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Developing Cloud Based University-Industry Linkage Model for Improving Quality of Education: Case of DebreBerhan University

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Abstract:*In the information aspiring today's socio-economic environment across globally, the need to have universities, work together with industry to update and upgrade the whole sphere of activities to ensure students graduate with relevant skills for the workforce cannot be exaggerated. It is also progressively recognized that universities should play a critical role in applying research and innovation to address socio-economic problems as well as promote innovation for economic growth by duplicating strategic partnerships with the productive sectors of the economy and national innovation strategies. Therefore, the study were intended to act as a bridge for the design of university-industry (U-I) cloud model linkages, thereby promoting quality of education and the production of quality manpower towards Ethiopian academic and industry sectors, and to mobilize all stakeholders to highly participate on various activities that are needed to create such linkages. However, there is no any single attempt that tried to analyze or investigate the challenges and prospective of cloud based university-industry linkage potentials in Ethiopian context.*

The study, which reflects the overall goal of the cloud based University-Industry linkage model to improve the quality of products and the services in the industry as well as universities can produce competent and skilled professionals, will serve the needs of universities and industries at various points on the U-I pathway and provide collaborative among the various stakeholders with practical aspects of the linkages.

Specifically, the study provides a model on how to initiate and accomplish U-I linkages as well as illustrate technology and knowledge by transferring or sharing different things like policies procedures, working cultures and other activities between the university and the industry. In addition it is used to disseminate valuable and trusted knowledge and technology that have of potential contribution on university and industry linkage. Therefore, the study was investigate the potential significant of cloud based university-industry linkage to some selected disciplines across sampled universities and different industries, thereby improving quality of work and education in Ethiopian higher education plus industries.

This study therefore was employed mixed types of research methodology (i.e. Qualitative and quantitative research approach) in order to properly explore or investigate the applicability of cloud based university-industry linkage potentials in Ethiopian, thereby designing a framework that can provide effective collaboration through the linkage.

Finally, the findings of the study and the resultant framework is highly applicable in all university-industry linkage activities in Ethiopia.

Keywords: *Cloud Model, University-Industry linkage, Cloud service, security*

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I. Introduction

Currently information communication technology plays a vital role in every domain especially in higher education institutions to enhance quality of education. With the accelerated development of information technologies, there is an increasingly wide range of ways to reach learners who are geographically dispersed, of remotely accessing real equipment, of displaying and visualizing personalized distributed user interfaces and of running real time simulations over computer networks. Emerging technologies are leading to the development of many new opportunities to guide and enhance learning that were unimaginable even a few years ago. There are already about one million courses on the internet, 30,000 of them compiling with a scientific definition of online, 22,000 of these are listed on the tele-campus portal, with many of them making didactic use of the World Wide Web [1].

Although the late nineties are identified as the time when the link between higher education institutions and universities assumed it's highest, the relation goes centuries back. This is specially so in the United States of America where such relationships can be traced back industrial revolution [2]. In Europe where a different

feature of development in U-I linkage was prevalent in the older days, the linkage between the two could also go back to the mid to the late 1800s, though the whole link had been for too long constrained by legal prohibitions and cultural predispositions that were against academic involvement with commerce [2] .

Truly, the 1980s and 1990s are credited with an increase in the number and nature of industry-university ties as evidenced by the mushrooming of a complex array of research consortia, research parks, industrial liaison programs, growing share of industry funding in university income and increasing number of university researchers engaged in academic entrepreneurship in many parts of the world with the exception of such regions as Africa where such phenomenon still appear to be exceptions than realities [3].

The core mission of the University-industry linkage is the education and training of students and the advancement, preservation and propagation of knowledge. U-I linkage encourages research and development and social outreach by creating a research culture that actively responds to the needs of the peoples in the country, whilst also contributing to the global research community. In doing so, U-I linkage seeks to protect the rights and privileges which members of the Ethiopian community traditionally enjoy in the pursuit of knowledge, whilst at the same time [2].

There are varieties of reasons that have influenced the need for university-industry linkage since the 1980s. Chief among these are the decreasing of public resources needed for funding a highly expanding higher education system; the need for improving the relevance of teaching and research; and the need to entice competitiveness of national economies and increase institutional reputations, University-industry linkages can take various forms and levels of partnerships; from contract or sponsored research to joint research, professional courses, and consultancy as well as to creating opportunities for student placements, staff exchange, and joint curriculum development [4].

A study by sebuwufu et al [5] revealed that in order to carry out their role within the innovation system, universities need to be well linked to enterprises, other research institutes, and supported by government policies. The USA, for example, enacted key legislation commonly known as the 1980 Bayh-Dole Act to incentivize patenting, licensing, and technology transfer of university research. Specifically, under the Act, inventions made by universities that have received federal funding may be owned by the university. The inventor must disclose the invention to the university and to the government with a statement that the invention was made with government support. The government retains a non-exclusive, non-transferable, irrevocable, paid up, worldwide license. The government can require the inventor to grant reasonable licenses to third parties under certain circumstances. Many countries in the world have formulated their equivalents of the 1980 Bayh-Dole Act.

With the exception of very few universities in the world, universities generally have been accused of being ivory towers pursuing knowledge of little relevance to the developmental needs of their countries; producing a workforce ill equipped to meet the challenges of industry; and, in general, contributing very little to the practical development needs of respective countries. Therefore, African universities, which do not fully contribute to socio-economic development of their countries, are not quite different from many other universities in the world [6].

As other universities in the world, African universities are focused on the three core missions of providing opportunities for teaching and learning, conducting research, and providing community engagement in various forms. Despite some challenges such as decreasing funding, limited research capacity and inadequately prepared graduates fit for the world of work, the renewal of the continent's higher education at the turn of the 21st century, has led to a number of African universities increasingly voicing an interest in fostering linkages with industry to make them more relevant to their societies as agents of change and development. However, many universities and industries are not effectively equipped or prepared to promote such collaborations with universities in Africa [7].

Over the past few years, the idea of cloud computing, has gained much impetus and has become a more popular trend in information technology [8]. Cloud computing may be defined 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" [8]. Many groups have started implementing these new technologies to further decrease costs through improved machine utilization, reduced administration time and infrastructure costs [8]. Cloud computing is the environment that enables customers to use applications on the Internet such as storing and protecting data while providing a service [9].Further, Cloud computing is receiving a great deal of attention, both in publications and among users. It is a subscription-based service where you can obtain networked storage space and computer resources. One way to think of cloud computing is to consider your experience with email. Your email client, if it is Yahoo!, Gmail, Hotmail, and so on, takes care of housing all the hardware and software necessary to support your personal email account. When you want to access your email, you open your web browser, go to the email client, and log in. The most important part of the equation is having internet access. Your email is not housed on your physical computer; you access it through an internet

connection, and you can access it anywhere. If you are on a trip, at work, or down the street getting coffee, you can check your email if you have access to the internet. Your email is different than software installed on your computer, such as a word processing program. When you create a document using word processing software, that document stays on the device you used to make it unless you physically move it. An email client is similar to how cloud computing works. Except instead of accessing just your email, you can choose what information you have access to within the cloud [10].

II. Literature Review

Cloud computing the term "cloud", as used to have its origins in network diagrams that represented the internet, or various parts of it, as schematic clouds. "Cloud computing" was coined for what happens when applications and services are moved into the internet "cloud." Cloud computing is not something that suddenly appeared overnight; in some form it may trace back to a time when computer systems remotely time-shared computing resources and applications. More currently though, cloud computing refers to the many different types of services and applications being delivered in the internet cloud, and the fact that, in many cases, the devices used to access these services and applications do not require any special applications[13]. Many companies are delivering services from the cloud. Some notable examples as of 2010 include the following:

Google — has a private cloud that it uses for delivering many different services to its users, including email access, document applications, text translations, maps, web analytics, and much more.

Microsoft — Has Microsoft Sharepoint online service that allows for content and business intelligence tools to be moved into the cloud, and Microsoft currently makes its office applications available in a cloud.

Salesforce.com — runs its application set for its customers in a cloud, and it's Force.com and Vmforce.com products provide developers with platforms to build customized cloud services.

But, what is cloud computing? The following sections note cloud and cloud computing characteristics, services models, deployment models, benefits, and challenges.

Characteristics Cloud computing has a variety of characteristics, with the main ones being:

Shared Infrastructure — Uses a virtualized software model, enabling the sharing of physical services, storage, and networking capabilities. The cloud infrastructure, regardless of deployment model, seeks to make the most of the available infrastructure across a number of users.

Dynamic Provisioning — Allows for the provision of services based on current demand requirements. This is done automatically using software automation, enabling the expansion and contraction of service capability, as needed. This dynamic scaling needs to be done while maintaining high levels of reliability and security

Network Access — Needs to be accessed across the internet from a broad range of devices such as PCs, laptops, and mobile devices, using standards-based APIs (for example, ones based on HTTP). Deployments of services in the cloud include everything from using business applications to the latest application on the newest smartphones.

Managed Metering — uses metering for managing and optimizing the service and to provide reporting and billing information. In this way, consumers are billed for services according to how much they have actually used during the billing period.

In short, cloud computing allows for the sharing and scalable deployment of services, as needed, from almost any location, and for which the customer can be billed based on actual usage [13].beyond direct instruction by a teacher-education now centers around creating a viable, productive learning environment, regardless of how teacher-centric that environment might be. When the term education is combined with entertainment, the term edutainment is coined. Edutainment also called "e-learning" are new methods and practices that enabled learning in faster, more efficient and more entertaining ways. The idea is usually to combine games with learning, using software or interactive courses [14].

Engaging kindergarten to Year 12 students in scientific processes is central to science education reform, yet, teachers at all levels have failed to provide students with lab experiences that truly incorporate scientific methodologies Technology can play a key role in improving science teaching and this paper introduces one technology-based approach to provide lab experiences with scientific processes built in. Science laboratories will be presented in historical context to identify current classroom needs [13].

The use of computers as a means to present virtual demonstrations and laboratories will be reviewed as a potential solution, with reference to one particular approach, the Smart Science education system, developed by the authors and their associates [14]. Education is defined as the conscious attempt to promote learning in others. Traditionally, analysis of this attempt has centered around direct teaching on the part of teachers.

2.1. Cloud Services

Cloud is analogical to internet. Cloud computing is internet based computing where virtual shared servers provided software, infrastructure, platform, devices and other 108 Nitin Kumar et al resources and hosting to customers on a pay-as- you-use basis. Cloud computing customers do not own the physical infrastructure rather they rent the usage from a third party provider. They use resources as a service for performing a task and pay only for what they are utilizing. IT organization vendors provide services to the customers which are in turn utilized by customers on pay-per –use basis. Customers can access these services provided by vendors using web-browser. Huge amount of data is stored in many cloud servers and the collection of servers forms a Data center. The services provided by vendors can be classified in three models that actually depict how services are being provided to the customers. Service models are service oriented architecture that tells us about the different level of abstraction [15]. They are as follows:-

Platform as a Service (PaaS)

Paas supplies all the resources required to build applications and services completely by using internet without having to download or install software. PaaS services include application design, development and hosting. Other services include collaboration, web service integration, DB integration, security, scaling etc. Users don't have to worry about purchasing hardware and software or hire experts for management of the software and hardware, it provides flexibility in installing software on system, scalability is a another advantage of the PaaS. A downfall of thePaaS is the lack of interoperability and portability among providers [16].

Software as a Service (SaaS)

Software as a service is the model in which an application is hosted as a service to customers who access it via the internet. It provides us the facility of using different software application, operating system and resources without the need of installing them on your own machine, upgrading and buying licensees.

C. Infrastructure as Service (IaaS)

This model is responsible for providing virtualized computing resources, network resources with IaaS users assemble their own virtual cluster on which they are responsible for installing, maintaining and executing their own virtual cluster on which they are responsible for installing, maintaining and executing their own software stack. IaaS uses different tools for virtualizing and converting physical resources to logical resources that can be provisioned and published to customers as needed.

2.2. Models of Cloud

A. Private Cloud: The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.

B. Public Cloud: Public cloud applications, storage, and other resources are made available to the general public by a service provider. These services are free or offered on a pay-per-use model. Generally, public cloud service providers like Amazon AWS, Microsoft and Google own and operate the infrastructure and offer access only via Internet (direct connectivity is not offered).

C. Community Cloud: Community cloud shares infrastructure between several organizations from a specific community with common concerns (security, compliance, jurisdiction, etc.), whether managed internally or by a third-party and hosted internally or externally. The costs are spread over fewer users than a public cloud (but more than a private cloud), so only some of the cost savings potential of cloud computing are realized

D. Hybrid Cloud: The hybrid cloud merges the benefits of both the private cloud and the public cloud. It delivers the private cloud's high-security features coupled with the fast connection and easy-to-access features of the public cloud. The official definition from the National Institute of Standards and Technology is "the cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability."

Table 1: Cloud Advantages for University-industry Linkage

Advantages	Description
Flexibility	Cloud computing offer more flexibility (often called elasticity) in matching IT resources to business functions than past computing methods.
Scalability	Organizations which use cloud computing not need scramble to secure additional higher-caliber hardware and software when user loads increase.
Decrease Cost	Organizations can reduce or eliminate IT capital expenditures (capEX) and decrease ongoing operating expenses.
Rearrangement of staff	By reducing or eliminating constant server updates and other computing problems and by cutting expenditures of time and money or application development.
Sustainability	The poor energy efficiency of most data centers, due to substandard design or inefficient asset usage, is now understood to be environmentally and economically unsustainable cloud service providers.
Easy implementation	Without the need to buying hardware, software licenses, or implementation services, an organization can deploy cloud computing rapidly.

Table 2: Comparison of Cloud Computing Deployment models.

Deployment Model	Scope of Services	Managed by	Security Level
Public model	General public and large industry groups	Cloud service provider	Low
Private model	Single organization	Single organization	High
Community model	Organization those share the same policy, mission and same security aspects	Several organization or Cloud service providers	High
Hybrid model	Organization and public	Organization and Public	Medium

III. Related Works

We investigated the related works on cloud based U-I linkage works are described below:

Regarding benefits and challenges of adapting Cloud Computing for the universities, discussed the possible offerings that Cloud Computing could deliver, especially in Malaysian Universities. The 21st century students are not satisfied with the traditional learning process; thus, the researcher used Cloud Computing to enhance the learning environment by using Cloud Computing benefits in cooperation with the multimedia contents, and made the learning process highly interactive to meet student expectations. Discussed more than ten Cloud computing offerings, pointing out that the Cloud Computing users gain the illusion of resource availability as an infinite on-demand resource, which enables storage and huge amounts of information on the Cloud. In addition, the researcher stated that introducing the students to Cloud technology will prepare them to work in the industry since they gained the skill of dealing with new technology. Cloud Computing offers cost effective solutions for Universities, staff, and students since all of the needed hardware and software are available via the Cloud, which makes their files highly portable, easy to share while computing power is easy to manage [9].

Additionally, claimed using Cloud Computing would improve collaboration and communication in the learning environments. On the other hand, it clearly stated that the Cloud Computing has some drawbacks: need for Internet connection and trust in the CSP service availability, privacy of the data, and security [9].Built Open-source software (OSS) for e-learning based on Cloud Computing in China. The researchers proposed the EduCloud platform to launch their e-learning environment on a public Cloud, using IaaS and SaaS to overcome resource limitation and lack of e-learning scalability. The researchers constructedTheir solution using Hadoop with two interfaces which were mapper and reducer. EduCloud consists of a set of tools and technologies to build a virtual and personal learning environment; thus, it focuses on migration of the current application to a

Cloud based one via the SaaS level, especially interactive and collaborative applications, such as Sakai and Moodle which are Course Management Systems (CMS)[10].

The Computational Intelligence Research Group (CIRG) at University of Pretoria, South Africa [9], they were doing research on CI algorithms, but students face challenge that the problems they are trying to solve are not trivial. This means that the search space for CI algorithms can become extremely big, resulting in very computationally expensive workloads. To achieve statistical significance results, each students workload needs to include in order of thousands experiment using different parameters, inputs, problem types, etc. each student's work load could potentially take day or weeks and for some extra cases it takes even months to compute on a single workstation running 24 hours 7 days. Students from CIRG attempt to solve their challenge by running their experiments on more than one workstation simultaneously. This provides some improvement on throughput, scalability and failover but it has many problems on scheduling and management. Therefore the researchers proposed Cloud based university-industry linkage for improving quality of education to some selected disciplines in Ethiopian higher education.

IV. Materials and Methods

Selecting the best data for targeting model development requires a thorough understanding of the market and the objective. Although the tools are important, the data serves as the frame or information base. The model is only as good and relevant as the underlying data. For the purpose of this research we used primary data source, secondary data source and survey techniques, the data source was collected from DebreBerhan University.

V. University-IndustryLinkage Cloudmodel Development

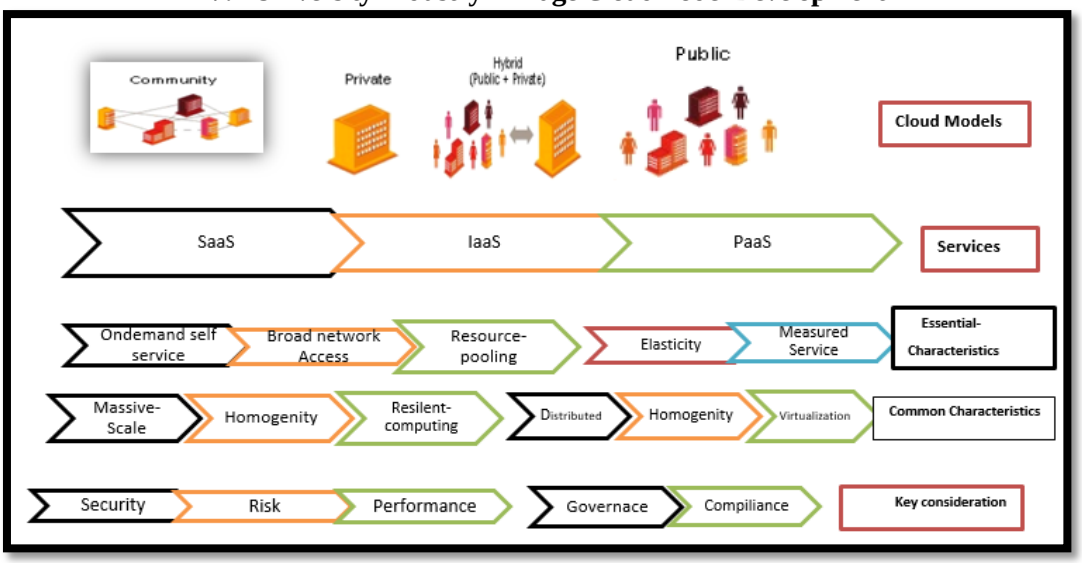

Figure 1: Model and Characteristics of cloud

Cloud computing equipment can provide solutions for the above mentioned problems inuniversity-industry linkage. Cloud computing enables users to control and access data via the Internet. The main users of a typical university-industry linkage cloud include students, teachers, University, administrative staff, Industry administrative, researchers and project teams as shown in Figure 2 below. All the main users are connected to the cloud .Separate login is provided for all the users for their respective. The University-industry linkage cloud system will make it possible for teachers, researchers, project teamstodo different activities through this developed model according to their needs on the cloud any time anywhere if the connection is available

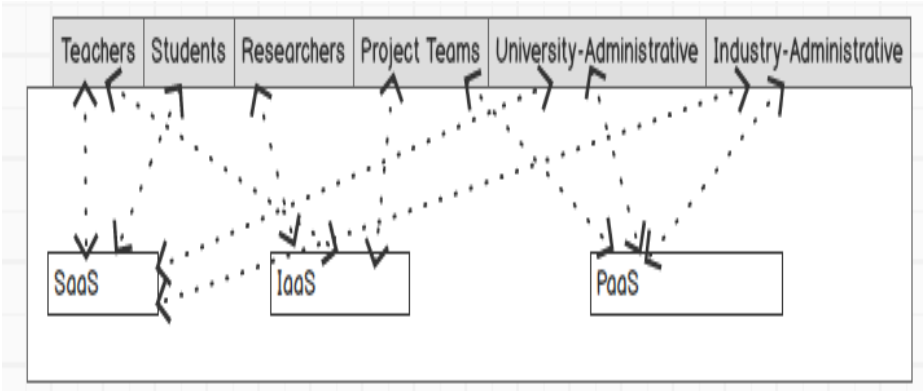

Figure 2: Users of University and Industry linkage Cloud Model System

VI. Developed Cloud Model Advantages

For Students: Cloud computing gives opportunities for greater student choice in Self-learning. Using an Internet-connected device, students can access a wide array of resources, searching internship and job searching after graduation using cloud system. And software tools that suit their learning styles, compute thought the world and interests.

For industry: Cost savings through established university-industry cloud model, infrastructure and workforce; matching funds, very generous tax incentives; ability to train workforce to its needs and to mine the talent pool produced by universities; and because universities are research centers, long-term research projects that are too cost prohibitive in an industry setting can easily be undertaken by the universities through the linkages of cloud model.

For Researchers (professionals): Technical collaboration through contract research: Project-based funding to address specific industrial needs; unique training opportunities through cloud services;longer term collaborations: Industrial investment advancing finding specific areas of research; and Technology transfer: Translation for social, commercial, health benefit and completion of the research lifecycle; financial support of fund gain and working different projects with team through cloud services online .

Cloud can offer the potential for researchers to reduce y environmental impact. Physical resources in a cloud are generally virtualized and can host a number of independent virtual hardware instances that can be used by a number of different projects, or institutions to optimize available CPU capacity. If these projects or institutions each had separate physical hardware resources, they might sit idle for a significant amount of the time, consuming power and space and requiring cooling.

VII.Discussion and Model Suggestion

In the aforementioned developed cloud model of university-industry linkage and interpretations different figures were presented and explained. However, the following discussion were forwarded to incorporate in the proposed model as follows:

Public cloud As the name suggests, this type of cloud deployment model supports all users who want to make use of a computing resource, such as hardware (OS, CPU, memory, storage) or software (application server, database) on a subscription basis. Most common uses of public clouds are for application development and testing, non-mission-critical tasks such as file-sharing, and e-mail service.

Private cloud True to its name, a private cloud is typically infrastructure used by a single organization. Such infrastructure may be managed by the organization itself to support various user groups, or it could be managed by a service provider that takes care of it either on-site or off-site. Private clouds are more expensive than public clouds due to the capital expenditure involved in acquiring and maintaining them. However, private clouds are better able to address the security and privacy concerns of organizations today.

Hybrid cloud in a hybrid cloud, an organization makes use of interconnected private and public cloud infrastructure. Many organizations make use of this model when they need to scale up their IT infrastructure rapidly, such as when leveraging public clouds to supplement the capacity available within a private cloud. For example, if an online retailer needs more computing resources to run its Web applications during the holiday season it may attain those resources via public clouds.

Community cloud this deployment model supports multiple organizations sharing computing resources that are part of a community; examples include universities cooperating in certain areas of research, or police departments within a county or state sharing computing resources. Access to a community cloud environment is typically restricted to the members of the community.

With public clouds, the cost is typically low for the end user and there is no capital expenditure involved. Use of private clouds involves capital expenditure, but the expenditure is still lower than the cost of owning and operating the infrastructure due to private clouds' greater level of consolidation and resource pooling. Private clouds also offer more security and compliance support than public clouds. As such, some organizations may choose to use private clouds for their more mission-critical, secure applications and public clouds for basic tasks such as application development and testing environments, and e-mail services. Finally we decided to choose hybrid cloud because of it connect both public and private cloud infrastructure and best for security purpose.

VIII. Conclusion and Future Work

In the information aspiring today's socio-economic environment across globally, the need to have universities, work together with industry to update and upgrade the whole sphere of activities to ensure students graduate with relevant skills for the workforce cannot be exaggerated. It is also progressively recognized that universities should play a critical role in applying research and innovation to address socio-economic problems as well as promote innovation for economic growth by duplicating strategic partnerships with the productive sectors of the economy and national innovation strategies. Therefore, the study were intended to act as a bridge for the design of university-industry (U-I) cloud model linkages, thereby promoting quality of education and the production of quality manpower towards Ethiopian academic and industry sectors, and to mobilize all stakeholders to highly participate on various activities that are needed to create such linkages. However, there is no any single attempt that tried to analyze or investigate the challenges and prospective of cloud based university-industry linkage potentials in Ethiopian context.

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