses on agricultural market information for farmers, researchers, merchants and other peoples who are wants to using the cloud technology and show the information related to agricultural products.

Hence the main problem is there is unbalance market information for farmer, the information that deliver on farmers and stakeholders are not balanced, Lack of scalability/ independent devices that access information anywhere and anytime. Because the agricultural organizations restrict dissemination of their product to deliver the resources for customers using devices. Even

electronically available, agricultural market information resources are not readily and widely available to many users because existing virtual or physical libraries are not comprehensive. Lack of order in the market and its actors, Practioneries limited awareness on cloud computing and market information, Lack of trusting vendor's service with files including personal information, Lack of information accessibility by electronic devices means the end-users such as farmers, experts, consultants, researchers cannot be accessed easily any time from any location through the devices that are connected to the cloud system via laptops, smartphones and tablets and Lack of fresh software which is customers/ farmers run the business with latest version the application. So to handle the above problems researcher proposed adopt cloud based architecture for agricultural market information in agricultural institutions which makes them to share and access the resources which would be cost effective, accessible and deliverable by migrating and integrating the traditional common agricultural market information and to disseminate project and research works.

1.2.1. Research Questions

This research intends to answer the following questions:

1. What are the benefits of cloud computing in enhancing the quality of agricultural market?
2. What are the challenges to develop an agriculture market information system for farmers in Ethiopia?
3. What are the limitations and key challenges of cloud computing integration to agricultural systems?
4. How a highly available and accessible cloud based application design for agricultural resource?
5. How could cloud computing offer support for proper utilization and access agricultural resources?

1.3. Objectives of the Research

1.3.1. General Objective

The main objective of this research is to design a cloud based architecture for Ethiopian agricultural institution to enable them to collaborate and to access market information resources in any independent devices.

1.3.2. Specific Objectives

The specific objectives of this thesis is to:

- To access market information products relevant to agricultural sectors.
- To explore the potential benefits of Cloud Computing in rural Agricultures.
- To identify the determinant factors influencing the adoption of Cloud computing by Agricultures.
- To identify the main concerns and challenges that Agriculture are likely to face when considering migrating applications to the Cloud.
- To formulate the Cloud computing architectures for adoption of Cloud technology.
- To design the proposed cloud based architecture.
- To develop and test the prototype system for the validation of the proposed architecture

1.4. Scope and Limitation of the Study

1.4.1. Scope of the Study

The main intent of the study is to design cloud computing architecture for market information services delivery to support Ethiopian agricultural sector by adapting available technologies to the Ethiopia context. For the designed architecture, a web based prototype system have been developed which were tested on hybrid cloud platform. However in the developed prototype system, we can share and access the selected information relevant to agriculture products.

1.4.2. Limitation of the Study

The limitations of this study were the difficulty to get timely responses to the interviews and questionnaires. The awareness of practitioners about cloud computing skill in the institutions was also the limitation of the study and the programming tool the researcher used. This because cloud computing uses different programming language from there the researchers choose Asp.net c# MVC architecture and it is not integrating easily with other cloud computing platforms.

In addition to limitations of awareness and programming language the researcher works it deployment on the local machine due to the connection and other infrastructure limitations. To deploy and integrating the implementations on the real cloud computing services like window azure, app engine etc, is the other challenges.

Moreover, implementation of the prototype system on public cloud, evaluating the performance and efficiency of the architecture online by creating virtual machines also the limitation of the study.

1.5. Significance of Study

This study is significant because it adds both theoretical and practical knowledge to the available literature of cloud computing in agricultural sector for market information. The motivation of the research follows the current developments in the computing industry. Organizations are now moving from capital costs to operational costs. This is because no organization wants to constantly keep replacing or upgrading equipment and also sending their IT personnel for training because of technology advancements. This is not only time consuming but also costly to the organization because organizations are no longer able to focus primarily on their core objectives.

The direct beneficiaries and indirect benefits of the result is listed below

Benefits for Agricultural Institutions

- The Agricultural institution has the opportunity to collaborate and share agricultural resource over time ubiquitously.
- It will used as initiatives to develop and implement Agricultural based application and to provide supportive supervision to the ICT staff throughout the organizations.
- It makes the resource cost effective, interactive and deliverable for the agricultural institutions and it leads to sustainable ability to solve problems, to implement changes and to build effective action to reduce inaccessibility of agricultural resources.
- It can be used for Local and global communication
- It can be easily deliver the agricultural product information for farmers and other client which needs to access and use
- Data Readiness any time and any where

Benefits for Agricultural Employees

- This paper gives great benefits for the employees of agriculture who are living remote area which is not getting the accessing of information.
- The employees have getting the updated information on timely.
- Data availability at any time and at any location without delay
- Improve market price of Food, seeds, other product

Benefits for farmers

- Even though most of Ethiopian farmers are not educated, there is number of educated farmers which are not the accessing of this information, so educated farmers that lives in remote areas will be beneficiary in this cloud technology.
- Farmers facilitate their activity without any intrastate.
- They can act like Rural-Urban movement.

Benefits Agricultural Research Industry and other community

- The study will be excited to know that Agricultural architectures are now moving towards having leaner IT teams and investing in services that will only be paid for on demand.
- This means that Agricultural Architectures will concentrate on their core business of research and there will be no capital costs of investing in technology.
- It will be easier to account for donor funds by accurately accounting for operational costs per project and
- Contribute to the existing body of knowledge in Cloud computing.
- The completed study can also be referenced by other scholars who want to carry out further study in the subject area.

1.6. Organization of the Thesis

This section describes the organization of the rest of the thesis. Chapter two discusses related works on cloud computing in general and cloud computing for agriculture in specific.

What the trends in cloud computing tell us, Service and deployment types Cloud Computing, How is cloud computing used in agriculture, Who are currently using cloud computing in agricultural sectors, What does cloud computing, is there any research work related with it, What are the best design considerations in architectural designing of cloud computing for agricultural sectors and related concepts is discussed in chapter two.

In chapter three all concepts related with cloud computing design and methodology consideration is covered. The research sampling design, research design, and the data collection techniques used to gather information and number of population size that responds the suggestions and ideas based on questionnaires.

Chapter four presents the general analysis and discussion of data and interpretations. This chapter contains all the interpretations of data graphically in detail. The next chapter presents about cloud service provider selection and comparisons of cloud service providers based on parameters to select and build the proposed architecture for the purpose of adopt agricultural market information

Chapter six presents the overall architectural development prototype of the system and the testing phase of the thesis what it looks like and the integration of the conceptual framework with its implementation evaluation and validation testing.

Finally in chapter seven discussions, conclusions about the research and recommendations for future research direction is presented.

CHAPTER TWO: CONCEPTUAL DISCUSSION AND LITERATURE REVIEW

2.1. Introduction

This section definitions stated on the term cloud computing and explains the different characteristics, deployments and services models. Furthermore it presents a review of literature on awareness of cloud computing, extent of adoption of cloud computing, drivers to cloud computing adoption as well as the barriers affecting adoption at the same time introduce the theoretical framework of this research.

2.2. Cloud Computing

The history of Cloud Computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [7].

A Cloud is a type of parallel and distributed system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements established through negotiation between the service provider and consumers [8].

Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services. The services themselves have long been referred to as Software as a Service (SaaS). The datacenter hardware and software is what we will call a Cloud. When a Cloud is made available in a pay-as-you-go manner to the general public, we call it a Public Cloud; the service being sold is Utility Computing. We use the term Private Cloud to refer to internal datacenters of a business or other organization, not made available to the general public. Thus, Cloud Computing is the sum of SaaS and Utility Computing, but does not include Private Clouds. People can be users or providers of SaaS, or users or providers of Utility Computing [9] [10].

The advancements in information technology require a new computing methodology that supports delivery of smart computing services on minimal charges without installing them at local sites. Cloud computing offers a part of that methodology, in which services are delivered over the internet in an on-demand elastic way for which the charges are paid at release time of resources.

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., Networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This Cloud model promotes availability and is composed of five essential characteristics, three service models, and four deployment models [11] [8] [7].

2.3. Cloud Computing Features and Characteristics

There are many definitions on the term cloud computing, but to understand the definition from IASA and what it really describes we should go through the subject of cloud computing and how it works. Also what different services that can be used within the area of cloud computing.

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models [12] [13].

Cloud computing is the delivery of a service rather than a product. The service is an application, storage space, social networks or server hire. The service is totally managed in the cloud, usually the internet, intranet or extranet and accessible through computers as well as devices (smartphones, tablets, laptops) [14]. The services are provided through data centers all over the world, all that is required is of course an internet connection. The resources obtained from the cloud can be used and released with small means of management and involvement by the provider. In some cases it is possible to start using service just moments after ordering it [15, 2].

The cloud computing model made by the National Institute of Standards and Technology (NIST) has a good well accepted model of cloud computing used by many when describing cloud computing (see Figure 2-1). It describes the characteristics, deployment models and the service models. The model defines the different parts of the concept cloud computing well and will be covered below [16] [9].

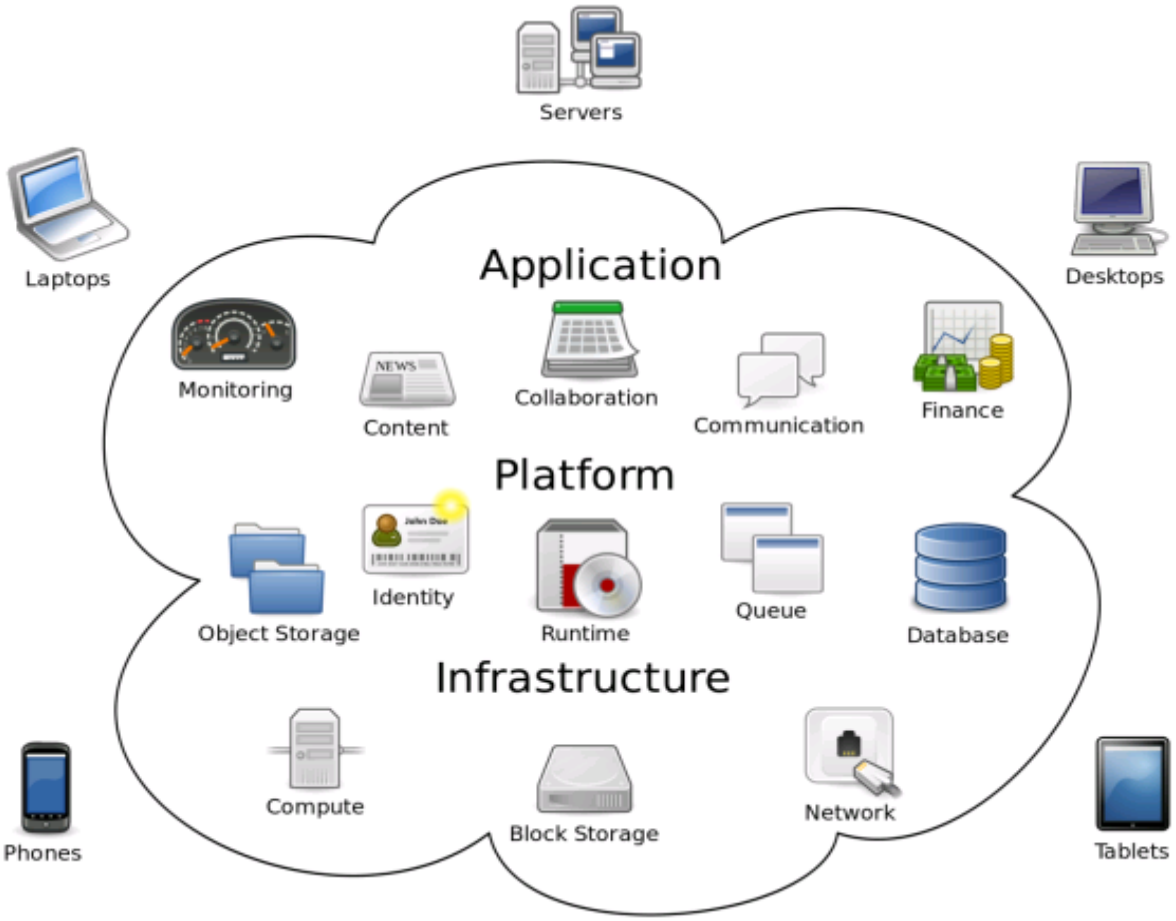


Figure 2-1: Cloud Computing Features - source *[16]*

A Cloud service has five distinct characteristics that differentiate it from traditional hosting. It is sold on demand self-service, typically by the minute or the hour; it is elastic, it can be easily maintaining and upgrading, have broad network access - a user can have as much or as little of a service as they want at any given time; and the service is fully managed by the provider (the consumer needs nothing but a personal computer and Internet access). Significant innovations in virtualization and distributed computing, as well as improved access to high-speed Internet and a weak economy, have accelerated interest in cloud computing [17] [8] [7].

Cloud computing delivers IT as a service. It might be your own private cloud accessible only within your organization, the public cloud of an external provider or a hybrid cloud that spans both. The Essential characteristics of Cloud Computing features include:-

2.3.1. On Demand Self-Services

Computer services such as email, applications, network or server service can be provided without requiring human interaction with each service provider. Cloud service providers providing on demand self-services include Amazon Web Services (AWS), Microsoft, Google, IBM and Salesforce.com. New York Times are examples of companies using AWS (NIST).

2.3.2. Broad Network Access

Cloud Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms such as mobile phones, laptops and PDAs.

2.3.3. Resource Pooling

The provider's computing resources are pooled together to serve multiple consumers using multiple-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. The resources include among others storage, processing, memory, network bandwidth, virtual machines and email services [18]. The pooling together of the resource builds economies of scale Resource pooling is the concept that multiple organizations can share the underlying physical cloud infrastructure (Gartner). [19].

2.3.4. Rapid Elasticity

Cloud services can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time [20].

2.3.5. Measured Service

Cloud computing resource usage can be measured, controlled, and reported providing transparency for both the provider and consumer of the utilized service. Cloud computing services use a metering capability which enables to control and optimize resource use. This implies that just like air time, electricity or municipality water IT services are charged per usage metrics – **pay per use**. The more you utilize the higher the bill. Just as utility companies sell power to subscribers, and telephone companies sell voice and data services, IT services such as network security management, data center hosting or even departmental billing can now be easily delivered as a contractual service.

2.4. Cloud Service Models

There are three different service models that are used in cloud computing to describe the different services that can be obtained, Software as a service, Platform as a service and infrastructure as a service. They will all be presented more in detail here.

2.4.1. Software as a service (SaaS)

Software as a service (SaaS) is focused on renting out applications to users that use it over a subscripted time. The application is not owned by the user, it is owned by the provider that makes the user pay for the amount of time they want to be able using it. The user is not responsible for the maintenance of the application. Unlike the usual applications where you install directly on the physical computers and manage the applications totally by your own, the SaaS is a service that a company pays usually a monthly fee to obtain [21].

Cloud computing definition SaaS is the renting of both infrastructure and applications which are totally managed by the provider through a web client, for example a web based email. The entire infrastructure is situated in datacenters [22] . Consumers purchase the ability to access and use an application or service that is hosted in the cloud. A benchmark example of this is Salesforce.com, as discussed previously, where necessary information for the interaction between the consumer and the service is hosted as part of the service in the cloud [23].

2.4.2. Platform as a service (PaaS)

Platform as a service (PaaS) is very similar to SaaS; it focuses on the rental of infrastructure so the user gets a platform to build their own applications with programming tools provided by the provider. The services include servers, operating systems or storage space and the help with building an application. The main difference between SaaS and PaaS is that SaaS gives you little space to build something of your own while PaaS gives room for maintaining the application on own terms [18] [23] [8].

PaaS delivers a computing platform and/or solution stack as a service, often consuming cloud infrastructure and sustaining cloud applications. It provides a consistent hardware and software infrastructure aimed entirely at running applications, such as within Microsoft Windows Azure.This type of renting gives the user free handles to maintain their own applications. It is a good option if there is an application that needs a better platform to work properly but resources in an

organization cannot support it. Then PaaS lets an organization to hire the necessary infrastructure to support the application to a full [8] [23].

The developed archticture of agricultural market information used platform as a service because during the development phase the developer, develop the application by using cloud platform which is programming language, database and other tools. Due to this the application is platform as a service.

2.4.3. Infrastructure as a Service (IaaS)

Infrastructure as a service (IaaS) takes it one step further than SaaS and PaaS. IaaS is when providers are handling only the infrastructure for a user and the user can run and develop software within the hired cloud infrastructure which is situated in a datacenter often. The user can run operating systems and applications on their own terms, maintain the storage and deploy the network they want by hosting firewalls [23] [8].

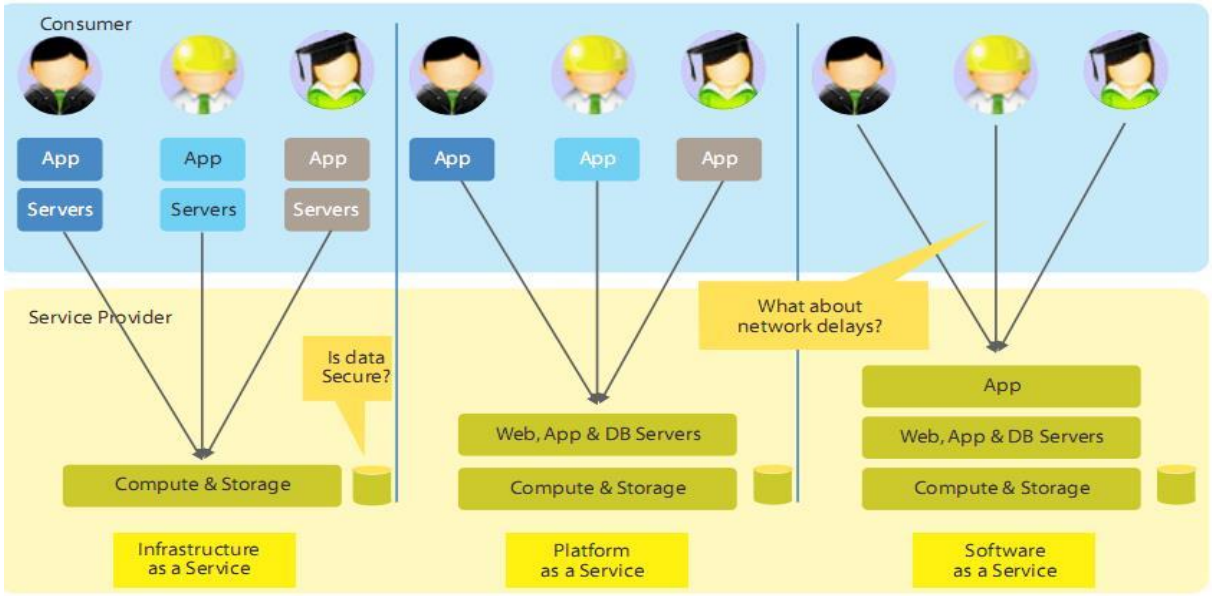


Figure 2-2: Relationships of PaaS, IaaS and SaaS - *[24]*

2.5. Cloud computing Deployment Models

There are four different deployment models unrelated to what service model that is used there are deployment models that can be applied to all of them.

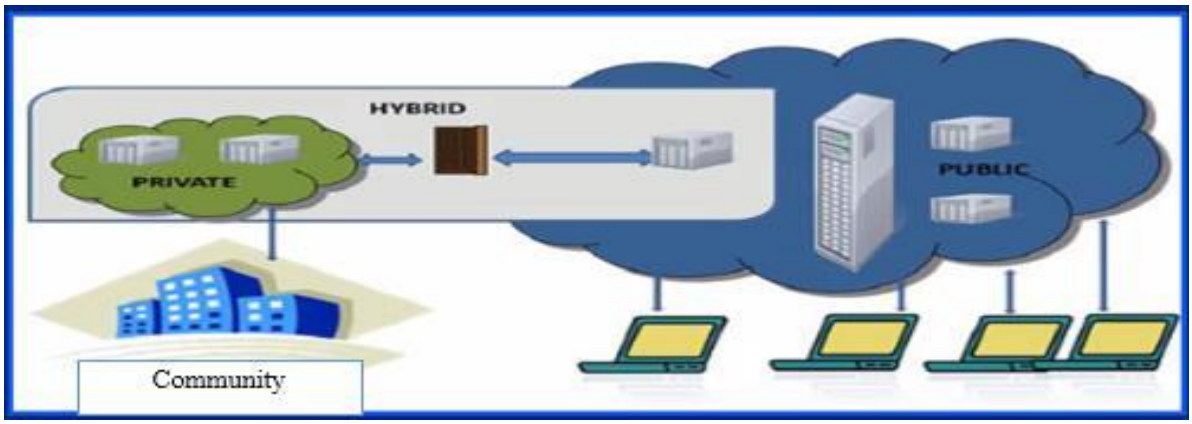


Figure 2-3: Cloud Computing Deployment models - *[21]*

2.5.1. Private Cloud

This type of cloud structure is to be used by only one organization and is managed by them also. The infrastructure could be handled by a third party or themselves depending on the service agreement that exist. The cloud infrastructure has been deployed, and is maintained and operated for a specific organization. The operation may be in-house or with a third party on the premises [8] [23].

These clouds are dedicated to a particular organization. That particular organization can use the cloud for storing the company's data, hosting business application, etc. The data stored on public cloud can't be shared with other organizations. The cloud is managed either by the organization itself or by the third party [25].

2.5.2. Public Cloud

The public cloud is available to the general public often for free and with a payable option. The service could be provided by many like: government, businesses and unions [13]. A good example is the providers of free online storage. The cloud infrastructure is available to the public on a commercial basis by a cloud service provider. This enables a consumer to develop and deploy a service in the cloud with very little financial outlay compared to the capital expenditure requirements normally associated with other deployment options [8] [23].

A service provider makes the clouds available to the general public which is termed as a public cloud. These clouds are accessed through internet by users. These are open to public and their infrastructure is owned and operated by service providers as in case of Google and Microsoft [25].

2.5.3. Community Cloud

This type of cloud is used by communities that consist of many organization or other users. It may be owned by the community to serve the community or by a third party member that is external. The involvement of the provider is here again depending on the service model that is applicable. The cloud infrastructure is shared among a number of organizations with similar interests and requirements.

This may help limit the capital expenditure costs for its establishment as the costs are shared among the organizations. The operation may be in-house or with a third party on the premises [8] [23].

2.5.4. Hybrid Cloud

Hybrid cloud is a mixture of the explained deployment models (Private, public and community). They are bound together but still belonging to itself as a deployment model. An example could be that a public cloud exists within an organization for all employees and within this cloud is a private cloud only accessible for managers The cloud infrastructure consists of a number of clouds of any type, but the clouds have the ability through their interfaces to allow data and/or applications to be moved from one cloud to another. This can be a combination of private and public clouds that support the requirement to retain some data in an organization, and also the need to offer services in the cloud. [8] [23].

When two or more clouds are bound together to offer the advantage of both public and private clouds, they are termed as Hybrid Cloud. Organizations can use private clouds for sensitive application, while public clouds for non-sensitive applications. The hybrid clouds provide flexible, scalable and cost-effective solutions to the organizations [25].

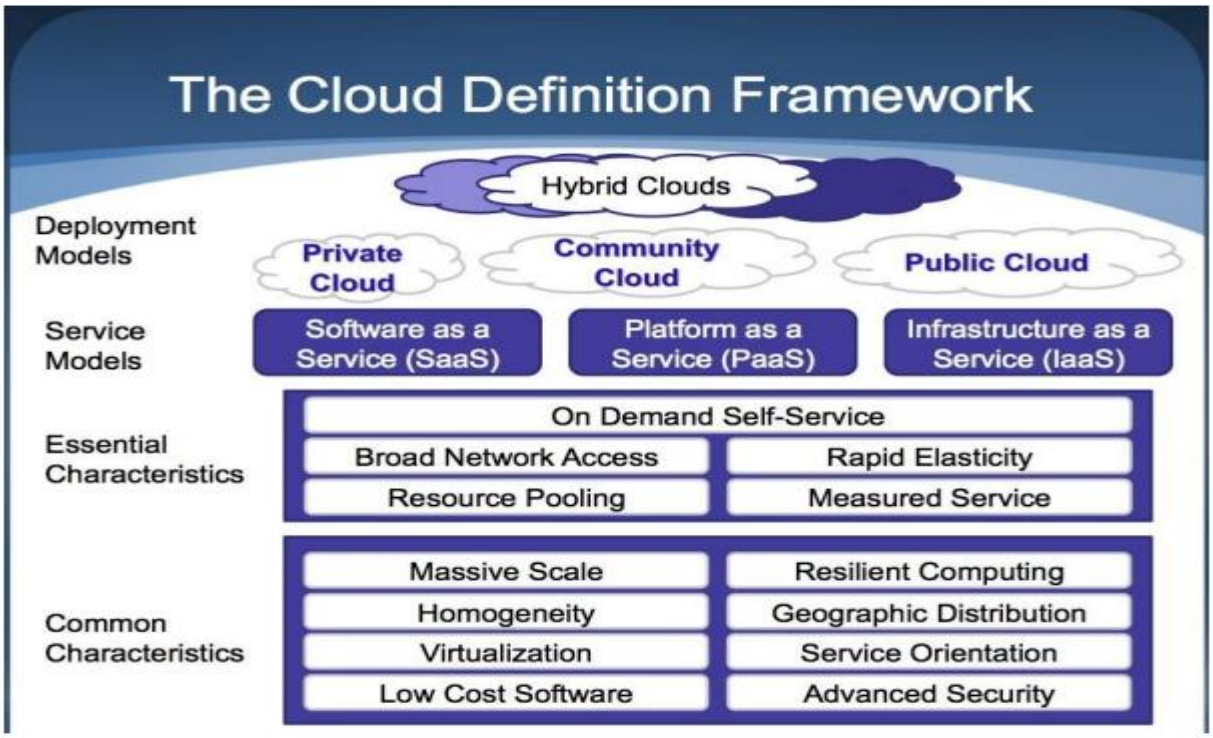


Figure 2-4: The Cloud Computing Characteristics –*[19]*

2.6. Roles of Cloud Computing and Agriculture Market

As Information Communication Technology (ICT) have developed and become more pervasive, they have become more relevant in agricultural innovation systems. The most pertinent developments for research, extension, and e-learning are reviewed briefly below.

First and foremost, the increased pervasiveness of telecommunication networks has enabled ICT to reach rural areas. Technologies that have long been applicable to poor agricultural communities have not been effective simply because they are difficult to get into the hands of rural users [1] [6]. Expanded telecommunications networks have increased the speed, reliability, and accuracy of information exchange—through text, voice, and applications—between farmers and other stakeholders.

Second, cloud computing services have immense potential to improve agricultural innovation systems. The advantage of cloud computing is that it offers pooled and elastic resources on demand over the Internet. More specifically, cloud computing has been described as "a model for enabling convenient, on-demand network access to a shared pool of configurable computing

resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" . Cloud computing's elasticity and variable capacity make it possible to process very large datasets, which can also be shared with anybody with adequate internet connectivity [1] [3] [4] [5].

Third, the movement toward open access and public involvement through online or mobile tools also favors agricultural innovation, not only in research institutions but more broadly among all participants in an innovation system. Governments, organizations, and even the private sector are sharing data and reports with the public and one another through ICT. As ICT has alleviated the difficulties inherent in interactions among people in dispersed locations, knowledge sharing and multi-stakeholder engagement are widely acknowledged to have increased. [3] [9] [26].

Fourth, Cloud computing is the provision of computer or IT infrastructure through the Internet. That is the provisioning of shared resources, software, applications and services over the internet to meet the elastic demand of the customer with minimum effort or interaction with the service provider. Cloud computing can be accessed by the end-users such as farmers, experts, consultants, researchers easily any time from any location through the devices that are connected to the cloud system [27] [28].

Thus cloud computing includes, but not limited to the following roles to access the market information for the Agricultural practitioners and the organization itself.

- ❖ It is used for high integration & sharing of agricultural information of products easily for practitioners [4].
- ❖ It can be eliminate the farmer's limitations of technical knowledge & resources
- ❖ Data availability at any time and at any location without delay using the devices that access the product information's.
- ❖ The essential benefits of Cloud computing is used to improve agricultural products marketing price of Food, seeds, other product in agricultural sectors for farmers, researchers , customers and other practitioners which using the products and services.
- ❖ Large scale information storage, Cloud computing provides high capacity data stores to store the large scale data and information [2] [28].

The general conclusions adopting cloud computing based architecture has a great roles in agricultures especially for the users that used to access the agricultural market information's s products and services. Hence the Agricultural market system must focus on adopting the common architecture for agricultural institutions. And cloud computing will contributes high opportunities to make the adopting architecture more cost effective, available, deliverable and accessible by the agriculture institutions. As a result it will benefit the agricultural system of Ethiopia to address agricultural market information for the whole reactionaries.

2.7. Cloud Computing and Market Analysis

Nowadays, companies continue to grow larger and larger, not only in the number of employees, but in the number of departments and type of products and resources. In cases such as these, cloud computing is a resource that is readily available to help companies meet their needs and accomplish their goals. To respond to competition by making better use of Internet services and offering more incentives than their competitors. Cloud computing can help business shift their focus to developing good business applications that will bring true business value. It can serve as a vital improvement to the business by acting as a potential disruptive innovation for its employees [29] [30].

Cloud computing is the provision of computer or IT infrastructure through the Internet. That is the provisioning of shared resources, software, applications and services over the internet to meet the elastic demand of the customer with minimum effort or interaction with the service provider. India is one of the largest producers of foods, grains and other products, but still agriculture and its production process are decentralized, unsophisticated and outdated methods being followed by the farmers, together with several constraints of the farmers and modernization is very slow [27]. This data can be accessed by the end-users such as farmers, experts, consultants, researchers etc easily any time from any location through the devices that are connected to the cloud system.

Figure 5 shows that the application that involves on agricultural institution. The main concern of the researcher application is only focus on Agricultural Marketing information.

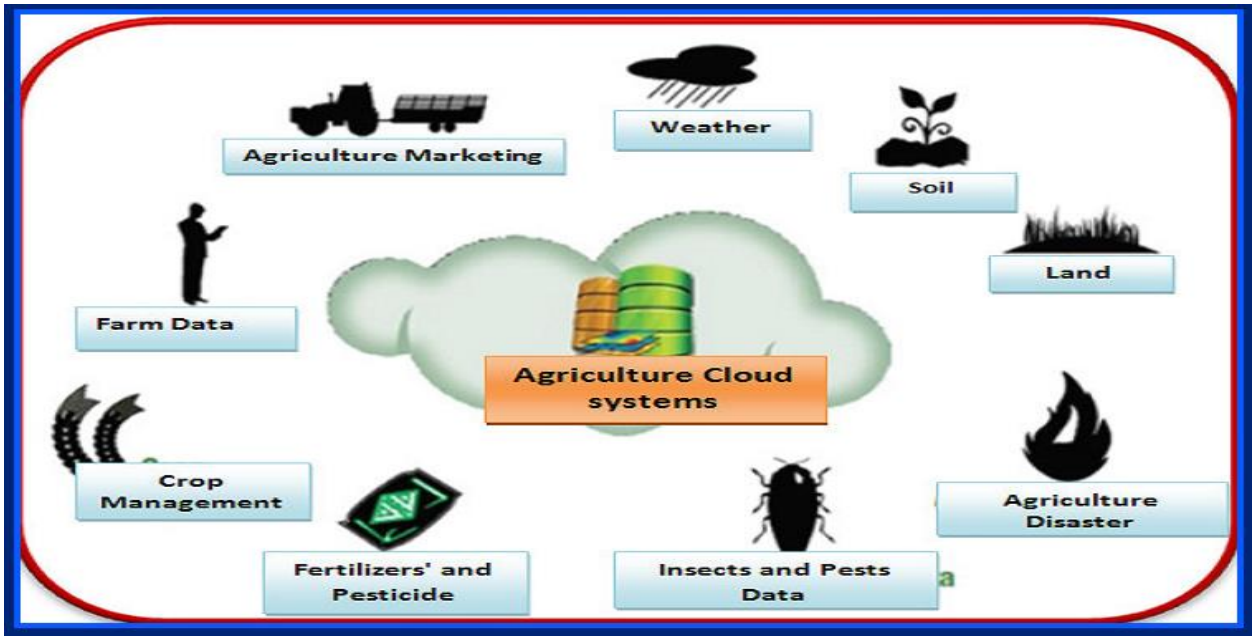


Figure 2-5: Application of Agricultural Cloud System- *[4]*

Cloud computing have its own benefits to address common market information for vendors that lives in different regions, gives high reliable ICT infrastructure for the users who wants to use the service of cloud and customize their products on cloud, and vendors have fully trusting the service with files including personal information to deploy their products, have free accessing information by mobility means workers who are done on the agriculture is avail anywhere via smartphones and tablets and can get fresh software which is customers/ farmers run the business with latest version the application [31] [32].

2.8. Related Works

Regarding to the benefits and drawbacks of adopting cloud computing based architecture for market information in agricultural sector can be discussed so of papers that the researchers doing in different country in different areas especially in developing country. The developing country agricultural sectors has not satisfied with the traditional exchanging of their products and services processes; This research can be used to eliminate the problems by developing and adopting application of cloud computing to enhance the exchanging of products and services like market analysis and estimation information and other services and made high interactive to meet agricultural sectors in different areas specially in the remote areas.

According to Providing Market Information for Ethiopian Farmers: Extending Participatory Design [33], Farmers have interest to use ICT for sharing the lessons learned with other farmers, present their produces, initiate trading, bargain on prices and sell. Moreover, farmers wanted to evaluate and analyze the services of cooperative unions with the aim of selecting the ones that match their preference and product characteristics. Lack of access to market information and cumbersome transport of goods does not allow the farmers to compare prices and puts them in a difficult position when bargaining.

According to [5] [34], implementing application of cloud computing in agricultural sector have their own benefits, some of the benefits that the researchers discusses **Demand-supply:** It can provide an up to date picture of the current demand and supply information of agro products in different parts of the country. It can help farmers in deciding on selection of the crops. It also provides the opportunity for a comparative analysis of the demand and supply chain.

Communication: implementing application of cloud computing in agricultural sector can used to facilitate and minimize the gaps in between illiterate and educated peoples because of most of the peoples that lives in rural areas are illiterate.

E-Knowledge sharing: The system also keeps provision to have online communication with the experts/consultants and attend online training programs using the Community Service Centers (CSC) as the local information databases. This will be specifically useful if they need information that is not locally available. Also farmers can be made aware of recent agro related concepts, such as "Organic cultivation" using this global ICT approach.

Conducting Research: It will help the national and international researchers to extract agricultural data directly from the e-data bank and analyses them in order to contribute to the agricultural sector of the nation. The research findings will be kept in the e-data bank and will be available to all its stake holders.

According to Cloud Computing and Agricultural Development of China: Theory and Practice [35]. In this paper, the author has discussed about the advantages and the status of China's agriculture development. A huge research is being carried out theoretically since long period and studies are also being done on its effects on China's agriculture and its various sectors. The concept of implementing Cloud is not yet matured in China. It suggests a cloud application system

framework that can be implemented in China. Due to government constraints and challenges, the implementation is not very matured and effective.

Traditional, agriculture or farming [1]; is an activity whose knowledge is passed down many generations together. The information on the methods and science of farming is confined only to the farming community. Another major problem in our country is rural-urban migration as unemployment ratio is constantly is increasing.

Sharing of information and knowledge is very critical for efficient and better productivity in agriculture. This information is maintained by farmers' communities. If Cloud computing is applied in the field of agriculture efficiently, then it will prove to increase overall productivity of the cultivation land. In addition to storing the information in cloud, information management of all sorts of data related to cultivated land, including location, land rights, area, and soil and land characteristics can be integrated.

In traditional farming, IT is very scarcely been introduced due to which it has affected the productivity. Introduction of IT and Cloud Computing in the field of farming, it will have efficient effect on the improvement of the production process and also on information sharing [4] [34].

To summarize, any of the researchers didn't touch the problem adoption of cloud computing based architecture in agricultural institutions to access the agricultural market information's, tools and approaches to access and browse the information's of agricultural market products and services based on levels. The cloud computing have its own different roles and responsibilities in different field perspectives. None of the researcher develops the architecture to enable sharing and accessing the agricultural market information's resources anywhere, any device. So to enable these, we propose to design a cloud based Architecture for agricultural market information's which improves the ability of access and browse in agriculture institutions.

CHAPTER THREE: METHODOLOGY

3.1. Introduction

This chapter describes the research methodology that was used in the research process. The chapter begins by deciding the area of interest, was performing literature review to get previous works about Adoption of cloud computing based architecture for agriculture market information. Secondly design the process models and data collection method to address the problems and to adopt agricultural cloud computing and setting solutions.

3.2. Process Model

In software Engineering, process model is a description of the sequence of activities carried out in the software project and the relative order of these activities. There are several process models which include prototyping, unified process, incremental and agile. We can rarely combine process models or use together in software development process

In this study, incremental process models is used, because, the incremental build model is a method of software development where the model is identify the problems, setting the hypothesis, designed, implemented and tested incrementally (a little more is added each time) until the product is finished. It involves both development and maintenance. The product is defined as finished when it satisfies all of its requirements. This model combines the elements of the waterfall model with the iterative philosophy of prototyping. It presents a description of a process from some particular perspective and as a software engineering gained more experience, different software development models were introduced to solve different concerns [36] [37] .Today there is an understanding that there is no one process model that will fit all the software projects .For this study the researcher used incremental process model.

3.2.1. Incremental Development

Object oriented methods are built up over time incrementally rather than all at once near the end when changes become expensive. Another reason for applying an incremental development process is that the staff can work more effectively. Developing systems through incremental release requires first providing essential prototyping system (main operating functions), then providing system users with improved and more capable versions of a system at regular intervals.

So Prototyping is a technique for providing a reduced functionality or a limited functional version of a software system early in its development life cycle. In this thesis incremental process modeling includes the following phases:

- Problem identification
- Identify the study area and Requirement Specification.
- Data collection
- Platform Selection
- Analysis the data results
- Architecture Design
- Prototype Implementation
- Evaluation and testing the prototype.

Based on these steps, Adoption of Cloud computing based architecture for agricultural market information and its prototype was developed to address the problem(Figure 3-1:).

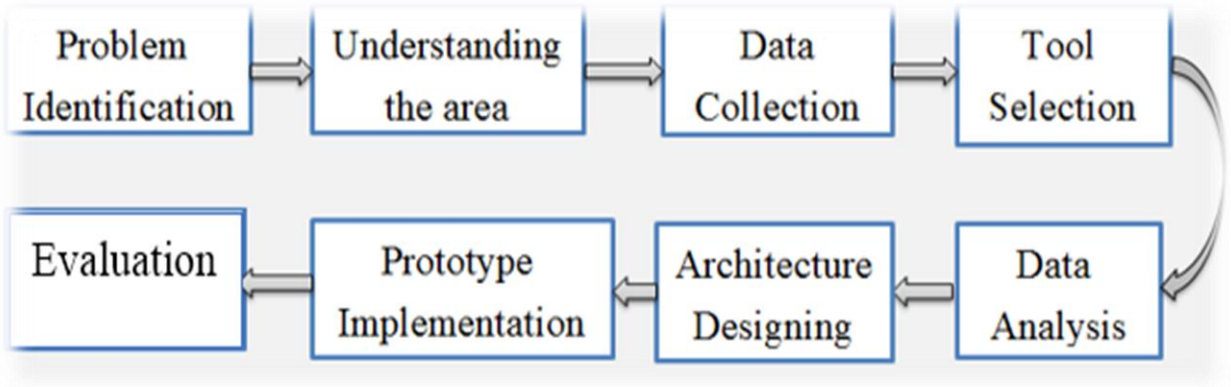


Figure 3-1: Steps in the Research Process

3.3. Research Sampling Design

Research sampling design involves the determination and delimitation of the number of participants. A sample is therefore a group of respondents, cases or records comprising of part of the entire study population that is empirically selected to represent the study population and a good sample must be accurate, precise and representative of the total population (Cooper and Schindler, 2001). A sampling frame is defined as a list of elements from which the sample

which has characteristics similar to those of the population is drawn (Cooper and Schindler, 2001). For the purpose of this study, the sampling frame is four governmental institutions and twenty four populations to address the research questions that to be solved **(see Appendix I and Appendix II).**

The random sampling without replacement technique was used to select the sample. This was considered to ensure that the desired representation from the study population will be achieved through sampling. Thus the proposed sample was taken from four governmental institution in Ethiopia related to the agricultural organizations.

Table 3-1: Respondent sampling frame in government organizations

No	***Descriptions / institution***	***Responded***	***Not Respond***	***Total***
1.	Ministry of Agriculture(MoA)	6	2	8
2.	Ethiopian Commodity Exchange (ECX)	8	-	8
3.	Ministry of Communication and Information Technology (MCIT)	3	1	4
4.	Ethiopian Institute of Agricultural Research (EIAR)	7	3	10
Total number of respondents		**24**	**6**	**30**

3.4. Research Design.

In this study there are three research design commonly used approaches which are quantitative, qualitative and design oriented to address the research results [38]. A qualitative method has been chosen to receive empirical evidence to the thesis's purpose, which is to develop an understanding of which factors that obstruct adoption of cloud computing in the agricultural institution, Smaller & not randomly selected. Open-ended responses, interviews, participant observations, field notes, & reflections and used Particular or specialized findings that is less generalizable [38] [39]. On the other hand, quantitative research method is focused on describing Identify statistical relationships, to test hypotheses, look at cause & effect, & make predictions

and Generalizable findings that can be applied to other populations [40]. Design-Oriented Research creates an artifact by artificial object and its basic objective is producing new knowledge during this process. It is mostly focus on knowledge flows and process steps that is problem awareness, suggestion, development, evaluation and conclusion; eventually aims to get result or output [41] [38]. The study was design using both quantitative, qualitative and design oriented research methods and conducted by face-to-face interviews questioner's methods that focuses on agricultural institutions, exchange of market information.

3.4.1. Research Question Procedure

- Identify questionnaire items.
- First, Identify main fields of the questionnaire and items for each field, and then prepare a preliminary questionnaire for use in the data and information collection.
- Then, take into account the rules of scientific research from objectivity and comprehensiveness in the preparation of this questionnaire.
- Then, show questionnaire to the advisor, in order to test their suitability for data collection, and then modify the questionnaire primarily according to the vision of the different bodies.
- Then, prepare the final form of the questionnaire according to the vision of the supervisor (Appendix I and Appendix II).
- Then ,organize and code the retrieved questionnaires
- Finally, analysis the data by using IBM SPSS v22 and summarize the results.

3.5. Data Collection Techniques.

The objective of this study is to find out the extent of use of Adoption of Cloud computing in agricultural institution and to come up with an architecture for developing /migrating services to the Cloud seamlessly. Data such as the following was sought:

- Perception of individuals within the organization towards adoption of the new technology.
- Perception towards external factors that influence adoption of the technology.
- Level of understanding of Cloud computing technology.
- Perception towards Cloud technology.
- Perceived advantages of Cloud technology.
- Concerns towards adopting Cloud technology.

To collect information about to our objectives and purpose of the study (people, objects, phenomena) and the settings in which they occur. For this research, the researcher used the following data collection

techniques and tools. Survey items were based on questionnaires from literature reviews sources and adapted and modified to fit the context of this study.

Data collection techniques such as interview, questionnaires and documentary analysis were used, interview with concerned bodies from Ministry of agriculture, Ethiopian commodity exchange(ECX), Ministry of Communication and Information Technology (MCIT) and Ethiopian Institute of Agricultural Research (EIAR) staff and ICT center and as well as review of documents and manuals including website of the MOA have been used to gather relevant information for the design of a cloud based architecture for Agricultural market information.

The aim of the interview is to find out what they believe on important attributes, services and modules for users to access agricultural market information system and to identify the user needs and interest in agricultural market information system in the institutions.

Document analysis was made to get general concept of cloud based architecture for agricultural sectors especially in agriculture institution perspective, to understand cloud based architecture in market information, to select best fit platform, service delivers and deployment models for this study, to make analysis for different tools for the architecture implementation. Document analysis also made to understand general methodology of a cloud based web application development, service integration and business operation aspects for this study.

3.5.1. Sample Selection and Analysis

To find suitable respondents for each case, that were highly involved in the studied process and relevant for the study, the research was done on the ministry of agricultural institution, Ethiopian commodity exchange(ECX), Ministry of Communication and Information Technology (MCIT) and on Ethiopian Institute of Agricultural Research (EIAR) to gain real result and problems related to my research. In this research the researcher have taken 24 persons in those organization and four section questionnaires and interviews.

The respondents from the organization of ministry of agriculture (MoA), Ethiopian commodity Exchange (ECX), Ministry of Communication and Information Technology (MCIT) and Ethiopian Institute of Agricultural Research (EIAR). Most of the respondents are IT professionals and have the right knowledge to be able to answer the questions. However, since the respondents have different experiences from technological implementations they occasionally had less knowledge in some areas and thus less to say in some of the questions.

3.5.1.1. Primary Data

This study's primary data have been gathered through the twenty four respondents that have been conducted with the four organizations, and an external actor. Through these interviews that have taken place either face-to-face, via telephone or e-mail (see table 1 from sampling frame), a large amount of empirical data have been gathered within a narrow timeframe, which has encouraged a more precise information gathering directly from the involved actors, hence minimized the risk of data loss.

All the face to face interviews were executed in Ethiopia and the interview questions were open and closed questions that uses to address the respondents answer. And each interview the respondents received about the purpose of the thesis.

3.5.1.2. Secondary data

To address the problems that lists on chapter one the researcher was reviewed different papers, journals and websites regarding to my research. Secondary data was collected from the following sources:

- Documents published by staff members
- Agricultural brochures
- Journals and research papers that publish by different professionals
- Organization report future plans
- Ministry of agriculture and Commodity exchange websites

The basic focus where data were collected concerning architecture of market information and cloud computing were, understand about the awareness of cloud computing, agricultural market information importance, way of delivering market information, cloud computing barriers on the current situations, availability of resources, cloud computing layers and models and solution suggestions to solve the current problem in agricultural market information because it helps the baseline for the architectural design.

Specific areas covered to gather relevant data about adoption of cloud computing based architecture for agricultural market information were Ministry of agriculture, Ethiopian Commodity Exchange (ECX), Ministry of Communication and Information Technology (MCIT) and Ethiopian

Institute of Agricultural Research (EIAR) in Addis Abeba. Each number of respondents in the organization shown on the above sample frame (**Table 3-1** :)

Generally, to address the problems the researcher uses both primary and secondary data collection methods. The survey of different agricultural delivery institutions was conducted using questionnaire and observation. Using the questionnaire, we have investigated the cloud based architecture concepts, way of delivery, problems they faced and possible solutions they suggested as well as their use of ICT and other technologies in their activities specially related with the agricultural market information based architecture activities.

The main purpose of this work was, looking forward to use the current technology for sharing and accessing market information resources in agriculture institutions to solve the problem. Cloud computing based platform architecture was proposed to solve the problem through accessing of all market information resources to all agriculture workers at all level. Cloud computing has a solution for sharing and accessing agricultural resources with cost effective, flexible, scalable and multi-tenant way. This will help the agriculture workers to develop ability, experience and knowledge, problem solving skill and technology adaption in their profession by accessing the shared resources using their mobile phone and other existing ICT infrastructures ubiquitously.

CHAPTER FOUR: DATA ANALYSIS AND DISCUSSIONS

4.1. Introduction

In collecting data for this case study, both primary and secondary sources of data were used. This section will focus on the data analysis, findings and discussion. The data was analyzed using means, standard deviation and then various comparisons were made. Analysis of the data was done using SPSS statistical software. Presentation of the data was made by use of tables. The figures were then interpreted from statistical analysis into descriptive statements. The influence of each determinant factor affecting the adoption decision is discussed. The factors limiting the use of Cloud technology and the main drivers that influence adoption are also discussed.

4.2. Data analysis

The data analysis was based on quantitative approach using descriptive statistics. The data analysis was done in line with the sections on awareness of cloud computing, cloud ideal questions, drivers and barriers of cloud computing. Data collected from the sections was analyzed to uncover relationships among several variables.

4.2.1. Questioner Response Analysis

From a total of thirty targeted questionaries' twenty four respondents' interviews were successfully returns within the specified period giving a response rate of 80 percent. Out of the thirty questionnaires received, six or 20 percent were incomplete There was no response from three target respondents. The table 4-1 and figure 4.1 shows that the valid and invalid respondents from the total of thirty targeted respondents.

Table 4-1: Questionaries' respondent analysis

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Responded	24	80.0	80.0	80.0
	Not Respond	6	20.0	20.0	100.0
	Total	30	100.0	100.0	

A total of 24 out of the thirty respondents who were targeted participated in this study and the rest of six practitioners does not say anything regarding to the questionaries' and they does not returns their feedback. As per the data described in Figure 4-1.

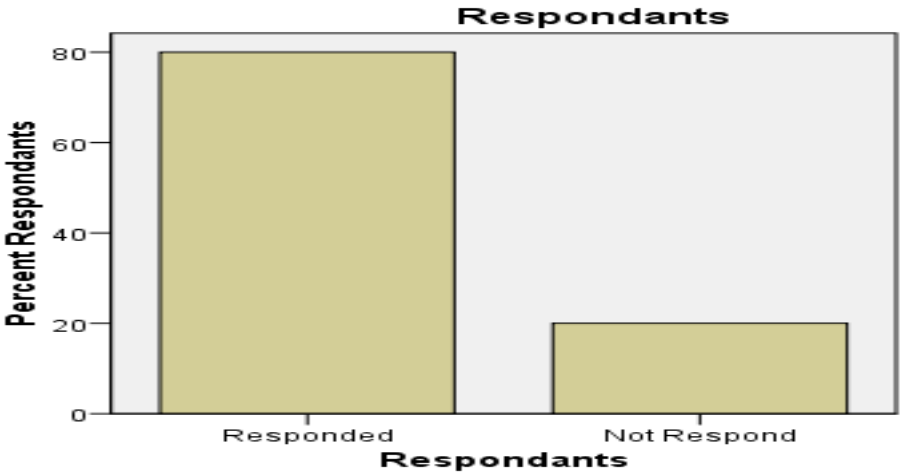


Figure 4-1: Questionaries' respondent analysis

4.2.1.1. Awareness and Ideal Questions of Cloud Computing

This study try to gather information from employees of Ethiopian Agricultural and relevant sector on the awareness levels of cloud computing by the Ethiopian Agricultural sector and the awareness of cloud computing divides in to four main sub category questions to address . The findings are organized in categories seeking to understand if the respondents have heard of the term before, they can be able to define it and point out their strategy towards adoption as well as assess if the sampled Ethiopian Agricultural sector s have internet resource that is paramount to adoption. The general response of practionres based on awareness of cloud computing describe in figure 4-2

Table 4-2: Respondents results on Awareness and ideal Questions of Cloud Computing

Respondant Analysis Statistics

		Acc1	Acc2	Acc3	Acc4	CIQ1	CIQ2	CIQ3	CIQ4	CIQ5
N	Valid	24	24	24	24	24	24	24	24	24
	Missing	6	6	6	6	6	6	6	6	6
Mode		2	2	2	1	2	2	1	1	1
Range		1	1	1	0	1	2	3	3	0
Minimum		1	1	2	1	1	2	1	1	1
Maximum		2	2	3	1	2	4	4	4	1

The table shows that most of the practionres the mean 3.726 or 80% of respondents agreeing that there is barriers or factors of cloud computing to adopt and using cloud computing in the organization on the awareness of cloud computing and cloud ideal question.

Awareness of cloud computing and cloud ideal question graphically

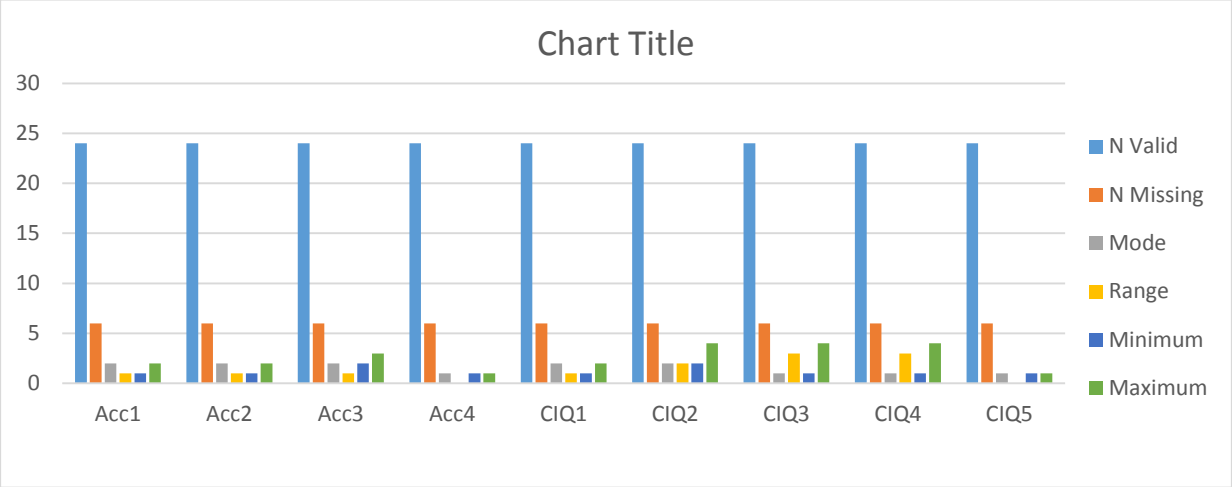


Figure 4-2: Awareness and ideal Question of Cloud Computing

Figure 13 shows that from the total of 30(100%) respondents 24 practionares 80% responds their valid data and 20 % or 6 respondents does not response and it shows the mean value median mode and the minimum and maximum range of the respondents on the awareness of cloud computing and cloud ideal question pictorially.

4.2.1.2. Barriers of Cloud Computing

To adopt Cloud Computing in agricultural sectors first what are the factors or challenging in the range of practical and socio political reasons. How the adoption to cloud computing is managed does not only depend on technical issues but also on socio-technical factors (i.e. cost, confidentiality and control), the impact on work practices and constraints derived from existing business operations models.

To evaluate the degree of influence of individual factors in the adoption decision, the respondents were asked a set of questions. Their responses were measured using a 5-point Like-type interval scale (Strongly disagree – 1 point, Disagree – 2 points, Neutral – 3 points, agree – 4 points, strongly agree – 5 points).

Table 4-3: Barriers of cloud computing result on respondents

Statistical Analysis

		BCC1	BCC2	BCC3	BCC4	BCC5	BCC6	BCC7	BCC8	BCC9
N	Valid	24	24	24	24	24	24	24	24	24
	Missing	6	6	6	6	6	6	6	6	6
Mean		3.7083	3.75	3.9167	3.7917	3.7917	3.5	3.875	3.6667	3.5417
Median		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Mode		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Range		3.00	3.00	2.00	3.00	2.00	3.00	3.00	2.00	2.00
Minimum		1.00	1.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00
Maximum		4.00	4.00	5.00	5.00	4.00	5.00	5.00	4.00	4.00

The table shows that most of the practionres the mean 3.726 or 80% of respondents agreeing that is barriers or factors of cloud computing to adopt and using cloud computing in the organization.

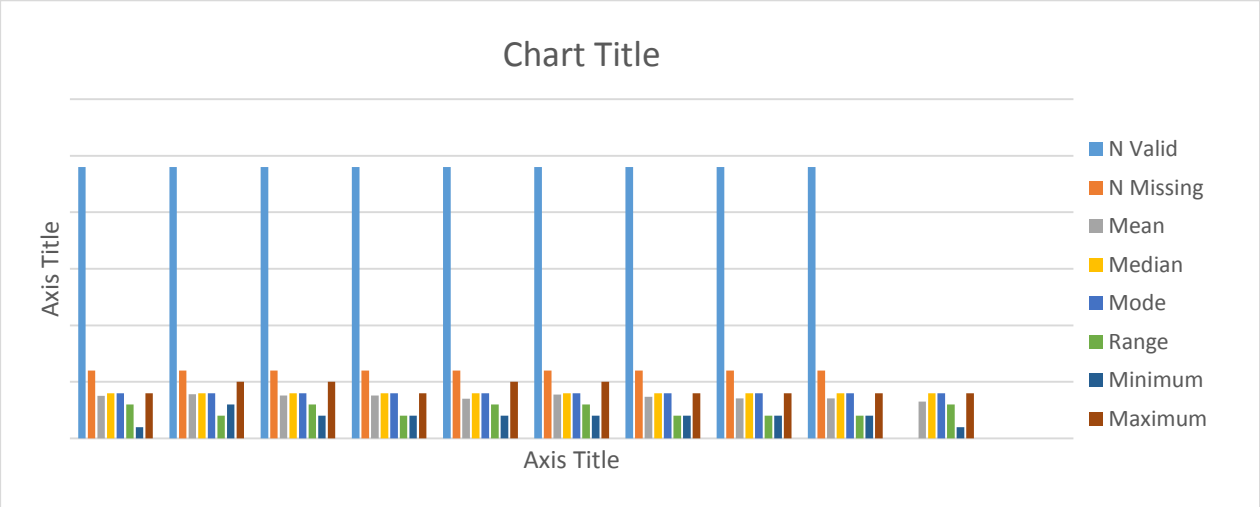


Figure 4-3: Barriers of cloud computing in graphically

Figure 4-3 shows that from the total of 30(100%) respondents 24 practionres 80% responds their valid data and 20 % or 6 respondents does not response and it shows the mean value median mode and the minimum and maximum range of the respondents.

4.3. Results

In order to analyzing data is to summarize the data into a single representative value. We have used mean to analyze a set of data using measures of central tendency based on the number of entries in the data set and, The value of each entry. Mean can be used to show the result of probability and statistics of expected value [42].

Mean: $\frac{\textit{Sum of Value of Entries}}{\textit{Number of Entries}}$ $(\sum_{i-1}^{n} xi/n)$

According to the survey on cloud they conducted on awareness questions motivates adoption of cloud computing appear to be more perceptual than prohibitive, Professionals who are most aware of and involved with cloud computing and cyber security generally trust the cloud model, and do not consider it a leading security vulnerability. The findings suggest cloud utilization is poised for rapid gains as awareness of cloud computing and the related cyber security implications grow the result of data as follows

Table 4-4: Awareness of cloud computing and ideal Question result percentage

Measurment		Percentage of Awarness and ideal of Cloud Computing										
		ACC1	Acc2	Acc3	Acc4	Mean	CIQ1	CIQ2	CIQ3	CIQ4	CIQ5	Mea
Valid	Yes	23.3	16.7	63.3	26	32.325	10	50	60	53.3	80	50.66
	No	56.7	63.3	16.7	56	48.175	70	10	20	3.3	20	24.66
	Total	80	80	80	80	80	80	60	80	80	80	76
Missing	System	20	20	20	20	20	20	20	20	20	20	20
Total		100	100	100	100	100	100	80	100	100	100	96

Based on the awareness of cloud computing and ideal questions 48% of practitioners does not have cloud computing awareness and 32.325 % of the respondents know the cloud computing definitions and its benefits and drawbacks of and other services but still they have confusion how to deploy and use the services of cloud computing. And based on ideal question of 50.66 from the 80% have the idea about cloud computing and the rest of are not do not have their technology of cloud computing.

Table 4-5: Respondents Average Value on Barriers of Cloud Computing

Measurment		BCC1	BCC2	BCC3	BCC4	BCC5	BCC6	BCC6	BCC7	BCC8	BCC9	BCC10	BCC11	Mean
		Percentage												
Valid	Strongly Disagree	3.3	3.3	10	10	6.7	20	3.3	3.3	10	16.7	16.7	16.7	10
	Disagree	6.7	3.3	66.7	66.7	3.3	3.3	6.7	6.7	6.7	3.3	3.3	3.3	15
	Strongly Agree		3.3			70	53.3	66.7	66.7	63.3	60	60	3.3	49.62222
	Agree	70	70	3.3	3.3		3.3	3.3	3.3				56.7	26.65
	Total	80	80	80	80	80	80	80	80	80	80	80	80	80
Missing	System	20	20	20	20	20	20	20	20	20	20	20	20	20
Total		100	100	100	100	100	100	100	100	100	100	100	100	100

Accordingly, the survey on the barriers of cloud computing to adoption of cloud computing, it found out that the top issue overall was a perceived lack of confidentiality, lack of deployment, insufficient internet bandwidth, lack of security and service level agreements (SLAs), with 10%

strongly disagree,15% disagree,26.65% agree and 49.6222% of respondents strongly agree from the 80% respondents.

To generalize the data analysis and its results we have grouped two type's questionaries' method that is secondary questions and interview method. Hence the most practionres does not have ideas about cloud computing and they needs to develop and design cloud computing models for the purpose of sharing and access the day to day activities of agricultural market information. Therefore we have designed common cloud based architectures to access the agricultural market cost and type information remotely using computing devices such as desktop smart phones, and other independent devices.

CHAPTER FIVE: CLOUD PLATFORM SELECTION AND DESIGNING A PROPOSED ARCHITECTURE

5.1. Cloud Platform Selection

In chapter two, we have discussed the three cloud computing service delivery models. In this study platform as a service (PaaS) cloud service delivery model has been selected. Because, for the proposed architecture, a prototype application has been developed for the purpose of validating the architecture on a hybrid cloud development model. So to develop the prototype application and deploy the application, also have used platform as a service which are used for web application development and hosting.

PaaS is used to develop web and mobile applications using components that are pre-configured and maintained by the service provider, including programming languages, application servers and databases. According to the requirement and characteristic of the cloud education, we choose the PaaS layer as the basic service model which has a relative complementary between the control and security. In this level, the user has the ability to develop and deploy the custom applications to the cloud platform.

There are a lot of tools available for the application developers in the cloud environment and we try to describe the most popular platform providers and their development and hosting tools .To select the best fit platform as a service tool ,we have gone through identified around fifteen tools. But due to software compatibility, license agreement, price and poor feature factor, we rejected eleven tools and we have done comparison and analysis on the four tools only, which are Microsoft Windows Azure (MWA), Google App Engine (GAE), IBM cloud service provider and Open Nebula [43].

5.1.1. Microsoft Window Azure

Windows Azure is an open and flexible cloud platform that enables to quickly build, deploy, and manage applications across a global network of Microsoft-managed datacenters. We can build applications using any language, tool, or framework. And we can integrate public cloud applications with the existing IT environment.

This definition tells us that Windows Azure is a cloud platform, which means we can use it for running your business applications, services, and workloads in the cloud. But it also includes some key words that tell us even more:

- **Open** Windows Azure provides a set of cloud services that allow you to build and deploy cloud-based applications using almost any programming language, framework or tool.
- **Flexible** Windows Azure provides a wide range of cloud services that can let us do everything from hosting website, web apps to running big SQL databases in the cloud. It also includes different features that can help deliver high performance and low latency for cloud-based applications.
- **Microsoft-managed** Windows Azure services are currently hosted in several datacenters spread across the United States, Europe, and Asia. These datacenters are managed by Microsoft and provide expert global support on a 24x7x365 basis.
- **Compatible** Cloud applications running on Windows Azure can easily be integrated with on-premises IT environments that utilize the Microsoft Windows Server platform.

Windows Azure's services is SQL Azure, which presents DB services from building the DB to deploy it and scale it through Microsoft data centers. SQL Azure includes relational database services, such as reporting, querying, and data synchronizing. Windows Azure offers several features including computing resources, storage, database, Virtual Machines (VMs), access control, Content Delivery Network (CDN), caching, virtual network, service bus, business intelligence, and market place.. Windows Azure provides a platform service which includes operating systems, a set of developer tools, and different levels on network controls to develop, host, scale, and manage developed applications on web and non-web environments [30].

In addition, the Windows Azure platform offers prebuilt sub-programs which often represent reuse functionalities to save the developers' time and let them focus more on their projects. By using Windows Azure, the Ethiopian Agriculture institutions do not need special equipment or infrastructure; all they need is Internet connection.

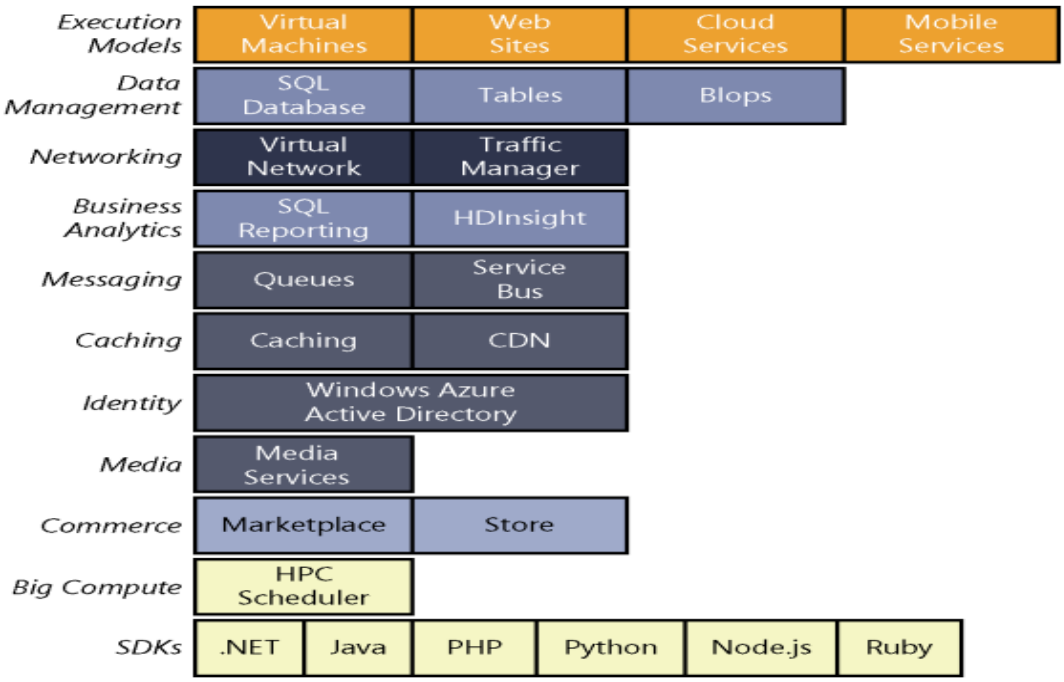


Figure 5-1: Components of Windows Azure Platform –source [25]

5.1.2. IBM Cloud Service Provider

IBM offers three hardware platforms for cloud computing. These platforms offer built-in support for virtualization. For virtualization IBM offers IBM Websphere application infrastructure solutions that support programming models and open standards for virtualization. The management layer of the IBM cloud framework includes IBM Tivoli middleware [43]. Management tools provide capabilities to regulate images with automated provisioning and de-provisioning, monitor operations and meter usage while tracking costs and allocating billing. IBM cloud computing service model provides scalable, elastic, and reliable resources, and it offers infrastructure as a service which include:

- Servers: IBM Elastic Compute Cloud (IBM EC2) is one of the IBM that offers resizable compute power. Using EC2, the user will be able to build one, hundreds, or even thousands of servers within minutes.
- Storage: IBM Simple Storage Service (IBM S3) is a web interface. It provides a storage service which can store and retrieve stored data on the web.
- Operating Systems: IBM cloud computing permits the user to choose from a wide variety of available operating systems already built in IBM cloud computing.

- Networking: Different services provide diverse networking services, such as IBM cloud computing Virtual Private Cloud (IBM cloud computing VPC) which uses a Virtual Private Network (VPN) connection to isolate the IT infrastructure and the IBM cloud computing infrastructure and IBM cloud computing which delivers the content base on the client location to improve the response time.

5.1.3. Open Nebula

OpenNebula [43, 44] can be primarily used as a virtualization tool to manage your virtualized infrastructure in the data center or cluster, which is usually referred as Private Cloud. OpenNebula supports Hybrid Cloud to combine local infrastructure with public cloud based infrastructure, enabling highly scalable hosting environments. OpenNebula also supports Public Clouds by providing Cloud interfaces to expose its functionality for virtual machine, storage and network management [45].

5.1.4. Google App Engine

Google App Engine is designed for distributed web applications and developers using Java, Python, PHP and Go. The Java environment supports other languages that make use of the JRE and there is a SDK for each of the four main supported languages as well as a plugin for Eclipse. The PaaS offers managed infrastructure and runtime environments that are guaranteed to scale, but only if the applications fit the restrictions of Google App Engine. The Data store, a transactional, schema-less data store based on key-value pairs, handles the complex management of data that's accessible to multiple machine instances.

Table 5-1: Comparison of Cloud Service Provider

Compare Factor	Open Nebula	Google AppEngine	Microsoft Azure	IBM cloud Service
User access interface	WebAPIs, Custom GUI	Limited GUI and Command line(Cf-cli)	Azure Web Portal and Custom GUI	WebAPIs, Custom GUI and command line interface
Language Support	C++, java, vb.net	Limited to Java ,python and PHP	Microsoft Visual Studio(.Net),Java,PHP ,C	Java EE, PHP, Ruby,MySQL, MONGODB
Platform(OS, Run time	Ubuntu 64 bit , MacOS	Linux, Windows	.NET on Windows	IBM Built computing
Scalability	Dynamic Scalability	Need codes to scale	Scalable based on bandwidth	Complicated
Reliability	Improved Reliability	Improved Reliability	Improved Reliability	Improved Reliability
Efficiency	Efficiently adopt cloud services by scheduling	Efficiently adopt cloud services in a scalable and automated way	Efficiently adopt services by identifying underutilized servers	Efficiently adopt cloud services by scheduling
Deployment Model	Customized web application(C# C++, VB,)	Deploying using BOSH directory	Azure Services, web deployment using IIS and using git hub	Customized Web application(Java,PHP,Node.js)
API	Sets of APIs	Limited APIs	More sets of APIs	Set of APIs
Availability	https://www.opennebula.com	https://www.GoogleAppengine.com	http://www.microsoft.com/azure	https://developers.IBMservice.com

Based on the comparison, we choose the Microsoft Window Azure. It has wide variety of languages and databases that enables the developer to create easily their applications and more understandable. We can manage our code by using azure web portal; The main criteria to select Microsoft Azure is, it gives for the developer more deployment options than the other three platform and more sets of application program interface (API) .using Microsoft azure the developer can deploy locally using web deployment on IIS .Cloud applications running on Windows Azure can easily be integrated with on-premises IT environments that utilize the Microsoft Windows Server platform.

5.2. Building proposed Architectures of cloud

Due to different factors, it is true that Information Communication Technology (ICT) usage in Ethiopian agricultural Institutions in its current situation is very primitive, as discussed in previous sections. Adopting the Cloud Computing technology for delivering different services such as distributed balanced information for farmers which are living in and out remote areas, managing, controlling and implementing tasks that performs in the institution, facilitates tasks the academic researches that involves in this agriculture research industry institutions and similar services will give more flexibilities and dynamic resource utilization which solves the scalability issues [5]. Then the Virtual agricultural Services on top of Cloud Computing layer helps to solve limitations of the current IT service deployment scenario. The next figure 5.2 shows a general agricultural market information conceptual architecture based on the cloud computing with an interface layer to control the user's access to different services.

5.2.1. Conceptual Architecture of Cloud Based Agricultural Market Information

This conceptual architectures specifies the virtualization technology to be used to build a cloud based Agricultural market information above the hybrid cloud infrastructure in order to use and access the resources everywhere, anytime and using any devices and also to use resources more effectively and to support the QoS (Quality of Service) objectives such as high availability, performance, reliability, scalability, load balancing and security in the service models (IaaS, PaaS, SaaS) of the cloud.

The Proposed conceptual Architecture consists of primarily of four User Interface, SaaS, PaaS, and IaaS) and two vertical layers (Service Management and Integration and System Security Layers).

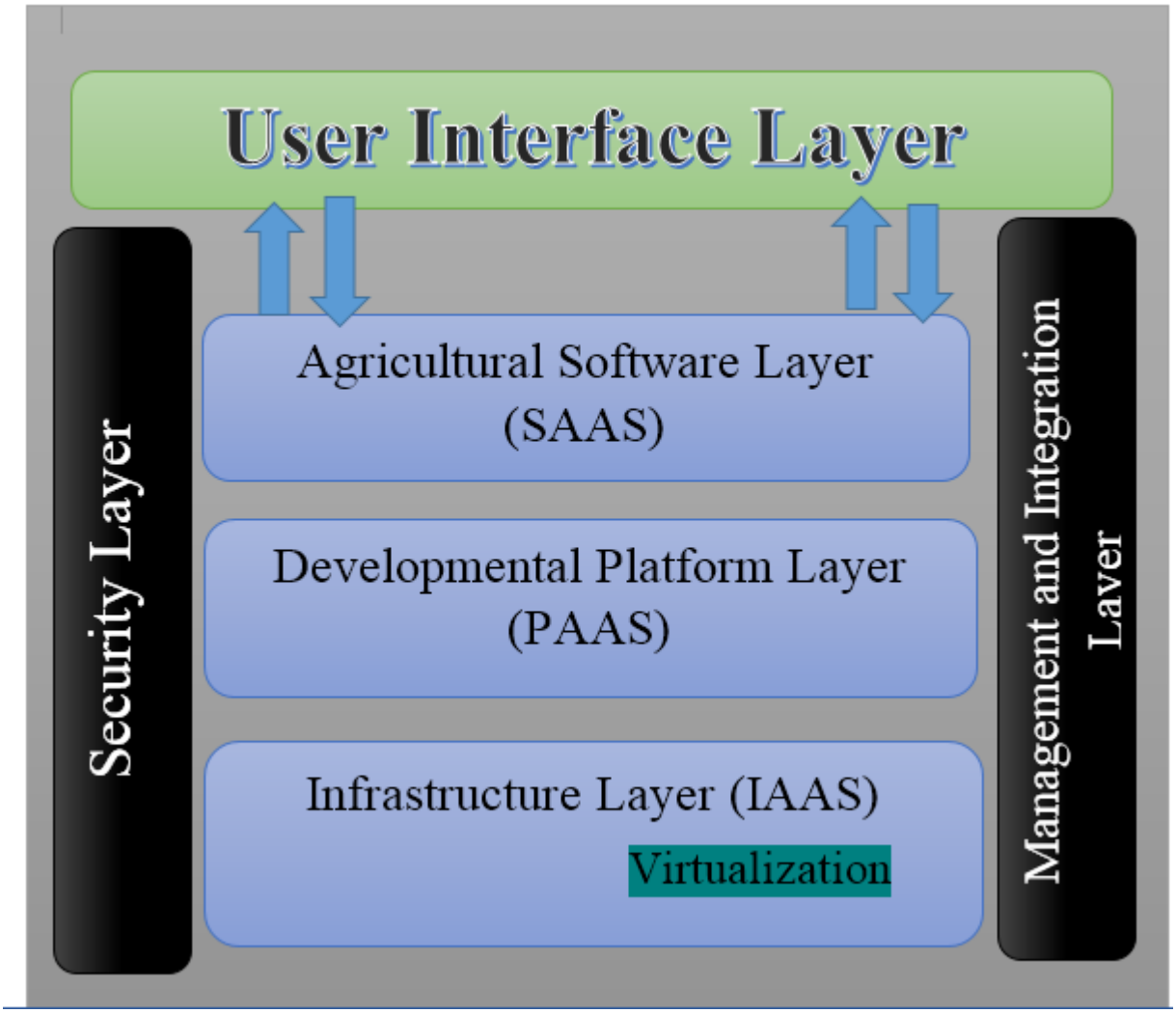


Figure 5-2: Agricultural Market information conceptual architecture

I. User Interface Layer

The user interface is simple, user-friendly and easily understandable, without much graphics and drawings. It will reduce the amount of memory required by the application and reduces the time of development. The original version would be designed with interactive and user-friendly icons and menus. The end-users communicate with the cloud based Agricultural market information system using the browser enabled devices by means of the protocols (like http, https).

II. Agricultural Software Layer (SaaS)

At the SaaS level, service providers offer consumer or industrial applications directly to individual users and enterprise users. At this level, the following technologies are involved: Web 2.0, Java Server Page (JSP), C#, ASP.Net, Microsoft SQL server 2012, Mashup, SOA and multi-tenancy. The development of AJAX technology of Web 2.0 makes Web application easier to use, and brings user experience of desktop application to Web users, which in Cloud Computing Technologies and Applications turn make people adapt to the transfer from desktop application to Web application easily. Mashup technology provide a capability of assembling contents on Web, which can allow users to customize websites freely and aggregate contents from different websites, and enables developers to build application quickly. Similarly, SOA provides combination and integration function as well, but it provides the function in the background of Web. Multi-tenancy is a technology that supports multi tenancies and customers in the same operating environment. It can significantly reduce resource consumptions and cost for every customer.

Agricultural Software as a service for users to manage interactions with Cloud Services in Ministry of Agriculture institution. Cloud application layer deliver software as a service over the Internet, eliminating the need to install and run the application on the customer's own computers and simplifying maintenance and support. This layer provides the SaaS to the end-users of the institutions. The agricultural resource access software using web2.0 tools or above and other licensed third-party software are installed in the Ministry of Agriculture institution s cloud and these are provided to the users as a service. Apart from this, it provides various customization options to the end-users using the protocols such as REST, SOAP etc.

III. Agricultural Development Platform Layer (PaaS)

Cloud platform services deliver a computing platform and/or solution stack as a service, often consuming cloud infrastructure and sustaining cloud applications. It facilitates deployment of applications without the cost and complexity of buying and managing the underlying hardware and software layers. The Platform Layer adds on a collection of specialized tools, middleware and services on top of the unified resources to provide a development and/or deployment

platform. Platform as a Service (PaaS) offers a high-level integrated environment to build, test, and deploy custom applications.

At the PaaS level, what the service provider's offer is packaged IT capability, or some logical resources, such as databases, file systems, and application operating environment. Currently, actual cases in the industry include Rational Developer Cloud of IBM, Azure of Microsoft and App Engine of Google. At this level, two core technologies are involved. The first is software development, testing and running based on cloud. PaaS service is software developer oriented. It used to be a huge difficulty for developers to write programs via network in a distributed computing environment, and now due to the improvement of network bandwidth, two technologies can solve this problem: the first is online development tools. Developers can directly complete remote development and application through browser and remote console (development tools run in the console) technologies without local installation of development tools. Another is integration technology of local development tools and cloud computing, which means to deploy the developed application directly into cloud computing environment through local development tools. The second core technology is large-scale distributed application operating environment. It refers to scalable application middleware, database and file system built with large amount of servers. This application operating environment enables application to make full use of abundant computing and storage resource in cloud computing center to achieve full extension, go beyond the resource limitation of single physical hardware, and meet the access requirements of millions of Internet users.

IV. Infrastructure Layer (IaaS)

IaaS comprised of the physical assets we can see and touch: servers, storage, and networking switches. At the IaaS level, what cloud computing service provider can offer is basic computing and storage capability. Infrastructure as a Service (IaaS) provisions hardware, software, and equipment's to deliver software application environments with a resource usage-based pricing model.

- Physical Sub-layer: It mainly supports the basic environment, including computers, storage, network interconnect devices, and database resources.

- ❖ Virtual Resources Sub-layer: Using virtualization technology, IT resources are combined into resource pools: the computing, data, network, storage resource pool. Thus a large number of the same type of IT resource is configured into graph isomorphism or near graph isomorphism, providing high performance services. So using virtualization technology, we could provide as little as 0.1 CPU in a virtual machine to the end user, therefore drastically increasing the utilization potential of a physical server to multiple users.

V. Service Management and Integration Layer

The Management and Integration layer is used to automate the flow of filtered data and information between the horizontal layers. It ensures that processed outputs from one layer to another are contextually related and syntactically correct. It also a management layer that leverages automation and functions across physical, virtual, and application resources is another required layer for higher IT maturity.

The cloud integration is the ability to deliver a complete integration stack from the cloud, including interfacing with applications, semantic mediation, flow control, integration design, etc.

VI. System Security Layer

The Security layer ensures the necessary authentication, authorization and auditing for the use of data and services by legitimate users. Further, it ensures secure personalization of end users services based on pre-defined preferences for processing and retrieval of contextual information from a Cloud environment. Each service layer has different levels of security requirement in the cloud based educational resource sharing environment.

5.2.2. Proposed Cloud Computing Architecture

This is the proposed architectures for adopting of cloud architectures in agricultural sectors of Ethiopia especially in market informations. In this architecture the researchers was proposed cloud service consumers which is using the system at the end of the result, service integration tool that used to integrate or configure cloud service providers and cloud service consumers by using different software platforms and development tools like application development software tools and cloud computing toolkits or linking of information flows between cloud-hosted applications and other applications hosted in different clouds or in the data center. Without integration, cloud

applications can't share data with the rest of the company and that limits or even eliminates the utility of the cloud. Basic cloud integration tasks can be performed by IT professionals using techniques similar to those already adopted for in-house application deployment. The other services that I had considers in this architecture cloud services this service can be combines different service models like Agricultural software as a service, that consists the user using services of like market prediction information, market surveillance system information, market data warehousing, weather information, soil related information and crop related information.

And also, the proposed architecture considers the service of Platform as a service. The proposed architecture uses platform as a service cloud computing tools that provides a platform allowing customers to develop, run, and manage applications without the complexity of building and maintaining the infrastructure typically associated with developing and launching an applications, development environments that specifies the applications and operating systems to be developing and managing the system and considers and combines the management services.

Similarly, the architecture compiled the service of Infrastructure as a service (IaaS) that refers to refers to online services that abstract the user from the details of infrastructure like physical computing resources, virtualization that used to the act of creating a virtual (rather than actual) version of computer platforms, storages that uses to hold data or information on the cloud and networking.

Finally, the architecture considers in all perspectives of Service Development and Application Integration Tool that refers to the overall of integrated products that provide for the management of public, private and hybrid cloud environments. The minimum requirements to be included in this category are products that incorporate self-service interfaces, provision system images, enable metering and billing, and provide for some degree of workload optimization through established policies. More-advanced offerings may also integrate with external enterprise management systems, include service catalogs, support the configuration of storage and network resources, allow for enhanced resource management via service governors and provide advanced monitoring for improved "guest" performance and availability. Not only covers the products it can be considers other services like the operational and business support services to integrate the services and applications from one to the other.

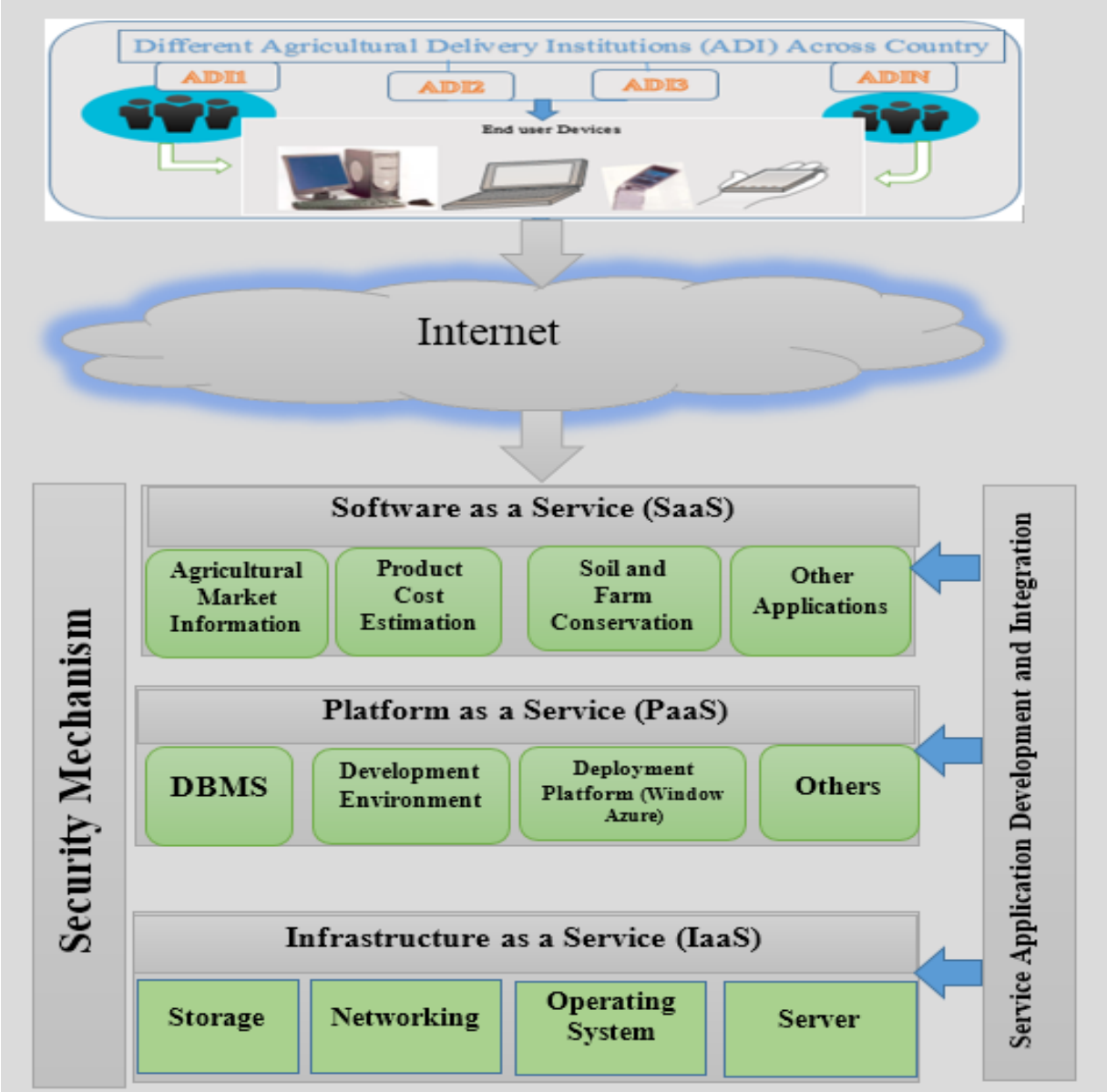


Figure 5-3: Proposed Architectures for agricultural sectors

5.2.2.1. General Definition of Proposed Architectures

The general description of the proposed architectures have six main components and modules to deliver agricultural resources and products in between end users. Those components are

1) Service Development and Application Integration Tool

This service development and Application integration Tool can be used to integrate different components of agricultural services with other agricultural service layer to access and use the

service and resources and products of its layer. And also its development tool can be used for end users to access and exchange information.

2) Infrastructure as a Service(IaaS) Layer

Infrastructure as a service (IaaS) takes it one step further than SaaS and PaaS. IaaS is when providers are handling only the infrastructure for a user and the user can run and develop software within the hired cloud infrastructure which is situated in a datacenter often. The user can run operating systems and applications on their own terms, maintain the storage and deploy the network they want by hosting firewalls [46]. The users access the information using compatible operating system, network and retrieve the data from server by using the layer of agricultural infrastructure service(like agricultural market information, product cost estimation and others).

3) Platform as a Service (PaaS) Layer

This layer used for users to access the products or resources that develop by the developer using any independent devices which is deploy on the server. The windows azure provider can be used for the purpose easily access and view the information which stores the data globally or locally. The researcher deploys the development on the local machine by compiling the windows azure service like .NET programming languge, DBMS (to integrate data from multiple source systems, enabling a central view across the Ethiopia agriculture institutions, to restructure the data so that it makes sense for users which uses the agricultural market information and to restructure the data so that it delivers excellent query performance, even for complex analytic queries, without impacting the operational systems.)

4) Software as a Service(SaaS) Layer

Software as a service (SaaS) is focused on renting out applications to users that use it over a subscripted time. The application is not owned by the user, it is owned by the provider that makes the user pay for the amount of time they want to be able using it [14]. In this layer the architecture combines different components as a software service like soil related information that describes/used to make better farm management decisions with irrigation, drainage, fertility and amendment applications and understand soil variability to target precise sampling locations,

sometimes reducing the number of samples required – thus saving time and money, Market surveillance for products ensures that products on the market are in conformity with the applicable law. This helps foster trust from consumers buying products or financial services. The user is not responsible for the maintenance of the application. The users can access the agricultural market information by using any independent devices which is responsible to use the system.

5) Devices

In this components what are the available devices that can access and use the end products and resources of agricultural services. The most devices that used to deliver and use the resources computers, different laptop, smart mobiles and other supported services

6) End Users of Services

The End users of a cloud service is an enterprise or an individual, researchers, policy makers, experts and farmers who uses the cloud service provided by the cloud computing provider. The user doesn't have any hardware of infrastructure in-house but use the provided service from the provider by a connection to the internet.

5.2.3. Architecture for Delivering Agricultural Market information Services through Cloud

This architecture for delivering agricultural Market Information services through Cloud based architecture to implement in agricultural institutions .The proposed architecture for agricultural Market Information services is shows in Figure 9. The four layers architecture distributing the service platforms.

I. User Layer

In the agricultural Market Information services users have their administrator and guest roles to manage and access the information what they want to be based on their roles. When implementing cloud based agricultural Market Information services it is important to clear define scope of each user role in terms of access right and set of available features. This user layer mainly responsible for checking the track of the authorizations users and its access mode which is selected in the User Interface layer checked them via this module. Users' information is stored in the Users Logs module.

II. Devices layer

The end-users communicate with the cloud based agricultural Market Information services using the browser enabled devices such as (handheld computers, notebooks, net-books, ultra-books, tablets and mobile phones) by means of the protocols such as RDP, SSH and Http/Https.

III. Connection Layer

In order to use cloud computing services, a device has to ensure secure and reliable network connection. Considering availability, GSM network are the most often used network connection technology in Ethiopia context and also (3G and 4G) and wired network connection technology also possible to enable access the services. In terms of reliability, Network bandwidth and latency for Mobile device connection to Internet.

IV. Cloud services Layer

Cloud that hosts agricultural Market Information services can be implemented in hybrid cloud infrastructure in order to use the resources more effectively and also to support the QoS (Quality of Service) objectives such as high availability, performance, reliability, scalability, load balancing and security in the service models. Considering service models (SaaS, PaaS and IaaS) of cloud computing, SaaS is the most appropriate. Agricultural Market Information services applications are provided to the users of Agricultural Market Information services system by using user registration and direct accessing the web application.

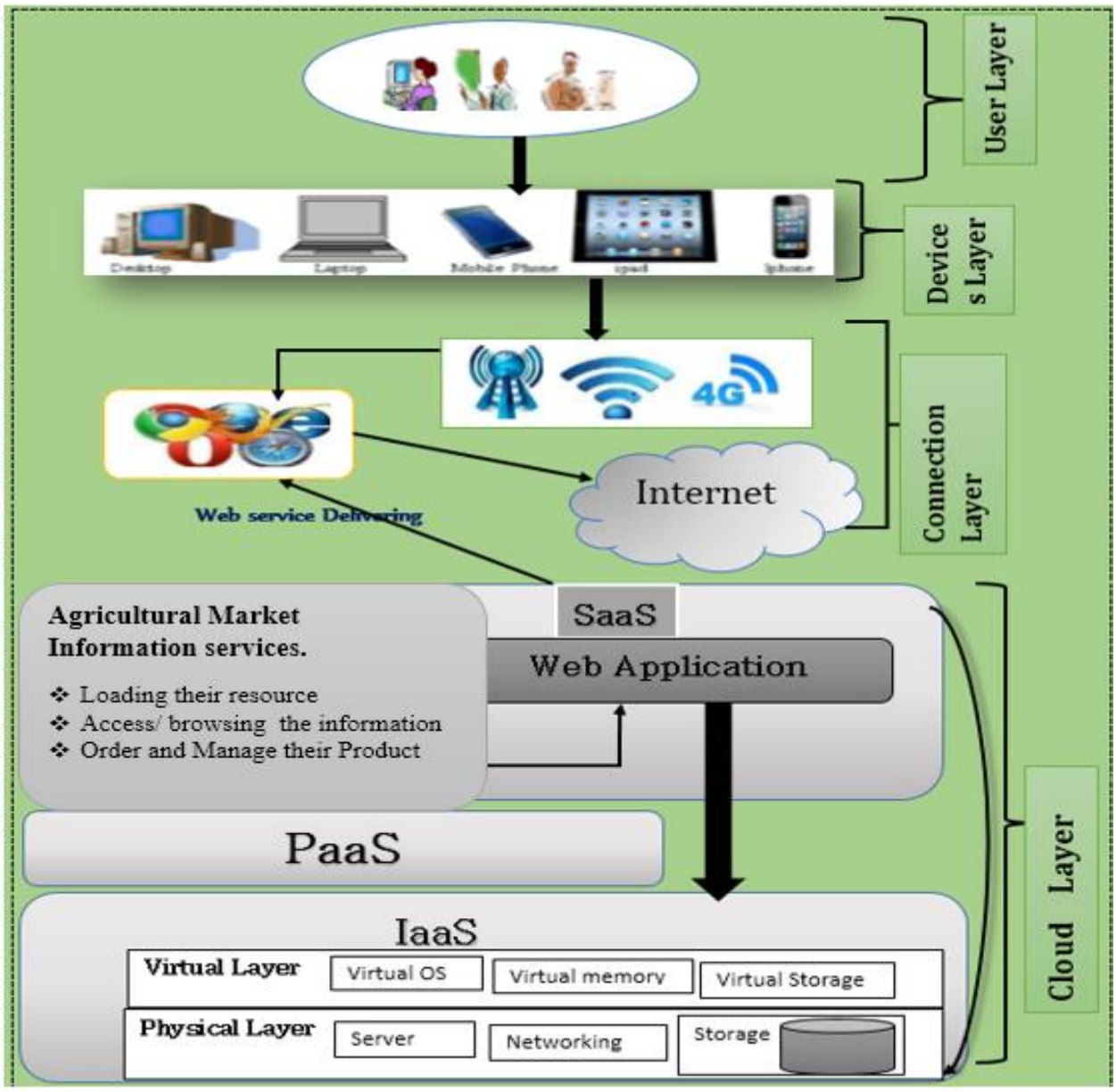


Figure 5-4: Agricultural Market information resource service delivering architecture

Based on the identified services and selected Cloud platforms, the researcher proposed Cloud Computing architectures for Agricultural Market information resource that apply in Ethiopian agricultural institutions.

CHAPTER SIX: DEVELOPMENT PROTOTYPE

In this chapter, we provide overview of the prototype implementation of the suggested architecture elaborated in chapter five.

6.1. Architecture Description Approach

Object-oriented programming development, model-view-controller (MVC) is the name of a methodology or design pattern for successfully and efficiently relating the user interface to underlying data models. The MVC pattern is widely used in program development with programming languages such as Java and visual studio programming language [47].The MVC pattern has been heralded by many developers as a useful pattern for the reuse of object code and a pattern that allows them to significantly reduce the time it takes to develop applications with user interfaces.

The model-view-controller pattern proposes three main components or objects to be used in software development: **A Model** [48] it represents the data to the user. This level defines where the application's data objects are stored. The model doesn't know anything about views and controllers. So, whenever there are changes done in the model it will automatically notify observers that the changes are made. The model may be a single object or a structure of objects.

A View A view is a visual representation of the MVC model. This level creates an interface to show the actual output to the user. However, a view will not display anything itself. It is the controller or model that tells view what to display to the user. It also handles requests from the user and informs controller. A view is connected to its model and gets the data necessary for the presentation by asking certain questions. Sometimes, it also updates the model by sending appropriate messages. All these questions and messages are sent back to the model in such an easy terminology that it can easily understand the information sent by model or a controller.

A Controller [48] which represents the classes connecting the model and the view, and is used to communicate between classes in the model and view. **The Controller** is essentially the traffic cop of the application, directing traffic to where it needs to go, figuring out which view it needs to load up, and interacting with the appropriate models. For example, when you go to login to your email on a website, the controller is going to tell the application that it needs to load the

login form view. Upon attempting to login, the controller will load the model that handles logins, which will check if the username and password match what exists within the system. If successful, the controller will then pass you off to the first page you enter when logging in, such as your inbox. Once there, the inbox controller will further handle that request.

The main reason that used this MVC architecture [49] it can be faster development process if an MVC model is used to develop any particular web application then it is possible that one programmer can work on the view while the other can work on the controller to create business logic of the web application. Hence this way, the application developed using MVC model can be completed three times faster than applications that are developed using other development pattern. Ability to provide multiple views, Modification does not affect the entire model it is obvious that you make frequent changes in your web application like changing colors, fonts, screen layouts, and adding new device support for mobile phones or tablets. Moreover, adding new type of views are very easy in MVC pattern because the Model part does not depend on the views part [48]. Therefore, any changes in the Model will not affect the entire architecture, MVC model returns the data without formatting and With MVC it can be easier to test the core of the application, as encapsulated by the model.

6.2. Implementation Overview

The Agricultural Market information based Architecture cloud portal is designed to be easy to navigate, simple to look at, easy to access the available resources and any relevant information's, user friendly and easy for Agricultural institution providers and other practeonries who want to access and load their products and resources for others and itself . The technologies that were used for development of the prototype are:

- Asp.net C# and CSS for designing the web interface of the web application
- Visual studio 2013 asp.net C# language for frontend side of the prototype
- Window Azure online platform for creating and testing the Agricultural Market Information Cloud computing Based Architecture(CCBAAMI) application
- Microsoft SQL Server 2012 for backend database application to store and access all relevant information's.

- ❖ Internet Information Service (IIS) for local server deployment the application because it is one of the window azure role. A web role is designed for code that talks directly with web browser or other HTTP clients, i.e. it depends on IIS, Microsoft webserver

The application can be deploy using www root to show the cloud applications of Microsoft azure. Instead of windows azure the researcher deploy the applications on the local machine using internet information service (IIS) and run the application in World Wide Web (WWW) directory due to the internet connectivity problems.

Figure 6-1 shows the how to deploy the application and access on IIS.

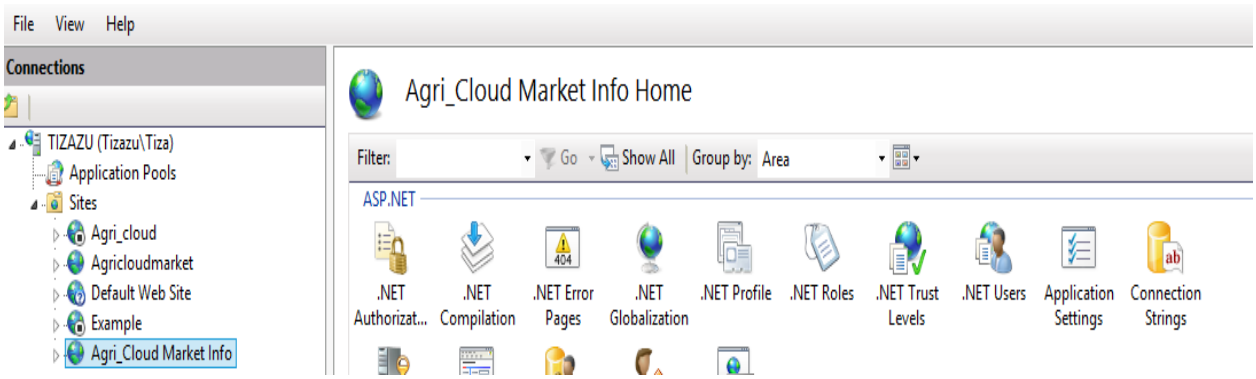


Figure 6-1: Web App Deployment using Local machine

The prototype is designed for both desktop and mobile devices. Figure 6-2 shows the developed application screenshots for desktop and mobile view respectively.


Home
Agri_Market information
Exchange Products
Post your Product
About
Contact
Register
Login
Cloud Based Architecture for Agricultural Market information
Marketinformations
Welcome to AMI
AMIS aims at providing comprehensive one-step market price information services. It aims to provide agricultural commodity intelligence to wider audiences at once.
Agricultural Market Information generates access the informations like reports, prices and policy impacts. The Agricultural Market Information (AMI) is initiative important for agricultural specially which live in rural area or far apart in urban and they can be seen and advert theier product like wheat, maize, rice and soybeans using their own phone .
Exchange Products
Ethiopia is highly dependent on the export of agricultural productivity, but there is no application Infrastructure to Export and import the products. There are a lots of products to export and import(such as coffee products, oil Seed products Pulse products) and so on.Coffee is the prime export product for Ethiopia. However, this application used to access the informatons which products are avilable and used to share the the products items and costs.
Join a Member
If you want to join a member you can and you can see latest agricultural information
Post your Product
If your product is in document or image format level you van post / advert and download the files or imeges that you want to access. simply clicking the link on themenu bar or on the home page and you can share and access the resources
Product Price
Here is the link to see the products maximum minimum cost and avarage cost that you want to see the product cost based on its type and name. you can also upload your products with its fixed price
Join a Member
If you want to join a member you can

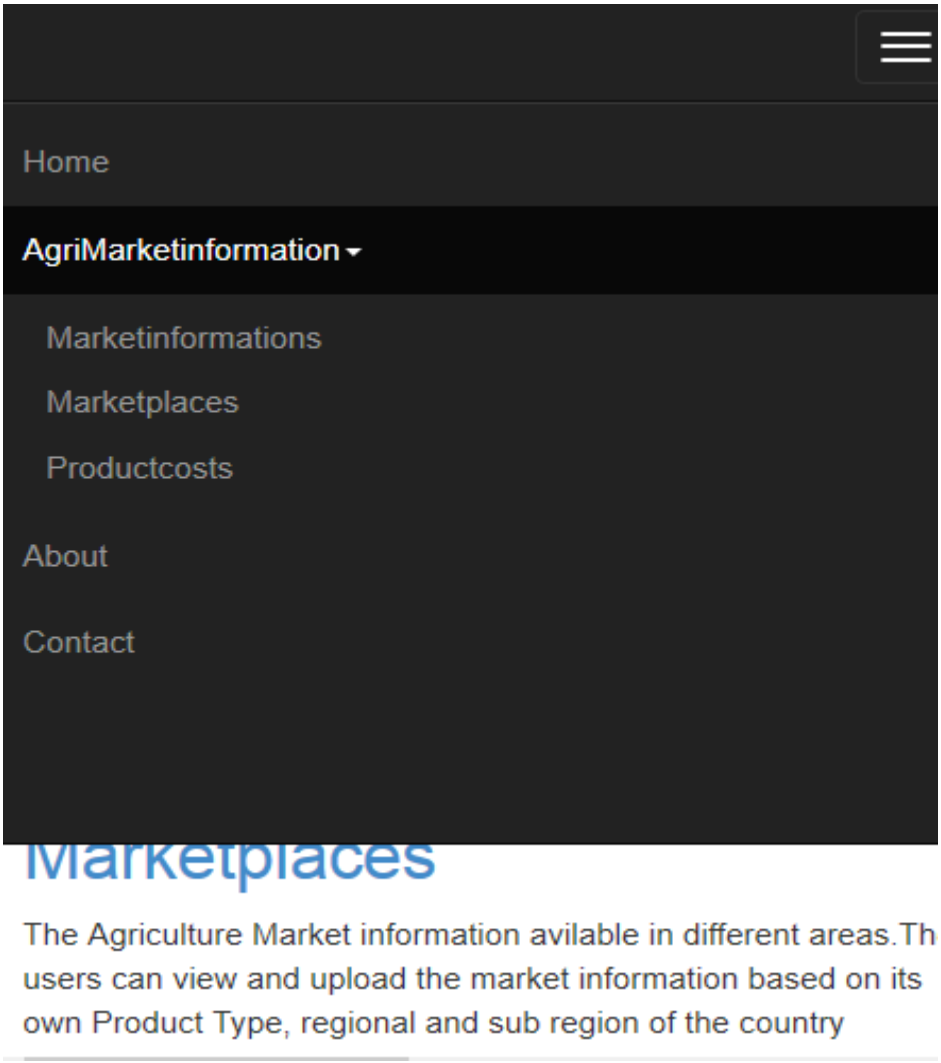

Home
AgriMarketinformation
Marketinformations
Marketplaces
Productcosts
About
Contact
Marketplaces
The Agriculture Market information avilable in different areas.Th
users can view and upload the market information based on its
own Product Type, regional and sub region of the country

Figure 6-2: Screenshots of desktop and mobile view prototype respectively

The architecture contains the functionalities of the system to share and access agricultural market information's like uploading, editing, deleting and creating of any agricultural market information's from local machine database.

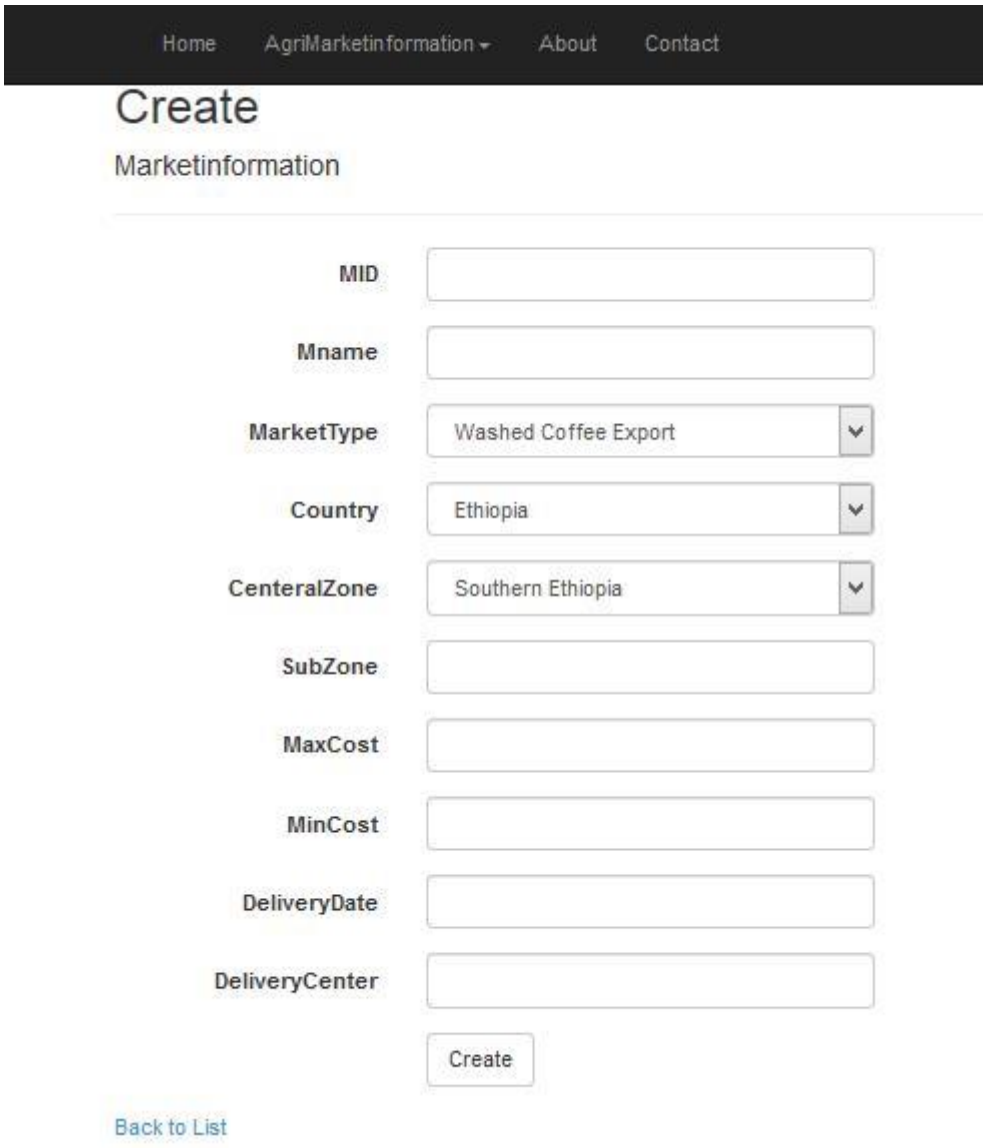


Figure 6-3: Screenshot to creating and loading market Resources

6.3. System Integration with other devices

This architecture is used to integrate to share and access the Agricultural market information using any smart devices that use browsers to access the uniform resource locater (URL). To access the information the implementation part of MVC uses bundle configuration, route configuration, identity configuration and other class to compatible with other devices

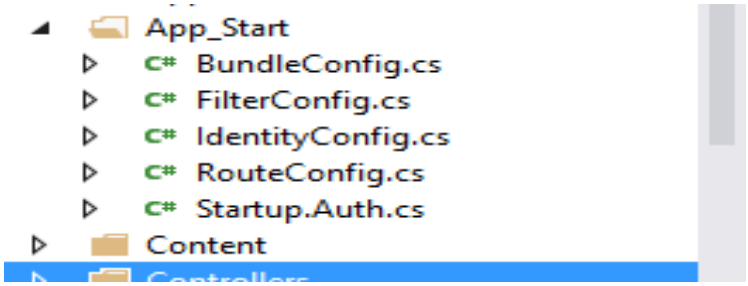


Figure 6-4: Screen Shoot for System Integration class implementation

6.4. System Evaluation and Validation Testing

Cloud computing based architecture for agricultural market information (CCBAAMI) from the area of agricultural institutions, providers and practionries checks the functionality and usefulness of the systems that deliver the products and resources of market information. Because of this study is qualitative, evaluation criteria also based on availability, scalability, cost and performance. In terms of availability CCBAAMI system were accessed anywhere any time principle using any browser and is automatically scalable with reduced cost and good performance.

6.4.1. Unit Testing

The CCBAAMI (Cloud Computing Based Architecture for Agricultural Market Information) to be tested to accessing relevant information. Both resource sharing and resource accessing were tested on window azure platforms after implemented using cloud technologies and visual studio web forms.

Table 6-1: Sample Unit Testing

Test NO	Test case Objectives	Descriptions	Results
1.	Registering users by identifying their level	Click on registration from the front page ; provide information	User information sent to database
2.	Get the information and access to the resource and products that available on the database	Click on login from the front page and provide information	Users login to the system
3.	Storing , accessing and posting relevant data on the database	Point on Browse menu and click on Create, Details/edit resources link	Store the resources to the database

6.4.2. Integration Testing

This system was integrated different components and tested based on unit interface, completeness of interface and by creating integrated test condition for all interface. The following integration test conditions were used

- ❖ Resource and comment storing and retrieving test, file processing test and search test were checked. Each interface are validated based on providing input and using output.
- ❖ Integration was done for resource accessing, sharing and management using visual studio and local server database.

Table 6-2: Sampling Integration Testing

Test NO	Test Case Objectives	Descriptions	Results
1.	Check the link between resources and services	Click on resources link and then service link	To be directed to services from resources
2.	Check the link between login and Browse	Enter username and password and click on login	To be directed to Browse feature
3.	Check the accessing of information on service	Accessing the information using any browsers on different locations	To be getting relevant information's that the user wants

6.5. Validation Testing

6.5.1. Testing Logging Authentication

In this study the authentication mechanisms is based on role claims contained in the authentication token. This is often referred to as role-based access control and it may allow a more granular level of control over access to features and resources. If the user wants to login and enter an errors password or user name the system shows a message on the screen, indicates Please enter valid user name and password.

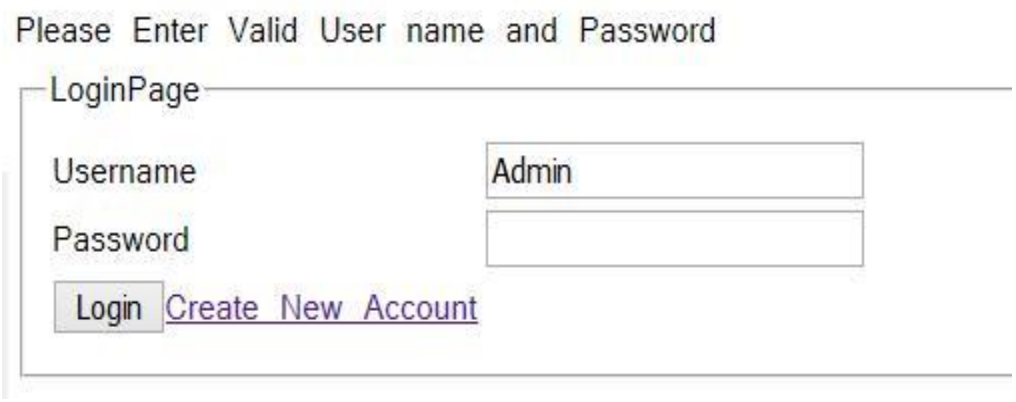


Figure 6-5: Logging Validation Testing

6.5.2. Testing New Registration

When the system Register a user that to create account ,all the information are fulfilled by Input all the information in the text box to a certain value and press the create button. Then a successful message shows on the screen, indicates register successfully. If Register a user without all the information fulfilled: that Input the information in one text box and press the register button ,an error message would be pop up on the screen that indicates registering data unsuccessfully. At below figure shows user registration that the user miss his user name, first name and father name field to fill and the system reject his registration, and display user name, first name and father name field is required. Figure 6.6 shows that validations of new registration

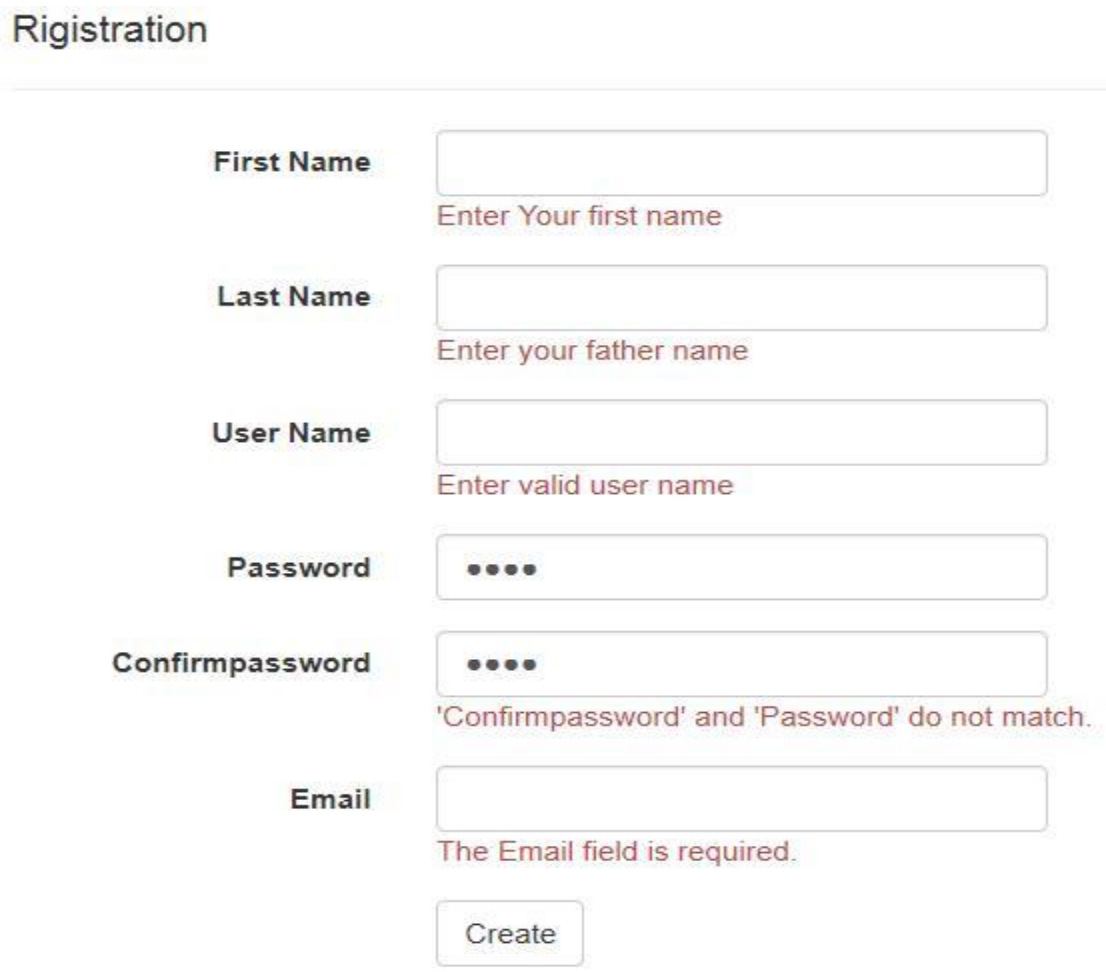


Figure 6-6: Validation testing for new registration

6.6. Evaluation of the Architecture

In the previous section we discussed the functional validity testing. In this section, we explain surveys that we conducted with users in order to evaluate and validate the developed prototype system. Seven closed ended questions for 5 main criteria's prepare to found the result. Based on the questionaries' different practionres gives response based on the system and architectures of interface status and the technical levels of the system. For this thesis twenty four valid sample size of population is selected. (6)Ministry of Agriculture,(8) Ethiopian Commodity Exchange (ECX),(3) Ministry of Communication and Information Technology (MCIT) and (7) Ethiopian Institute of Agricultural Research (EIAR) questionaries' select and analyze based on the requirements

To evaluate the response of the questionnaires, we used the Likert scale one to five i.e. is 1 (poor), 2(fair), 3(good), 4(very good), 5(excellent).The following table shows the evaluation parameter, evaluation questionnaires and the response.

Table 6-3: Evaluation of the architecture and system based on different parameters

No	**Evaluation criteria**		**1 (Poor)**	**2 (fair)**	**3 (good)**	**4 (V.good)**	**5 (Excellent)**
1.	User attractiveness	How do you think the prototype system of the user interface attractiveness?	2	1	11	7	3
2.	User friendliness	Is system architecture of cloud computing easy to use and access using the service?	1	0	14	9	0
		Is the system easy to access resources and tools?	1	1	8	11	3
3.	Reliability	Is the system confidential?	0	0	8	12	4
		Do you think that this system make easier to get necessary resources for your work?	1	1	12	8	2
4.	Performance	How is the browser response time when you start to request a service on the server?	0	0	9	9	6
5.	Efficiency	Is the implementation of cloud computing solutions to share and access resources cost-effective?	3	3	11	5	2

6.7. Evaluation and Results

6.7.1. To Assess User Interface Attractiveness

To evaluate the user attractiveness asked the questions and the respondents gives their response. Cumulative results of the respondents are shown in Table 6.4 and figure 6.7. Table shows that 8.3% poor, 4.2 % fair, 45.8% good, 29.2% and 125% of the responses are very good and excellent respectively. Figure 6.7 presents the result of table 6.4 graphically.

Table 6-4: User Attractiveness

		Frequency	Percent	Valid Percent
Valid	Poor	2	8.3	8.3
	Fair	1	4.2	4.2
	Good	11	45.8	45.8
	Very Good	7	29.2	29.2
	Excellent	3	12.5	12.5
	Total	24	100.0	100.0

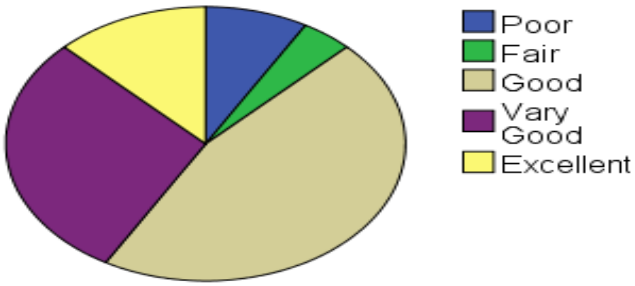


Figure 6-7: User Attractiveness result

6.7.2. To Evaluate User Friendliness

Two questions are asked to evaluate the user friendliness. Cumulative results of two questions are shown in Table 6.5 and figure 6.8. Table shows that 8.3% of the response are Poor, 45.8 % of the response are good, 41.7% of the responses are Very good and 4.2% of the responses are excellent respectively. Figure 6.8 presents the result of table 6.5 graphically.

Table 6-5: User Friendliness Cumulative Result

		Frequency	Percent	Valid Percent
Valid	Poor	2	8.3	8.3
	Good	11	45.8	45.8
	Very Good	10	41.7	41.7
	Excellent	1	4.2	4.2
	Total	24	100.0	100.0

Figure 6-8: User Friendliness Respondent's Cumulative Result

6.7.3. To Assess the System Reliability

Two questions are evaluated in the questionnaire to measure the reliability to conclude the result. Table 6.6 shows that 4.2% of responses are fair, 41.7% of the responses are good, 41.7% of the responses are good, and 12.5% of the respondents are excellent. Figure 6.9 displays the results of Table 6.6 graphically.

Table 6-6: User Reliability Response Results

		Frequency	**Percent**	**Valid Percent**
Valid	Fair	1	4.2	4.2
	Good	10	41.7	41.7
	Very Good	10	41.7	41.7

	Excellent	3	12.5	12.5
	Total	24	100.0	100.0

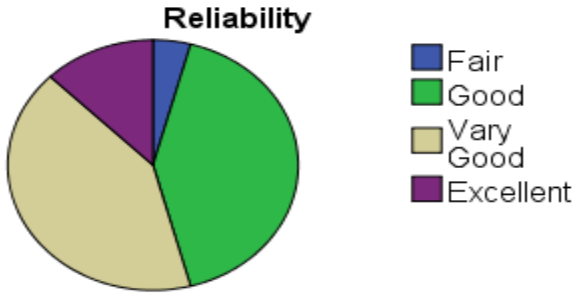


Figure 6-9: User Reliability Respondent Result

6.7.4. To measure the System performance

To measure the performance of architecture and system development takes the respondents response to conclude the result. Table 6-7 shows that 37.5% of responses are good, 37.5% of the responses are V.good, and 25 % of the respondents are excellent. Figure 6-10 displays the results of Table 6-7 graphically.

Table 6-7: Respondents Result on Performance

		Frequency	Percent	Valid Percent
Valid	Good	9	37.5	37.5
	Very Good	9	37.5	37.5
	Excellent	6	25.0	25.0
	Total	24	100.0	100.0

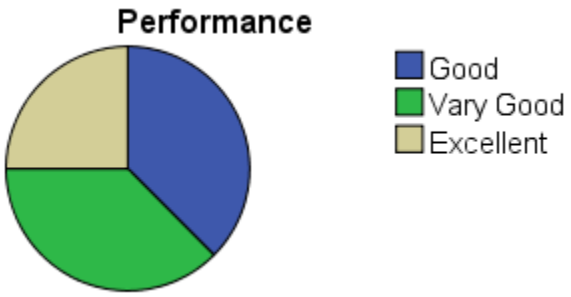


Figure 6-10: performance result respondents

6.7.5. To Measure the System Efficiency

To measure the efficiency of architecture and system development takes the respondents response and conclude the result. Table 6.8 shows that 12.5% of responses are poor,12.5% of responses are fair, 45.5 % of the response are good, 20.8% of the responses are V.good, and 8.3 % of the respondents are excellent. Figure 6-11 displays the results of Table 6-8 graphically.

Table 6-8: Efficiency result based on respondent

		Frequency	Percent	Valid Percent
Valid	Poor	3	12.5	12.5
	Fair	3	12.5	12.5
	Good	11	45.8	45.8
	Vary Good	5	20.8	20.8
	Excellent	2	8.3	8.3
	Total	24	100.0	100.0

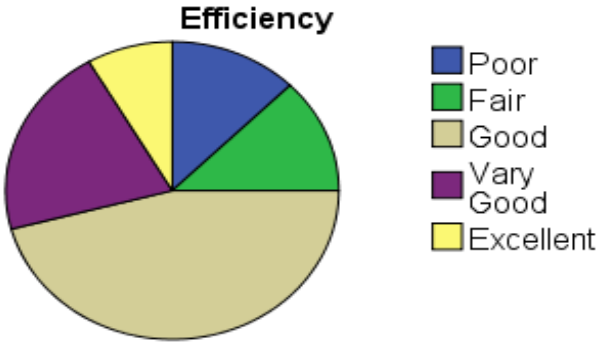


Figure 6-11: Efficiency Result Based on Respondent

Based on the respondents response the maximum number of respondents encourage positively accordingly the respondents result. The proposed cloud based platform architecture increases availability, reliability and efficiency for agricultural market information users and clients to access the information.

Therefore, the proposed architecture and the implemented prototype system seems to have capability of sharing and accessing resources of all types products on agricultural institutions. So it adds more flexibility in accessing resources that can be used for the clients. Also the prototype is customizable and managed by the cloud provider which reduces management overhead, the interactive user interface allows to easily registering and login to the system to access all resources and products, therefore increases collaboration of Agricultural institutions. Also, using cloud computing we can built and implement reliable and accessible architecture and application to access agricultural market information resources anytime, anywhere and which makes to increase the buying, selling and accessing on agricultural institutions.

CHAPTER SEVEN: CONCLUSION AND FUTURE WORK

This chapter begins with a discussion of the findings of the case study presented. This is followed by conclusions based on the study. Finally, the chapter includes recommendations for cloud computing technology adoption as well as for further research.

7.1. Discussion of a Conclusion

In this research found that Information communication Technology (ICT) infrastructure in Agricultural institutions have positive and negative impacts for agricultural market information to deliver and produce goods for their customers using the infrastructure of technology. The current ICT service delivery in the institutions, and identification of better ICT service delivery technologies has been studied to see the challenges and limitations of ICT. After identifying the challenges and limitations, the research showed that Cloud Computing can overcome most of these limitations to facilitate the goods and services in day to day activities in agricultural institutions.

The primary focus of this research is identify the limitations and challenges of cloud computing to develop a Cloud Computing architecture that can be used by Ethiopian Agricultural Institutions, which would enable service delivery much more efficient and effective than the current system. After identifying the limitations and challenges of cloud computing we have proposed the best service deployment models of cloud computing to adopt the architecture. A Hybrid Cloud Computing Model is chosen, because this cloud deployment scenario enables Ethiopian Agricultural Institutions (EAI) to use private cloud in collaboration with other public cloud service providers in case if it is difficult to deploy the service in private clouds. This framework is designed to be implemented and managed by the collaboration of Ministry of Agriculture (MOA) and other sectors like Ethiopian Commodity Exchange (ECX).

In addition, to deployment models we have discuss the cloud service layers to adopt cloud based architecture for agricultural market information, in cloud there are different service layers but the most essential and common service layers are Infrastructure as a service(IaaS), Software as a Service(SaaS) and Platform as a Service(PaaS) [19] [21] [16] [20]. A Platform as a Service (PaaS) is chosen because it delivers a computing platform and/or solution stack as a service, often consuming cloud infrastructure and sustaining cloud applications. It provides a consistent

hardware and software infrastructure aimed entirely at running applications, using cloud providers such as within Microsoft Windows Azure than other service layers.

And also we have discuss the results of data analysis based on different questioner and interview parameters that classifies with section what the user says and needs in **APPENDEX I** and **APPENDEX II**, Even though the practionares different ideas but most of our criticize to adopt common cloud computing architecture for market information is the only options to aware and deliver products and services in agricultural sector and to address the differences and limitations.

7.2. Conclusions

In this thesis, discusses different cloud topics like cloud deployment types, service delivery models and related concepts. It also discusses the benefits and limitations of cloud computing to Agricultural institutions. This research investigated the potential benefits of adopting cloud architecture for agricultural sectors and data analysis to see the gaps in between respondents. The aim of this thesis was introduces how to share market information relevant to agricultural sectors, access the market information based on their types using any type of technology devices, Explore the potential benefits of Cloud Computing in rural Agricultures and Identify Cloud technology drivers using cloud computing with in Agricultural institutions in Ethiopia.

We have presented the hybrid cloud platform architecture and prototype implementation for adoption of cloud computing based architecture for agricultural market information's to sharing and accessing of agricultural market information resources in the agricultural area in cloud service. Cloud services are a good option for Agricultural institutions market information since they can save money in hardware and software investments. Lack of ownership, loss of confidentiality and lack of clear strategy have been validated as some of the key barriers to adoption of cloud computing. Therefore decision maker's need to make careful and informed trade-offs between the drivers and barriers once a decision to adopt cloud computing in their organization are evaluated and made. According to the respondents result it is important adopting and designing cloud based architecture to consider and minimize these key limitations. As users keep accepting IT and the use of web applications, an increasing number of organizations are adopting cloud computing. A good alternative versus in house solutions for most Agricultural institutions market information

Generally, Agricultural institutions will benefit significantly if the model and architecture is implemented properly. The model bridges the information gap both within and outside the nation. In agricultural sector, the suggested model could be considered as a pilot project. The effective implementation of this model will encourage other sectors also, which will lead to optimal benefit of shifting towards cloud computing. This will definitely have a positive impact in the overall economic development of the nation. Cloud computing is a newly introduced concept and most of the developing nations were not readily willing to accept and implement it at the beginning.

Adoption of cloud computing based architecture for agriculture market information have various benefits like, cost efficiency, ease of manpower and infrastructure and minimal maintenance, most of the countries are shifting towards cloud technology to avail better ICT services. Therefore, the stakeholders have equal awareness, common market information in different regions and promotion among the prime stakeholders to acquire the full potential of cloud computing and have a well-established information base for the nation.

7.3. Future Work

The research possibilities regarding Cloud Computing for Ethiopian Agricultural Institutions market information are immense since the technology is relatively new. The main finding of the research are limited to adopt cloud computing based Architecture for Agricultural market information. Here is a list of some of the future work to be done:

1. The focus on this research is only the adoption of cloud computing architecture in agricultural market information, further research looking at the other service of agricultural sector like soil related information and weather forecasting information is suggested.
2. The research design was focused on only central agricultural sectors in Addis Ababa. Future Studies can be carried out on each regional levels as well as extend the study to cover the zonal levels across Ethiopia.
3. The data collection method was based on questionnaires. Further research can be carried out using qualitative data collection methods such as focused group discussions for the organizations. This would help bring out the more in particular and help generate or contextualization of strategies for adopting new technologies like cloud computing.

REFERENCES

[1] Mili, Rakesh Patel, "Application of Cloud Computing in Agricultural Development of Rural India.," *Patel international journal,* 2013.

[2] Kumbhar Suresh., "The Study of cloud computing challenges in agriculture with special reference to Sangali District(MS)," *International Conference on Advancements in Engineering and Technology,* p. 12, 2015.

[3] Mukabi and Indimuli James Stephen, "A Fraemwork for cloud computing adoption for agricultural conultative groups in kenya," University of Nairobi , Augest 2013.

[4] Dean and P. Holzworth "Agricultural production systems modelling and software: Current status and future perspects," *Enviromental Modelling & Software,* 2015.

[5] S. Chaudhuri, "Application Of Cloud Computing In Agricultural Sectors For Economic Development In Bhutan," *JOMASS ,* vol. Volume 1, no. Issue 2, April 2014 .

[6] H. Nuseibeh, "Adoption of Cloud Computing in Organizations," *Association for Information System Electronic Library (AISeL),* 2011.

[7] Mell and Grance, "The NIST definition of cloud computing. National Institute," 2012.

[8] S. Belachew, "A Cloud computing framework for Ethiopian Higher education institutions," Addis Abeba, 2012.

[9] Nyakeya and Dennis Maige, "Adoption of cloud computing in the NGO sector Kenya," University of Nairobi, 2012.

[10] DC Plummer, TJ Bittman, Austin, T., Clearley, D. and DM Smith, "Cloud computing: Defining and describing and emerging phenomenon, Gartner, Inc. Retrieved," December 22, 2012.

[11] Ronald L. Krutz, Russell Dean Vines Cloud Security: A Comprehensive Guide to Secure Cloud Computing, 2010.

[12] Peter Mell, Timothy Grance The NIST definition of cloud computing, U.S. Department of commerce.

[13] Z. Mahmood, "Cloud Computing: Characteristics and Deployment Approaches," *11th IEEE International Conference on Computer and Information Technology,* pp. 1-6, 2011.

[14] Seena Kalghatgi, Kuldeep P. Sambrekar, "Review: Using Cloud Computing Technology in Agricultural Development,"

IJISET - International Journal of Innovative Science, Engineering & Technology, no. Issue 3, p. Vol. 2 , March 2015 .

[15] "cloud Computing and its security," *National Institute of Standards and Technology,* pp. 14-15, 2009.

[16] M. &. Grance, "Cloud Computing features and characterstics," *National Institute of Standards and Technology (NIST),* 2009.

[17] Hoang Trancong,Steven Goh, "Cloud Computing," in *A Fresh Graduate's Guide to Software Development Tools and Technologies*, pp. 1-6.

[18] Naylor G. Bachiega, Henrique P. Martins, "Open Source Cloud Computing: Characteristics and its Overview," Paulista State University – UNESP, Bauru, Brazil.

[19] "Essentail characterstics of cloud computing".

[20] C. Olive, "Cloud Computing Characteristics Are Key," General physical corporation, [Online]. Available: www.gpworldwide.com.

[21] Gorelik and Eugene Cloud Computing Models, Cambridge: Massachusetts Institute of Technology , January 2013.

[22] Nikita Goel and Toshi Sharma "Cloud Computing- SPI Framework, Deployment Models, challenges," *International Journal of Emerging Technology and Advanced Engineering* , vol. Volume 4, no. Special Issue 1, February 2014.

[23] *Introduction to Cloud Computing, White paper.*

[24] "Windows Azure - The Cloud Computing Platform," Tata Consultancy Service.

[25] "Microsoft Azure Tutorials Point Simply Easy Learning," [Online]. Available: www.tutorialspoint.com. [Accessed September 2016].

[26] Major Singh Goraya and Harjinder Kaur, "Cloud Computing in Agriculture," *HCTL Open International Journal of Technology Innovations and Research (IJTIR)* , vol. Volume 16, July 2015 .

[27] Sushil Kumar Choudhary, R.S Jadoun and H. L Mandoriya, "Role of Cloud Computing Technology in Agriculture Fields," *Computer Engineering and Intelligent Systems,* Vols. Vol.7, No.3, 2016.

[28] Avinash Thakur, Manoranjan Kumar and Rajan Kumar Yadav "Cloud Computing: Demand and Supply in Banking, Healthcare and in Agriculture," *IOSR Journal of Computer Engineering (IOSR-JCE),* vol. Volume 16, no. Issue 3, May-Jun. 2014.

[29] "Cloud computing Market Maturity:Study Results," in *Cloud Security Alliance*.

[30] "The 2016 Report on Cloud Computing World Market Segmentation and Major Players Analysis 2020," 24 November 2016. [Online]. Available: http://www.einpresswire.com/article/334892834/the-2016-report-on-cloud-computing-world-market-segmentation-and-major-players-analysis-2020.

[31] Staten, " Is cloud computing ready for the enterprise Forrester Research,," Augest 12,2013.

[32] Alexander Orrgren and Bennet Gustafson, "The Adoption of Cloud Computing for Small and Medium Enterprises," JONKOPING University, JONKOPING University Business School, 2012.

[33] Amanuel Zewge, Yvonne Dittrich and Rahel Bekele, "Providing Market Information for Ethiopian Farmers: Extending Participatory Design," *Adama Science and Technology University*, pp. 1-5.

[34] Singh, Kusumakar and Archana, "A Proposed Framework for MAD-Cloud and MAD-Expert Service Module," 2013. [Online]. Available: http://inpressco.com/category/ijcet. [Accessed 19 June 2016].

[35] Yanxin Zhu, Di Wu and Sujian Lil, "Cloud Computing and Agricultural Development of China: Theory and Practice Authors," *International Journal of Computer Science and Information Technologies.*, vol. Vol. 4 (6), 2013.

[36] D. Bell, Software Engineering for students A Programming Approach fourth edition., 2005.

[37] " Wikipedia. (n.d.)," Software prototyping., [Online]. Available: www.wikipedia.org: . [Accessed 21 Ougest 2016].

[38] "Qualitative Versus Quantitative Research," Johnson, B., & Christensen, 2014.

[39] *Quantitative, Qualitative, and Mixed Research,* Case 2.

[40] D. A. De Vaus, "Organizing Your Social Sciences Research Paper: Types of Research Designs," University of California, [Online]. Available: http://onlinelibrary.wiley.com/doi/10.1111. [Accessed 21 Ougest 2016].

[41] Collective, "Design-Based Research: An Emerging Paradigm for Educational Inquery".

[42] Thomson, "Descriptive statistics," [Online]. Available: http://wiki.stat.ucla.edu/socr/index.php/SOCR_Courses_2008_Thomson_ECON261.

[44] Gregor von Laszewski, Javier Diaz,et.al "Comparison of Various Cloud Simulation tools avilable in Cloud Computing," *International Journal of Advanced Research in Computer and Communication Engineering* , vol. Vol. 4, no. Issue 3, March 2015.

[45] Dr. Rahul Malhotra, and Prince Jain "Study and Comparison of Various Cloud Simulators Avilable in Cloud Computing," *International Journal of Advanced Research in Computer Science and Software Engineering,* vol. Volume 3 , no. Issue 9 , pp. 1-4, September 2013 .

[46] Mayank Shekhar ,Utkal Sinha, "Comparison of Various Cloud Simulation tools available in Cloud Computing.," International Journal of Advanced Research in Computer and Communication Engineering, vol. Vol. 4 , no. Issue 3, March 2015.

[47] "Definitions of MVC archticture," Amazon web service, [Online]. Available: http://whatis.techtarget.com/definition/model-view-controller-MVC. [Accessed 21 september 2016].

[48] "www.brainvire.com," MVC Models, [Online]. Available: https://www.brainvire.com/six-benefits-of-using-mvc-model-for-effective-web-application-development/ . [Accessed 12 September 2016].

[49] "wekipedia.gov.com," Benefits and Drawbacks of mvc pattern archticture, [Online]. Available: www.wikipedia.com/benefits of MVC Archticture. [Accessed 19 November 2016].

APPENDIX I: QUESTIONNAIRE

Questionnaire to be completed by professionals / higher education staff and IT professionals working in Ethiopian Institute of Agricultural Research (EIAR), Ministry of Agriculture (MOA), Ministry of Communication and Information Technology (MCIT) and Ethiopian Commodity Exchange(ECX) Organizations**.**

Survey Questionnaire on: **Adoption of Cloud Computing Based Architecture for Agriculture Market Information (CCBAAMI) in case of Ethiopia.**

Instructions:

The objective of this questionnaire is to collect the information for thesis that will done in Adama Science and Technology University (ASTU) in relation to designing adoption of Cloud Computing Based Architecture for Agriculture Market information in Ethiopia. Your answer is important to the accuracy and preciseness of the research. Your personal information shall be kept strictly confidential and the data will be exclusively used for this research only. The questionnaire comprises four sections closed and open questions. Please read the questions in each section carefully and complete the questionnaire according to the given instructions.

Definition

It is a technology that uses the internet and central remote servers to maintain data and applications. Cloud computing allows consumers and businesses to use applications without installation and access their personal files at any computer with internet access.

Directions:

- ✓ No need to write your name.
- ✓ Answer by putting a tick mark in the box or by writing in the space provided.
- ✓ In case you have ambiguities on any of the questions, please do not hesitate to contact us through the address mentioned at the end of this questionnaire.

Section I: DEMOGRAPHIC INFORMATION

Name of the organization: _____

Sex: ☐ Male ☐ Female

Department / Theme / Project: _____

Duration worked for Institute:_____year(s) _____ month(s) duration worked in IT industry: _____year(s)_____month(s)

Section II: AWARENESS OF CLOUD COMPUTING

1. Have you heard of the term cloud computing before?

☐

☐ Yes ☐ No

2. When you hear the term "cloud computing", what definition first comes to mind? (Select one)

☐ Fundamental change in how technology services are provided

☐ A tool that might work for another organization.

☐ Another buzzword

☐ Unsure/No idea

3. Which statement best describes your organization's strategy towards cloud computing? (Select one)

☐ Cloud computing has been discussed formally and it is part of our IT strategy.

☐ Cloud computing has been discussed formally but no adoption plan in the pipeline.

☐ Cloud computing has only been discussed informally.

☐ Cloud computing has not been discussed as a topic within your organization.

4. Does your organization have an internet connection?

☐ Yes ☐ No

Section III. CLOUD IDEAL QUESTIONS

1.Does your company host any applications in the Cloud?

☐ Yes ☐ No

2.Which solution do you see as the most suitable for your organization according to this possible Cloud computing taxonomy?

☐ Public cloud (owned and managed by an unrelated business).

☐ Private Cloud (owned and managed internally).

☐ Hybrid cloud (some services hosted internally and some hosted in the public cloud).

☐ Other (Please specify)……

3.Did you believe that cloud computing has benefits to enhancing the quality of agricultural system in market prediction?

☐ Yes ☐ No

☐ Others……

Section IV. BARRIERS OF CLOUD COMPUTING

In your expectations/your knowledge, rate the factors affecting adopting of cloud computing in your organization. (Single response per statement)

Please indicate to what extent you agree with the listed statements by using the following

Scale.

		Strongly disagree	Disagree	Not sure	Agree	Strongly agree
		1	2	3	4	5
No	Questions	Please tick the most appropriate answer Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
1.	Loss of confidentiality					
2.	Lack of control and ownership					
3.	Lack of clear strategy on cloud computing					
4.	Insufficient internet bandwidth					
5.	Loss of confidentiality					
6.	Impact on work practices					
7.	Lack of trusted vendors in the market					
8.	Lock-in to a specific infrastructure vendor					
9.	Lack of security and SLAs					
10.	Cost of deployment					
11.	Maturity levels of your organization					

APPENDEX II: INTERVIEW QUESTIONS

These questions will be used to interview a selected ICT directors, cloud computing professional and Agricultural stakeholders in ministry of agriculture (MOA) and Ethiopian Commodity Exchange (ECX).

1. What is the basic issue that prevent to adopt cloud computing effectively in agriculture institutions?
2. What are the ICT services and supports that are provided to the organization by your office?
3. Do you think these services are enough to achieve your mission and vision, supporting and creating qualified services?
4. What are the limitations in providing the above discussed services?
5. Do you think that these organization has work corporately with other perspective sectors especially in market information?
    A. If you say yes, justify how agricultural market prediction are takes place.
    B. If you say No, describe the problem.
6. What are the requirements of agricultural market prediction institutions toward cloud computing?
7. If a central cloud computing infrastructure is to be built in Ethiopia that could be used by all agriculture institutions of the country to provide ICT services, what will be your reaction to this strategy, what kind of services your organization need from the cloud?
8. What should be done to reach the vision of a cloud supported agricultural sector for market information?

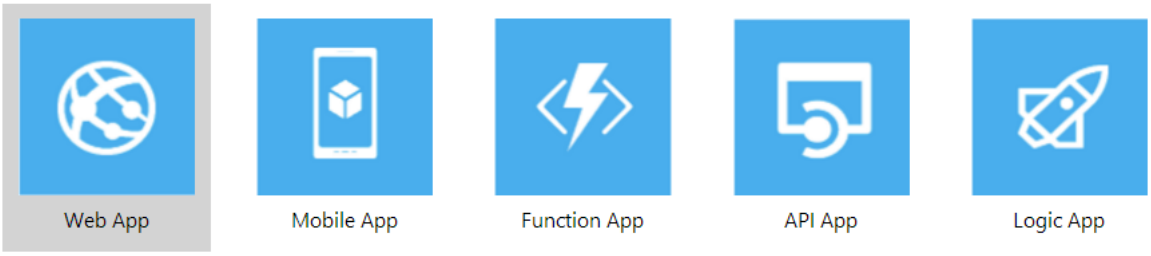
Appendix III: Working with Microsoft Window Azure Platform

In this section we discussed how to work with Microsoft window azure to develop and host application .So to create the proposed application on window azure platform services: we have used App service; that is the platform services is provided to the user by app service. The APP services enable developers to focus on their code and reach a stable, highly scalable production state quickly. With APP services, we can develop web app, mobile app, API APP, logic API etc. Among this, we have selected the web app services.

Creating Web APP Service

To create the web app services on the azure app service platform, we have followed the following three steps.

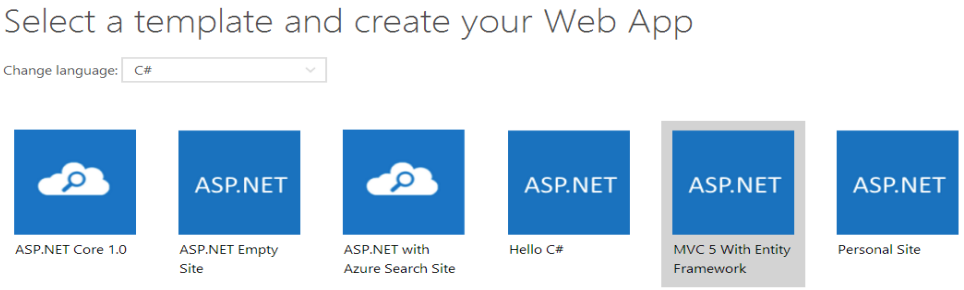
1. Selecting app service type



As we shown in above figure we have selected web app service. Azure Web Apps enable developers to easily deploy and scale enterprise grade web applications written in a variety of languages and integrated with a multitude of services without ever worrying about infrastructure management.

2. Selecting a language

In window azure platform, there is Visual Studio integration tools that allows for the developer for creating, deploying, and debugging applications in online and at developer local machine. The following diagram shows the language selected and its template.



Appendix IV. Sample Code

```
using System;
using System.Collections.Generic;
using System.Data;
using System.Data.Entity;
using System.Linq;
using System.Net;
using System.Web;
using System.Web.Mvc;
using Example.Models;

namespace Example.Controllers
{
    public class MarketinformationsController : Controller
    {
        private MyDatabaseEntities db = new MyDatabaseEntities();

        // GET: Marketinformations
        public ActionResult Index()
        {
            return View(db.Marketinformations.ToList());
        }

        // GET: Marketinformations/Details/5
        public ActionResult Details(string id)
        {
            if (id == null)
            {
                return new HttpStatusCodeResult(HttpStatusCode.BadRequest);
            }
            Marketinformation marketinformation = db.Marketinformations.Find(id);
            if (marketinformation == null)
            {
                return HttpNotFound();
            }
            return View(marketinformation);
        }

        // GET: Marketinformations/Create
        public ActionResult Create()
        {
            return View();
        }

        // POST: Marketinformations/Create
        // To protect from overposting attacks, please enable the specific properties you
want to bind to, for
        // more details see http://go.microsoft.com/fwlink/?LinkId=317598.
        [HttpPost]
        [ValidateAntiForgeryToken]
        public ActionResult Create([Bind(Include =
"MID,Mname,MarketType,Country,CenteralZone,SubZone,MaxCost,MinCost,DeliveryDate,DeliveryC
enter")] Marketinformation marketinformation)
        {
            if (ModelState.IsValid)
            {
                db.Marketinformations.Add(marketinformation);
```

```
                db.SaveChanges();
                return RedirectToAction("Index");
            }

            return View(marketinformation);
        }

        // GET: Marketinformations/Edit/5
        public ActionResult Edit(string id)
        {
            if (id == null)
            {
                return new HttpStatusCodeResult(HttpStatusCode.BadRequest);
            }
            Marketinformation marketinformation = db.Marketinformations.Find(id);
            if (marketinformation == null)
            {
                return HttpNotFound();
            }
            return View(marketinformation);
        }

        // POST: Marketinformations/Edit/5
        // To protect from overposting attacks, please enable the specific properties you
want to bind to, for
        // more details see http://go.microsoft.com/fwlink/?LinkId=317598.
        [HttpPost]
        [ValidateAntiForgeryToken]
        public ActionResult Edit([Bind(Include =
"MID,Mname,MarketType,Country,CenteralZone,SubZone,MaxCost,MinCost,DeliveryDate,DeliveryC
enter")] Marketinformation marketinformation)
        {
            if (ModelState.IsValid)
            {
                db.Entry(marketinformation).State = EntityState.Modified;
                db.SaveChanges();
                return RedirectToAction("Index");
            }
            return View(marketinformation);
        }

        // GET: Marketinformations/Delete/5
        public ActionResult Delete(string id)
        {
            if (id == null)
            {
                return new HttpStatusCodeResult(HttpStatusCode.BadRequest);
            }
            Marketinformation marketinformation = db.Marketinformations.Find(id);
            if (marketinformation == null)
            {
                return HttpNotFound();
            }
            return View(marketinformation);
        }

        // POST: Marketinformations/Delete/5
        [HttpPost, ActionName("Delete")]
```

```
        [ValidateAntiForgeryToken]
        public ActionResult DeleteConfirmed(string id)
        {
            Marketinformation marketinformation = db.Marketinformations.Find(id);
            db.Marketinformations.Remove(marketinformation);
            db.SaveChanges();
            return RedirectToAction("Index");
        }

        protected override void Dispose(bool disposing)
        {
            if (disposing)
            {
                db.Dispose();
            }
            base.Dispose(disposing);
        }
    }
}
```