Implementing Frame Work of Cloud Computing in Pharmaceuticals Industries of Pakistan

Asif Kamran[1,*], *Asmara* Haidery[2], *Sikander* Hussain[3], *S. M Ahsan* Rizvi[3], and *Danish* Muhammad[3]

[1]Nazeer Hussain University, Department of Business and Management Studies, Karachi, Pakistan
[2]NED University of Engineering & Technology, Department of Economics & Management Sciences, Karachi, Pakistan
[3]Nazeer Hussain University, Department of Business and Management Studies, Karachi, Pakistan

Abstract. Cloud computing is providing cheaper, cost effective efficient automation, data management services to the organizations and this trend is gradually increasing. Using cloud based services can eliminate cost and complexity of managing the underlying application. It allows users to access and use the most sophisticated technologies without being required to pay enormous amounts of money to purchase the system or to develop it in-house. This study aimed to investigate cloud computing advantages and disadvantages, its services and implementation stages in pharmaceutical industry of Pakistan. Cloud computing practices included Cost Saving, Security & Privacy, Automation, Data Integrity, and Regulatory compliance. An Adopted survey was planned and circulated over an example of 400 workers. Research hypotheses were evaluated using structured equation modelling. The outcome shows that cost savings, security and privacy, competitive pressure, automation and awareness have a positive and fundamental effect on pharmaceutical operations. Strangely, there is a negative effect of external support on cloud computing. The effects are noticeable in the pharmaceutical industry. **Keywords:** Cloud computing, LIMS, SaaS, LabWare, Automation, Regulatory compliance.

1 Introduction

The rapid development of recent information and communication technologies has enabled companies to enhance their responsiveness, flexibility and adaptableness to changes within the internal and external environment [1]. In particular, pharmaceuticals are known for the late introduction of new technologies. The industry carefully studies the risks, advantages and disadvantages before using any new technology. But now that companies are forced to enhance their operations and reduce costs, they're trying to find new ways to enhance complex processes using cloud computing. Cloud computing is an innovative service that leverages the facility of the web to extend business agility in their communications and data storage. The benefits of the cloud "pay as you go" model, low investment and low implementation costs will innovate fast-selling products and services [2].

*e-mail: Asifkamrankhan@gmail.com

1.1 Problem Statement

Cloud computing is one of the best current Internet-based computer models that assists small and medium-sized organizations with getting closer to large companies technologically. This new phenomenon allows companies to get sophisticated computer services on the network. Customers will have the option to get to the administration upon demand, which implies that they will have the option to utilize this access at whatever point they approach the organization (for instance, the Internet). They have a practically limitless measure of assets that can be quickly expanded or diminished relying upon client interest. Customers don't need to place assets into any IT system. The nature of cloud payment model is utility-based where customers only pay simply the proportion of assets he utilized. Organizations need to acquire or design and manage a complex IT infrastructure that is costly to produce and requires Internet support for existing systems for all types of applications. The increasing need for developing personalized medicines has added to the complexity of care. A wave of mergers and acquisitions has produced large, competing multinational corporations. Strict regulation and tighter price controls have forced many firms to take cost-saving measures while also paying a lot of attention to evolving compliance needs. And several pharmaceutical firms find it important to change their business models and to implement emerging technology to meet demands.

The majority of the difficulties that Small and Medium Enterprises face are because of their absence of admittance to enough assets [3]. These assets incorporate however are not restricted to, financial and human resources. Regarding financing, planning, control, training, and even data innovation, this limitation makes little and medium enterprises more vulnerable than huge enterprises [4]. Keeping track of costs's control is one of the biggest pitfalls to those who care. (Communication Notices, 2008). Small and medium enterprises don't have any desire to spend huge measures of cash on their data innovation (IT). Notwithstanding significant expenses, IT extends likewise convey a high danger of disappointment. Around 20% of IT ventures are dropped before finishing, not exactly a third in an ideal way, and finished on spending footing with anticipated usefulness [5]. In general, small and medium enterprises do not tolerate the costs and risks of investing in IT. One system that has been shown to enhance the capacity of small and medium businesses to fight with larger organizations is the use of essential information and communication growth [6]. Small and medium-sized businesses benefit from the adoption of emerging technology to achieve a competitive edge, but this is often costly.

These costs include fixed costs (such as hardware, software, storage, permits, etc.), costs of operation (such as operation, maintenance, improvements to the system, etc and costs of training. Furthermore, IT projects are frequently correlated with run-over costs [7]. As another figuring worldview, cloud computing provides various benefits to organizations particularly the more modest ones. Adaptability, scale and cost investment funds are only a couple of the advantages that Cloud computing offers for small and medium businesses. Cloud Computing enhance Competitive Advantage of organizations [8]. It should likewise be noticed that cloud suppliers represent considerable authority in giving IT services, the services gave by these organizations are in a way that is better than those given by the SME IT Department. Expanding on large, incorporated server farms adds to economies of scale [9]. On the other hand, pharmaceutical firms retain large quantities of confidential data, including intellectual property and information about patients. As a result, the prime priority for business survival is the need to protect this information. The security instruments of the cloud are applied on a wide scale, making it a lot less expensive.

1.2 Objective of the Study

There are some objectives of the study to realize the goals. First aim of the study is to considering concept of cloud computing along with its architecture, service, deployment models, advantages and disadvantages and cloud computing services for pharmaceutical industries. Secondly, to recognize the laboratory information management system, laboratories' reasons behind implementing Laboratory Information Management System (LIMS), it's functions and advantages in pharmaceutical industries. Thirdly, to deploy LabWare LIMS solution software as a service, its importance for pharmaceutical quality assurance (QA) / Quality Control (QC) testing, its implementation stages like check laboratory status, LIMS selection, vendors selection, evaluate LIMS solution, installing LIMS solution, LabWare LIMS methodology overview. Fourthly, to examine and evaluate.

1.3 Significant of the Study

This study investigation incorporates a clarification of cloud computing. The study depicts cloud computing essential features, advantages, disadvantages and its services for pharmaceuticals industries. The study will help the pharmaceuticals industries to IT services costs while increasing processing efficiency, reliability, availability and flexibility and reducing processing times through implementing cloud computing. Cloud computing helps to solve many issues, including cost risk assessment and risk reduction, and helps corporations to conduct data transactions along with supply chain operations (e.g. manufacturing, finance, distribution, sales, customer service, information sharing and cooperation with trading partners).

1.4 Outline of the study

The study is consisting of various chapters to find out the result or consequences of implementing cloud computing in pharmaceuticals industries. There are five chapters in this study, including chapter introduction, study overview, problem statement, objective of the study, significant of the study, and outline of the study. Although the second chapter is a literature review, which is an in-depth study, it presents introduction of cloud computing features, architecture, models, advantages, disadvantages, CC services for pharmaceutical, understanding laboratory information management system, implementing stages of LabWare LIMS solution, reasons why LIMS fail after implementing what are the reasons and other alternative solutions of LIMS for Small and medium enterprises. Chapter third covers the research methodology of the relevant study. Fourth chapter is related to hypothesis results. Fifth chapter is related to discussion, conclusion, policy implication and in future research.

2 Literature Review

The most well-known and reasonable cloud computing definition was given by the National Institute of Standards and Technology (NIST) in 2009. According to this definition, cloud computing is a model that provides easy and convenient access to networks everywhere, on demand for a standard group of configuring computing resources (such as networks, servers, storage, applications, and services) it is provided and published without arranging or negotiating with a service provider. There are five core features of cloud computing, 3 service models (Infrastructure as a service / Platform as a service / Software as a service), and 4 deployment models. Deployment models contain private, community, public and hybrid clouds [10]. "Cloud" is an environment for flexible payment of resources, in which multiple interested parties participate and which provides a comprehensive measurement service for a particular quality service [11].

2.1 Architecture of Cloud Computing

There are 4 layers of cloud computing's architecture [12]. The hardware layer this is the primary layer of cloud design that oversee physical resources, for example, physical servers, network equipment. Equipment layers are normally found in server farms that give convenience to PC frameworks. The infrastructure layer this is a removable segment of cloud computing which permits asset pooling. This layer is likewise called the virtualization layer, gives the asset that utilizes the virtualization technique. The platform layer as the name passes on, this layer is comprised of stages and working frameworks that is present in top of the infrastructure layer. The application layer all the applications in cloud computing dwell in the application layer. This is the most accessible layer to the cloud client.

2.2 Essential Features of Cloud Computing

A major user of cloud computing networks in the United States is the National Institute of Standards and Technology (NIST) that offered some operational definitions. Cloud computing has five essential features. In resource management vendor combined IT resources in order to give services to multiple customers using a multi-tenant model. Cloud computing on a broad range of network access resources hosted in a private cloud network run inside a company firewall is available for access from a wide range of devices. Cloud services can be extended quickly with rapid elasticity. Cloud computing has capabilities to monitor and optimize the use of resources in measured services. In on-demand self-service all services which includes email, storage are provided without the need for human communication [13].

2.3 Cloud Computing Service Models

There are few service models of cloud computing. Software as a Service (SaaS) in this service software model service provider hosted applications for customers that are accessible via the Internet. And users can customize their applications according to their needs. Platform as a Service (PaaS) this service model provides platform for creating, deploying, and running applications. In PaaS model organization is solely responsible for the development, maintenance and management of applications. Infrastructure as a Service (IaaS) it provides prepared computing infrastructure resources that can be used like physical machines, virtual machines, virtual storage, etc.

2.4 Cloud Computing Deployment Models

There are few deployment models of cloud computing. Private Cloud infrastructure only works for one organization. Public Cloud model is provided on network for public use. In public cloud customers have no control over location of the infrastructure provided by service provider. Hybrid Cloud is a mixture of two or more public, private or shared clouds, where these clouds maintain their distinct identities. A variety of organizations share the Community Cloud infrastructure and are sponsored by a particular community with common challenges (such as missions, security requirements, policies, and compliance issues).

2.5 Cloud Computing Advantages

The last five years will be the maturation period for cloud marketing. In order to fulfill their business needs today and in the future, it would be necessary for the company to be accustomed to cloud services and a cloud-based approach. All of the cloud benefits are shown

below. The reduction in capital use is one of the cost savings made by certain organizations [14]. Fast distribution of cloud computing ensures that network users have flexible, extensive and on-demand cloud services. Users are paying only for services that the pay-as-you go model permits them to use [15].

By applying cloud computing, organizations incur significant cost savings [16]. Contrasted with the cost of offering services straightforwardly to the organization itself, the unit cost of cloud-based services is frequently lower [17]. This diminishes the effect of missing any hardware things because of brought together information data storage [18]. Compared to monitoring thousands of computers belonging to a well-established organization, data access monitoring becomes simpler as it is necessary to track only one location [18]. Its increased uncertainty to acquire a digital asset, making it almost impossible to believe for a thief to determine a physical component to steal [18]. Reduces additional costs or damages, and enables a fast replacement of the affected server stored in the cloud. It is also very easy to create a clone by using an image, so the downtime for computers in cloud could be drastically reduced [18]. As the cloud is wide enough to accommodate massive data sets, logs can be implemented [18]. Testing and implementation can be carried out easily [18]. Security can be more easily applied by delivering different services one rack at a time [17]. Frequently, companies fail to provide the resources to meet growing business needs. Companies are forced to use all means within their infrastructure because IT budgets are decreasing and virtual desktops have become the final response [19].

Virtual desktops and applications are helpful in improving your resources. Companies acquire the adaptability to create an ideal IT infrastructure that allows employees to be connected to work processes with RDP and application delivery each time for an improved quality of service [20]. The cloud-based mobility solutions allow organizations to take their company into the public in a powerful way [21]. When using the cloud computing model, there's no need to buy and configure hardware. Customers can easily scale up or down, depending on their needs [22]. Services are available to be used instantly as expenditures are smaller when using the same infrastructure. Payments are only paid during the hours that the service is being used. As the service provider makes them online available for you to use, you can easily verify the bill's cost [23]. It is also cost-effective aside from using cloud infrastructure to help minimize global waste. It is also environmentally friendly, as it is shared by multiple users. Resources are used to the limit and the downtime is reduced by half [24]. People can decide not to use it whenever they wish, as there is a high degree of adaptability when cloud computing is used. Even this is one of the key reasons why people are really likely to use this approach. Service level agreements are what manages the costs in this situation.

If the right quality is not provided a penalty cost must be charged [25]. All companies, in today's constantly changing market climate, face a survival test. Flexibility to acclimate to such changes is the little-known technique. The function of data innovation advancements, for example, cloud computing is evident in accomplishing organizational adaptability [25]. Cloud storage is a very simple and commonly used technology that can provide users a secure and enormous data storage space [26]. Customization of network functions is introduced by the Cloud Computing architecture. Customizable network features are very important for cloud computing environments. The architecture for modifying network functions with data caching and compression is proven for high performance cloud computing [27].

2.6 Cloud Computing Disadvantages

Despite the many benefits of cloud computing, as described above, cloud computing also has its weaknesses. In particular, before going to carry out this technology, smaller companies

should know about these perspectives. The principle chances engaged with Cloud Computing are.

2.7 Pharmaceutical Industries

In the present worldwide economic climate, start-up and arising biotech and pharma organizations are searching for more noteworthy cost-sparing activities, expanded agility, and the type of adaptability that is receptive to fast mechanical and business changes. Cloud computing with minimum cost pay-as-you-go plan of action, may hypothetically help these organizations handle comparable changes while changing IT into a market main thrust [28]. The immediate advantages of on-request cloud will in general give clients improved movability and the capacity to give safe admittance to data from anyplace, from practically any cell phone, independent of spot or season of day, regardless of whether from a research center, a client area, while voyaging, or during a gathering at the workplace. Also, life science organizations with small and medium-sized enterprises (SME) mirror an interesting business sector that might profit by this cutting edge registering worldview. These organizations could then economically scale their organizations varying, while quickly finishing complex exploration to-advertise undertakings that they essentially couldn't do all alone [29].

2.8 Cloud Computing Services for Pharmaceutical

With the assistance of cloud computing, it is very simple to get to drug and medical care services on the Internet utilizing an internet browser on your gadget. The following is a depiction of the cloud services for clinical industry, which can improve customary drug strategies and lessen the expense of buying IT.

Data Management: Data management is a significant concern in clinical consideration. Reason for care centers, especially organizations, should ensure about and keep up pica bytes of data, clinical records, patient records, including clinical history, examination, treatment, nourishment data, etc.

The traditional management requires enormous interest in IT staff and capacity framework

Drug Discovery: The discovery of a medicine is the way toward finding another drug that will affirm its viability and any results. This cycle requires tremendous computing resources for perceive potential medication blends from billions of possible substance structures. Clouds against illness, a project of Molplex, Newcastle University, and Microsoft Research, present the cloud development in the medication revelation measure.

Digital Libraries: Libraries are considered a primary source of knowledge for medical students, researchers and medical professionals. However, especially in developing countries, paper medical libraries are unable to meet the needs of the public due to financial restrictions. Digital libraries were understood as an opportunity in the cloud. Cloud service providers can provide library services for example, document storage, ordering services, inquiry language, facilitating services, and library the executives structures [30].

Virtual Medical Universities: Because of its adaptable and pay-as-you-go model nature, cloud computing has provided its types of services excessively to the academic community. IT companies such as Amazon, Google, Microsoft, IBM, and HP have been developing applications for on-campus and off-campus support [31].

Management Information Systems: The healthcare associations have started to utilize data the board frameworks to improve the progression of data inside and outside the organization. Specialists utilize this service to improve patient thought, customers use it to

searching services, executives use it in human resource management, charging and account, top administration utilizes this framework to settle on choices and make expectations.

Clinical Decision Support System: It is a system that imitates information and practice of specialist doctors to make proposals depend on an investigation of patients' clinical records. Both physicians and patients can use these systems to diagnose and treat [32, 33].

General Health Education: The Internet has an abundance of data for general society to know identified with wellness, wellbeing, diet and cleanliness issues. The vast majority look for clinical data online through trusted resources, for example, web pages, uphold gatherings and web journals on specific sickness [34].

2.9 Laboratory Information Management System (LIMS)

The Laboratory Information Management System (LIMS) is a network with a class of utilization programming framework designed for the organization and cutting of raw data that is required for smart purposes. In the hidden improvement phases, the models and tests were followed in the analytical labs and the status of the models and the test results were redesigned. In addition, in the most recent systems, the LIMS system is interfaced with the research community instrumentation and correspondence networks that allow the complete automation of the data aggregation and at the time of the studies [35].

2.10 Laboratories' Reasons for implementing LIMS

Many laboratories still rely on spreadsheets to coordinate and store their research data. Although options (such as Excel) which function for smaller laboratories, this approach is not flexible or adjustable to the complexities of particular industries and needs considerable manual effort. LIMS streamlines the recording and analysis of data obtained, processed and analyzed by scientific, clinical, industrial or any other form of laboratory. LIMS can skillfully manage large quantities of data coming in and out of the laboratories, greatly reducing the time it takes for humans to upload and monitor any sample data flowing in and out of the laboratory.

Sample Management: Laboratories need to document, monitor and maintain the inventory of controls and samples. When they need it, a LIMS can help scientists have what they need and reduce the amount of time and potential for human error that can come with manual entry of data.

Lot Management and Release: Getting a LIMS allows for batch use and batch output tracking. It can also monitor the distribution of lots among members of the lab. The system makes the data accessible for previous identical batches, so that research can be carried out in the sense of the whole product, not just a single batch.

Stability Study Management: Scientists may customize their sample inventory and research the impacts of storage at different temperatures and humidity's, monitor samples checked properly and correctly, and avoid future deterioration with data trends. These long-term studies include the construction of a complex research matrix that is several years old.

Environmental Monitoring: Laboratories may use a LIMS system in a distribution system to verify the quality of a batch processing or the quality of water. For each sample that may possibly be affected by the presence of unwanted bacteria or improper quality, the device offers accurate traceability.

Internal & Client Reporting: Due to its automated reporting, LIMS offers searchable audit trails that reliably record sample storage, consumption, findings and subsequent data analysis. LIMS offers a high degree of transparency for its full documentation. For third party audits and customers that need documentation, this provides value.

Minimize Resource Consumption: Laboratories may reduce the time they spend recording samples and spend more time on actual work and study. A digital record of all samples saves time and money trying to track down required samples or possibly regenerate them.

Regulatory Compliance: LIMS help to automate regulatory report, regulation-complaint audit, implement guideline lab techniques and results. It upgraded regulatory compliance necessities.

2.11 Implementation Stages of LabWare SaaS LIMS

There are some implementation stages of LabWare SaaS LIMS in pharmaceuticals laboratories.

2.12 Check Laboratory It is Ready for LIMS

You may have LIMS in place already, but you want to know about cloud-based LIMS, or you're an expanding laboratory, and you're evaluating whether you're right for a cloud- based LIMS. Here are some areas may signify that your lab is ready for the implementation of SaaS LIMS or not.

Lack of a Dedicated Internal IT Team: If you don't have an internal IT team committed to digging deep into your LIMS's inner workings, it can be especially hard to get the day-to-day help your teams need to succeed. Upgrades and improvements are supported through the cloud with a SaaS LIMS solution, so you always have access to the most stable and efficient version of the solution that also includes the latest enhancements.

Interest in Minimizing Impact on Internal Operations: If your laboratory is engaged in the management and troubleshooting of your LIMS, it can be wasteful to use laboratory facilities. It is also possible to minimize the effect on your internal operations with a trusted technical vendor managing your LIMS, so that you can continue revenue generating opportunities that will help fuel creativity for the future.

Requirement for Distributed Footprint: It can be complicated and difficult to maintain and store your data at a single location, particularly for long-term projects and managed tests that require a high level of security. You can store data on a cloud server with a SaaS LIMS solution easily and remotely, and have the ability to access data from a wide variety of locations. With on-site software, users are mostly limited to accessing data or business applications only from a corporate venue, but SaaS LIMS provides expanded choices.

Strict Requirements for Regulatory Compliance: SaaS LIMS solutions come with predefined workflows that already comply with industry regulations. Your LIMS can be enforced with uniform procedures, processes and controls, making it easier for you to quickly find a compliant solution.

2.13 Considerations for LIMS Selection

An ideal LIMS will cover the majority of the pharma operations. However, to identify the ideal LIMS is both a complex and challenging process [36]. Pharmaceuticals run different operational workflows and many of these workflows are not publicly available. As such, there is no single LIMS that meets the requirements of all current workflows. The final LIMS product would be of immense complexity, even though one application was made, which would in effect, undermine the feasibility of the method. A premature and uninformed decision of which LIMS to use in the laboratory, may cause the automation objectives to fail and waste considerable time and budget investments [37]. The additional inspections should be considered while picking a LIMS.

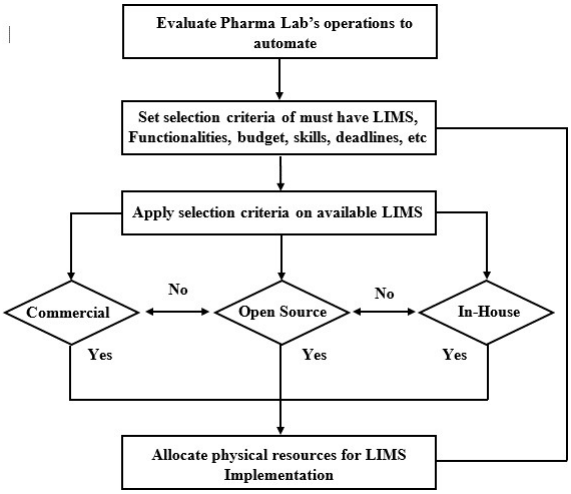

Figure 1. LIMS selection plan

- The system functionality must comply with the requirements of the laboratory user.
- Flexibility should exist to satisfy the changing requirements of the laboratory. This could also have a positive effect on the sustainability of pharmaceuticals.
- Presence of demonstrable robustness of system backend features (database, backup system).
- The ease of use and availability of technical support, online documentation and training from the system vendor.
- The budget allocated for the implementation of the system.

Despite the existence of a system which meets the above considerations, laboratory personnel may exhibit a certain hesitance and/or resistance to change the laboratory operational protocols [38]. Additionally, employees may consider the automation process as a possible threat to career stability. Laboratory managers should therefore make their personnel aware of the benefits of LIMS for the advancement of the laboratory, and involve them in the process of LIMS selection, especially considering that they may be more cognizant of the operations that require (or will benefit from) automation [39]. Laboratory personnel will be both positively and negatively influenced by the implementation of the LIMS. For example, while productivity may increase in the long term, adjustment and training may influence schedules and increase workload, in the short term [40].

2.14 Understand Users and Stakeholders in Implementation

The stakeholders involved in the implementation it vary with type of solution you are evaluating. For example, if you are implementing a SaaS system, all you need is laboratory staff as you only train, implement, and load some metadata. You will need the Lab Manager and Data Administrator to get the information to download based on your company's specifications. If you are deploying a LIMS that needs more configuration, such as an on-site infrastructure or a hosted infrastructure path, you will have different stakeholders involved. A self-hosted

on-site LIMS would require specialists from each area, plus an overall business lead, IT leaders and hardware, software, and network infrastructure specialists that can be very expensive (www.labware.cloud). There are some stakeholders can include:

Lab Manager: The lab manager is responsible for all workflows, work orders and workload management, as well as tracking KPIs and reporting on data.

Quality Manager: The quality manager uses LIMS as a dedicated QA / QC role or simply as a responsible person in the laboratory. This is the person who normally releases the batch and the last person to sign the certificate of analysis.

Scientists/Analysts: The scientist/analyst wants to clarify what work needs to be completed and what work has been allocated. To log the test results, you can use the system and complete the initial sample evaluation.

2.15 Research and Conduct Vendors Demos

To begin the research process, you can search software comparison websites like G2, Capterra, and TechValidate. Usually, you can trust a LIMS provider that has a long history of reliability and experience implementing it in your particular environment. Since you want your data to be secure, you want to work with a reliable provider. For your laboratory, you might need to think about scalability and development. In the future, the needs will change, and compared to a corporate laboratory in several countries, it would be difficult to rely on the same framework for a small laboratory. The next step is to schedule live demos with different providers. Before doing so, prioritize and evaluate the features you will need to support these standard features. If these features aren't what you expected, discuss what you'll need to fill in the void that might require a second demo. Consider the concept of cost reduction. Don't be too quick to think that you need to set up a LIMS for your ideal system that adds cost, effort, and risk (www.labware.cloud). There are some LIMS service providers in market that are mentions below.

- LabWare LIMS
- CloudLIMS
- Thermo Scientific SampleManager LIMS
- STARLIMS
- Benchling
- LabVantage

2.16 LabWare LIMS Methodology

LabWare gives an overall strategy and way to deal with how LabWare supports its clients through all periods LIMS ownership. This methodology is known as GOLD - Goal Oriented LIMS Delivery. LabWare urges all clients to utilize the GOLD system. GOLD help is incorporated into LabWare's LIMS item, online client assistance frameworks, and variety of layouts, manuals, and business models (www.labware.cloud).

GOLD takes the best thoughts from the IT field and applies them to LIMS. Implement effective project management practices, while complying with tight time limitations and administrative consistence that exploit a transformative and shared methodology. The classic waterfall model in which complete prerequisites and useful particulars are composed before any arrangement is performed, packet-based information systems where clients need to cooperate with the framework to comprehend what capacities and abilities are accessible. LabWare's engaged and iterative methodology is a substantially more effective approach to

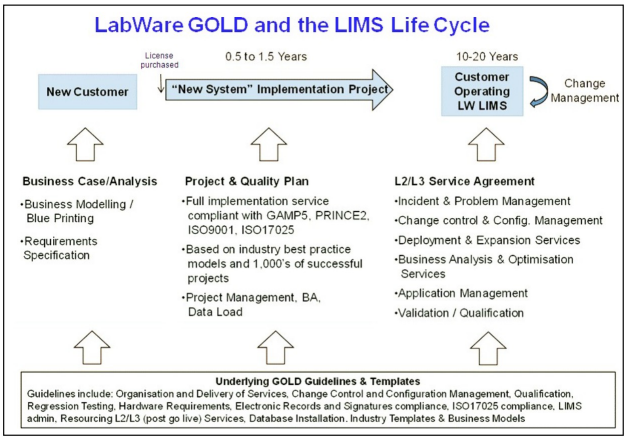

Figure 2. LabWare gold methodology overview

send business frameworks. LabWare's methodology depends on amazing assets, clear objectives and little, exceptionally talented groups. GOLD was created and refined utilizing the experience of several effective LIMS ventures. There are four primary periods of the GOLD technique, which are portrayed underneath.

Project Initiation: The principle goal of the task initiation stage is to construct a group and guarantee that all colleagues comprehend the extent of the work and communicate in a similar language. Basically, there are two significant information move exercises occurring. By means of a 5-day LIMS Administration 1 instructional class, client colleagues get LabWare item training, and LabWare colleagues pick up an away from of client work processes through gatherings and an intuitive work process rundown.

Pilot Development: The pilot development stage has two objectives: Completing the useful prerequisites and directing the client colleagues as they become familiar with the LabWare LIMS device set. An iterative setup approach is utilized to rapidly model a "piece" of functional prerequisites. The surveys are completed by topic specialists to decide the practical necessities and the usage engineering.

System Completion: The aim of the system completion process is to implement all the functions expected to begin the framework. The progress from the Pilot stage to the System Completion stage is normally consistent. As rules become more inflexible, the pilot System is progressively turning into a "genuine" framework. At the point when individuals from the client group acquire confidence in the LabWare LIMS item, they can accomplish more implementation work their own.

Rollout: The Rollout stage incorporates all testing and deployment exercises before the framework is delivered for use in a production climate, including developing and running test contents, preparing the client, and setting up the production environment.

2.17 Hypothesis

Hypothesis 1. Cost saving has positively influence on cloud-computing implementation for pharmaceutical industries.

Hypothesis 2. Security and privacy concerns have positively influence on cloud-computing implementation for pharmaceutical industries.

Figure 3. Research frame work

Hypothesis 3. Higher level of external support from cloud providers has positively impact on cloud computing implementation by pharmaceutical industries.

Hypothesis 4. Competitive pressure has positively impact on cloud-computing implementation for pharmaceutical industries.

Hypothesis 5. Automation has a positively influence on cloud-computing implementation for pharmaceutical industries.

Hypothesis 6. Awareness has significant influence on cloud-computing implementation for pharmaceutical industries.

3 Research Methodology

Research methodology can be defined as methods and processes of analysis. The methodology of science is a comprehensive study of research methodologies. It also articulates key research activities.

3.1 Research Design Approach

There are four kinds of ways to deal with research design, descriptive, informative and exploratory. The descriptive methodology is utilized generally if the researcher is keen on indicating the details and parts of a particular territory of issues, which are frequently grounded. The explanatory approach implies that a number of variables are causal to the investigator so that relations and causes between these variables can be identified. The explorative method is used if the researcher has only basic knowledge of the field and it is necessary to identify which research questions to work with. Subsequently, it is generally utilized during the initial phase of bigger research projects, for example the investigator plans to decide the issue of research. The predictive methodology is utilized to foresee the future improvement of the wonder [41].

3.2 Data Collection Techniques

Generally, data collection is classified into two quantitative and qualitative techniques. The biggest difference between numbers and statistics is the difference between these two methodologies. Depends on the selected research issue, which approach should be used. Such two approaches must not be divided, though, but may be advantageous to merge.

3.3 Quantitative Data Collection

The methods in quantitative data collection are explanatory. The essence of quantitative data is that it can be calculated and interpreted using various statistical techniques as a figure that can be evaluated. The scientist is involved in the variety of quantitative methods and wants no information of a huge number of units. For example, quantitative data are obtained through questionnaires. Consequently, the techniques of quantitative data collection are formalized and organized. Such methods are useful as researchers need to generalize data based on the knowledge they have obtained. Nevertheless, quantitative data can only inform us where we are and not why it is not possible to express attitudes and feelings.

3.4 Qualitative Data Collection

The main objective of qualitative methods for data collection is to understand the condition under inquiry. Qualitative data collection is characterized by the fact that the researcher needs only a lot of information about a few units. Qualitative data from personal interviews are collected through in-depth interviews or interview guides, for instance with no fixed questions or responses. Thus, the answers in a qualitative interview often provide a more objective interpretation of the facts and a deeper understanding of the subject. Consequently the strategies of qualitative data collection are less official and versatile than the techniques of quantitative data collection. However, it is not possible to generalize statistically using quality techniques.

3.5 Choice of Data Collection Technique and Method

The paper is focused on the design of descriptive analysis and was suggested for quantitative research. A questionnaire was created to gather the primary data for research experiments and different statistical tests in order to find the accuracy, consistency and relevance of variables.

3.6 Sources of Data

Data are available in two key categories: primary and secondary data.
(1) Primary data

Primary data is the information gathered and used for first time from original sources for a certain research question. Consequently, essential information is collected and not accessed for other purposes by academics. Sources of such information may be interviews or remarks. Interviews are the most common method of data collection.
(2) Secondary data

Secondary data was gathered by someone else for some other purpose prior to the actual research project. Primary guidance is produced by the sources of books, research studies and journals. Of comparison to internally and externally, secondary data may be isolated. The primary internals come from within a corporation, e.g. annual reports, revenue figures, etc. The advantages of such knowledge are that the expense and quality of the experience

are generally low. Specific information collected outside the organization, for example Government Reports, Documents, Books, and others, is additional supplementary content. The potential drawbacks of second-hand data can be the challenges of distribution and reliability of information that meets the specific needs of the actual research.

3.7 Sources of Data in the Thesis

(1) Primary data

Primary data are collected by using a survey method to obtain information on research priorities by choosing a questionnaire design. There were two segments of the questionnaire. The first segment consisted of population information, and the second segment consisted entirely of study variables. The questionnaire has been send through Google form on different platforms.

3.8 Sampling Strategy

Two primary sample types, probability sampling and unusual sampling processes are available. The preference of the two methods is dictated by the research purpose. Each unit of the whole population is known to be selected when using probability sampling. Therefore, this procedure enables statistical inferences to be measured. The sample is to some extent based on the subjective judgment of the researcher and the method also focuses on more qualitative and empirical assessments when using non - probability samples. Opinion sample is an unlikely sample which indicates that the sample is chosen based on special criteria previously considered especially important for the analysis.

3.9 Sample Size and Sampling Technique

(1) Description and participants

The participants for this research belong to any professional background and of different age groups. The data collected from the people belong the pharmaceutical industries either the staff, management or owner the study collected data from all individuals who are belong of different pharmaceutical of Pakistan so they fill the response the questions as per their preference.

(1) Quantitative data sample size

This research, 400 is the sample size. Samples of different educational backgrounds belonging to different professional groups are provided. The data were obtained on convenience bases using random sampling technique. As it is a random sampling, individuals of different demographics collect the response. The main purpose of data collection is to remove biases and collect relevant data from believable and future respondents.

3.10 Research Instrument

(1) Quantitative data research instrument

The questionnaire for quantitative data of research is designed on the Likert Scale. The questionnaire has five point scales in which: Strongly Disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, Strongly Agree = 5.

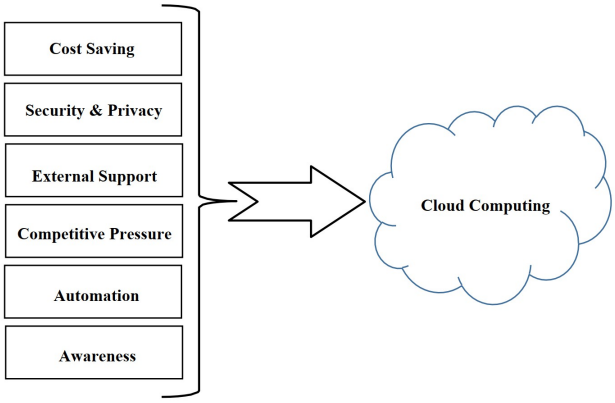

Figure 4. Conceptual model

Table 1. Previous used variables and their sources

Variables	Sources
Cost Saving	Mahyar Amini (2014), Shima Ramezani Tehrani (2013)
Security and Privacy	Shima Ramezani Tehrani (2013), Nouf Rashed Al Khater (2017)
External Support	Shima Ramezani Tehrani (2013), Nouf Rashed Al Khater (2017)
Competitive Pressure	Shima Ramezani Tehrani (2013)
Automation	Aqeel Ahmed Jatoi (2020)
Awareness	Aqeel Ahmed Jatoi (2020)

3.11 Conceptual Research Model

4 Results & Analysis

Pharmaceutical sector employees in Pakistan, who work at different levels, were the target population for this study. Participation was on a voluntary basis. This study covers an acceptable form of sampling as it enables researchers to choose from the intended sample subjects based on those who are eager and efficiently open to be selected in the examination. In addition, among any remaining methods, it is the most affordable, least difficult. A sum of 400 self-administered questionnaires is distributed to employees in various pharmaceutical industries, with an 80% rate showing 319 returned surveys. The survey questionnaire is derived from a recently set up method used in various studies below in the table, which consists of 16 inquiries.

All items under each variable develop have been tested using the 5-point Likert scale from 1-strongly disagrees to 5-strongly agree. To test the static effects, the Smart PLS (Partial Least Square) approach was used. It is highly sophisticated and also the most recent technique.

Table 2 shows gender identity concerned, most of the respondents were male (70%) and female (30%) of the study. In general, respondents were aged between 25 and 35 years, which was (84%) of the total respondents. The dominant portion (53%) of members have a master's degree for the qualification. (50%) have up to 7 years of experience. The result reveals that most of the respondents have a bachelor's and a master's degree and are young and dominant. This may indicate that the importance of cloud computing in enhancing work purposes is especially recognized by these gatherings. In addition, it can be seen from the result that the number of males is more than females, which can contribute to men having a greater ability to

Table 2. Demographic analysis

Variable	Category	Frequency	Percentage
Gender	Male	223	70%
	Female	96	30%
Age	18-24	25	8%
	25-30	98	30%
	31-35	173	54%
	36-40	11	3%
	40+	12	3%
Educational Qualification	Intermediate	1	-NA-
	Graduation	119	37%
	Masters	169	53%
	Special Certification	28	9%
	M.Phil. and PHD	2	-NA-
Total Experience	6 Months-1Year	12	4%
	1 - 3 Years	76	24%
	4 - 6 Years	69	22%
	7 - 10 Years	117	37%
	10 And above Years	45	13%

Note:N=319

implement cloud computing inside organizations. Finally, as per the results, individuals with more than 7 years of participation offer organizations a competitive advantage. Descriptive Statistic.

4.1 Structural Equation Modeling (SEM)

The Structural Equation Model (SEM) is used to test the study hypothesis using the Smart PLS analysis methods. In addition, the test was performed to determine the indirect and direct impacts of all the hypotheses. The structural correlation between exogenous and endogenous variables was evaluated using it. It incorporates factor inquiry and multivariate analysis. In addition, the regression equation focuses on disclosing each construct to determine the relationship between circumstances and effect results, while their circumstances and effect results could be seen at particular times by all the variables in the causal model. Furthermore, the use of this model ensures that bootstrapping techniques are used that have been found suitable for both small and massive sample sizes and do not need some form of indirect effect [42]. To check all direct and indirect effects, a method known as bootstrapping has been shown.

4.2 Measurement of Outer Model

In the measurement model, the purpose of measuring fit is to learn and check about the reliability and validity of the instrument. We conduct combined convergent validity and discriminant validity testing with software called Smart PLS.

4.3 Composite Reliability

Reliability means accuracy of the results of the questionnaire. It will give comparable results for the same targeted audience at any point at which the questioner reuses the questionnaire.

Table 3. Descriptive statistic

Variable		Questions	Descriptive Stats		Confirmatory Factor Analysis		
			Mean	Stand. Deviation	Outer Loading	T Stats	P Value
Implementing Frame Work Of Cloud Computing In Pharmaceutical Industries OF Pakistan	Cloud Computing	Is Cloud computing technology trustworthy?	3.592	1.078	0.894	66.100	0.000
		Do you think using cloud computing services enhances operating efficiency in pharmaceutical industries?	3.661	0.991	0.877	46.170	0.000
	Cost Saving	Do you think the use of cloud computing will help to reduce cost pharmaceutical industries?	3.536	1.022	0.847	38.156	0.000
		Is the cloud computing's maintenance costs are very low?	3.389	1.065	0.795	21.945	0.000
		Does cloud computing decreases organization's IT cost (such as IT personnel, resources etc)?	3.480	1.017	0.815	33.691	0.000
	Security & Privacy	Is security an important factor when it comes to cloud computing implementation in pharmaceutical?	3.596	1.072	0.867	44.192	0.000
		Do you think that storing data of an organization in a cloud running in another country has an impact on data privacy?	3.473	1.032	0.801	26.837	0.000
		Is security an important factor when it comes to cloud computing implementation in pharmaceutical?	3.552	1.025	0.767	19.101	0.000
	External Support	Do you think that external cloud provider support has a positive impact on the implementation of cloud computing?	3.323	1.147	0.995	2.969	0.003
		Is external support from the cloud providers essential for using cloud services?	3.505	1.053	0.356	0.947	0.344
	Competitive Pressure	Do you think that competitive pressure has a positive impact on implementation of cloud computing?	3.524	1.047	0.881	40.156	0.000
		Do you think that a competitors implement cloud computing, it would encourage us to use cloud services in our organization?	3.564	1.051	0.909	58.631	0.000
	Automation	Does automation plays a crucial role in transforming laboratory management system in pharmaceutical?	3.527	1.094	0.653	2.159	0.031
		Do you think automation can simplify the laboratory management's daily operations?	3.668	1.021	0.996	3.204	0.001
	Awareness	Is lack of awareness a reason behind slow adoption of IT practices for pharma laboratory?	3.533	1.061	0.901	4.729	0.000
		Could awareness to cloud computing provide benefits to the pharma laboratories?	3.586	1.091	0.901	5.499	0.000

Loading Value > 0.70, T Value > 1.96, P Value < 0.05

Table 4. Reliability analysis of Cronbach's Alpha

	Cronbach's Alpha
Cloud Computing	0.725
Cost Saving	0.755
Security and Privacy	0.746
External Support	0.620
Competitive Pressures	0.753
Automation	0.739
Awareness	0.768

Cronbach′s Alpha Value $>$ 0.70

Table 5. Convergent validity

	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Cloud Computing	0.728	0.879	0.784
Cost Saving	0.761	0.860	0.671
Security and Privacy	0.776	0.853	0.661
External Support	-4.612	0.674	0.558
Competitive Pressures	0.761	0.890	0.801
Automation	4.656	0.824	0.710
Awareness	0.768	0.896	0.812

CR Value $\geq$ 0.7, AVE Value $\geq$ 0.5

It demonstrates internal consistency and the study's repeatability is high. Maintaining an important strategic distance from injustice in the analysis is the essential measure of immovable quality. As such, it can usually be enhanced by evaluating the methodology and investigation of interest, using a variety of methods of analysis and examination, or by different researchers. In addition, this incorporates the investigation's reliability and authenticity. Using composite reliability, the reliability of the measurement instruments was evaluated. All values were above the usual value, i.e. 0.70, except for external support below 0.70. For reliability, this is the agreed value set. The degree of constancy between various variables can be carried out by reliability estimation [43]. Below is the composite reliability table. The results reveal, as can be seen in Table 3, that the constructs have sufficient reliability.

4.4 Factor Loadings Significant

Table of descriptive statistics showed loadings utilized in confirmatory factor investigation (CFA). Construct with the loading of 0.5 are strong loading factors while loading of below 0.5 are less strong factors.

4.5 Convergent Validity

Convergent validity implies, in at least two measures of the same construct, the degree of agreement. By analysis of variance for each factor, convergent validity was assessed.

Table 5 shows the results The event that the change is more prominent than 0.5, then convergent validity is defined and the result is drawn that the loadings are appropriate, but the analysis is called less efficient below 0.5.

Table 6. Discriminant validity

	Automation	Awareness	Cloud Computing	Competitive Pressures	Cost Saving	External Support	Security and Privacy
Automation	0.842						
Awareness	0.382	0.901					
Cloud Computing	0.021	0.084	0.886				
Competitive Pressures	0.039	0.079	0.478	0.895			
Cost Saving	0.034	0.056	0.608	0.544	0.819		
External Support	0.335	0.250	0.123	0.018	0.041	0.747	
Security and Privacy	0.023	0.018	0.559	0.609	0.723	0.057	0.813

AVE Loading > 0.50

Table 7. Model fit measures

	Saturated Model	Estimated Model
SRMR	0.090	0.090
d_ULS	1.106	1.106
d_G	0.406	0.406
Chi-Square	753.935	753.935
NFI	0.628	0.628

4.6 Discriminant Validity

If the model compares with different constructs, Discriminant validity can be regarded as any single construct. When the builds have an average loading of more than 0.5, the effects of discriminant validity are high which means that the construction took at least 50 percent of the difference. Discriminant validity is defined if in equal lines and parts, the components that are in inclination are diagonally greater than those values in off-diagonal. Tests for Discriminant Validity are guided to see whether or not non-related thoughts or estimates are actually disconnected.

Table 6 Show the viable assessment of discriminatory validity shows that there is no extraordinary correlation between a thought-trial and the numerous tests proposed to quantify potentially different ideas. The table for Discriminant Validity is given underneath.

4.7 Model Fit Measures

The fitness of the model in SEM-PLS is defined by a number of tests, e.g. standardized root-square residual (SRMR), specific models such as d_ULS and d_G, Normed Fit Index (NFI), χ^2 (Chi-square). Model fit measures including a deliberate evaluation of both the saturated model and the estimated model.

Table 7 saturated model demonstrates the relation between all the constructions. The estimated model considers the model structure to be taken into account and relies on the overall impact trend.

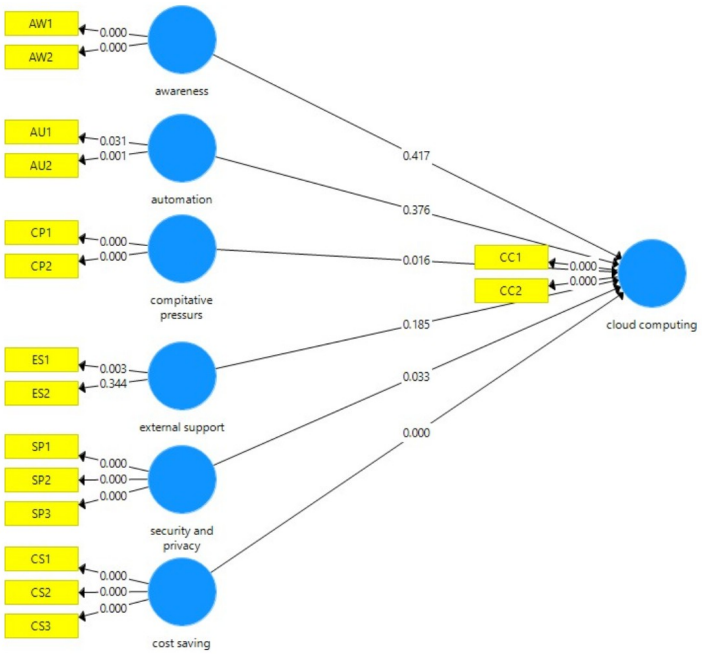

Figure 5. Path diagram

Table 8. Test of hypothesis

	Standard Deviation	T Statistics	P Values	Status
Cost Saving ≥ Cloud Computing	0.066	5.963	0.000	Accepted
Security and Privacy ≥ Cloud Computing	0.082	2.133	0.033	Accepted
External Support ≥ Cloud Computing	0.076	1.327	0.185	Rejected
Competitive Pressures ≥ Cloud Computing	0.064	2.413	0.016	Accepted
Automation ≥ Cloud Computing	0.059	0.886	0.376	Rejected
Awareness ≥ Cloud Computing	0.051	0.812	0.417	Rejected

$t - Value > 1.96,\ P\ Value < 0.05$

4.8 Hypothesis Testing

In PLS-SEM, one of the main steps is bootstrapping, which provides the accuracy of factor approximation knowledge. In this cycle, sub-tests are taken anywhere from the main model, including substitution [43].

Figure 5 show the Bootstrapping provides information on the stability of the coefficient calculation. An enormous number of sub-examples are taken from the first sample with substitution in this cycle [43]. The results of the path coefficients for all the hypotheses are shown in the following table. The t- value greater than 1.96 ($p < .005$) suggests that the relationship at the 95% certainty level ($a = 0.05$) is tremendous. Paths that indicate whether the correlation between measurable and latent variables is enormous or not. In figure 5, the route map appears.

Detail of above table 8 along with results interpretation of each variable is mention below.

First hypothesis: Cost Saving has positive impact on Cloud Computing implementation in pharmaceutical industries of Pakistan (t-value => 1.96, P=< 0.5) is accepted.

Second hypothesis: Security & Privacy has positive impact on Cloud Computing implementation in pharmaceutical industries of Pakistan (t-value => 1.96, P=< 0.5) is accepted.

Third hypothesis: External Support has negative impact on Cloud Computing implementation in pharmaceutical industries of Pakistan (t-value < 1.96, P=> 0.5) is rejected.

Fourth hypothesis: Competitive Pressure has positive impact on Cloud Computing implementation in pharmaceutical industries of Pakistan (t-value => 1.96, P=< 0.5) is accepted.

Fifth hypothesis: Automation has negative impact on Cloud Computing implementation in pharmaceutical industries of Pakistan (t-value < 1.96, P=> 0.5) is rejected.

Sixth hypothesis: Awareness has negative impact on Cloud Computing implementation in pharmaceutical industries of Pakistan (t-value < 1.96, P=> 0.5) is rejected.

5 Discussion and Conclusion

Cloud computing is developing rapidly and is commonly believed to be the future of the computation world. Cloud computing is a paradigm of computing that is favorable to both companies and individuals. From various points of view, cloud computing varies from different forms of computing model. It helps consumers to access and utilize the most advanced technology without having to spend tremendous cash measures to purchase or build the system in-house. The service is delivered over a network to users, and the network can be a private network or a public network, such as the Internet. In the on-demand premises, clients can use the service and pay only for the assets they have used. Small and medium-sized organizations are one of the components as gain profit most from cloud computing. Cloud provider services enable businesses to execute their tasks easier, quicker, and more competently as well as helping organizations to enhance their productivity and success. Cloud computing is nothing but a mind-confusing system, and clients will definitely figure out how to make the system work. Sometimes they do not perceive the difference, without implementing it locally, they use a similar method. Its installments method is another fundamental beneficial position of cloud computing for organizations. The Cloud Computing installment model, which is a utility-based installment, is special in comparison to various forms of computing. Using the pay-as- you-go payment method allows companies to fundamentally minimize their costs and to move from the use of resources to the use of operations. According to the study performed in these research organizations, the service offered by cloud computing is safer than the service delivered at home. These variables make it interesting for organizations to adapt to cloud computing. Pharmaceuticals are important players in every sector and contribute to every economy's GDP and workforce. Despite the fact that pharmaceuticals are not sufficiently revolutionary to have an independent influence on the economy, they generally have an extraordinary effect. In these lines, introducing new methods and technologies that will allow organizations to become more profitable and to have an additional positive effect on the economy as a whole. Despite organizations, the economy also benefits from an inescapable variety of cloud computing. One of the basic standards that cloud computing relies on is virtualization. Virtualization essentially takes down the measure of strength used by data centers. The unlimited use of cloud computing often limits the number of private server farms in operation. Cloud computing often has its own limits. Cloud computing is argued against by many scientists and critics. Cloud computing security and reliability consistency are being discussed by its competitors. Such distinct problems that are referenced by cloud computing rivals are information lock-in, applications accessibility, and data sharing and legal performance.

5.1 Implications

There are some are implications are mention below getting from research.

First, to promote transparency about the security practices in cloud services and try to make believing users that their data is safe by both government and service providers. And government should heighten awareness that cloud service users need to understand the risks of data breaches.

Second, policies must clarify the application of trade disciplines to the delivery of cloud services. Users must be linked to the Internet for cloud-based services to thrive. The government can boost availability and adoption of cloud computing through tax adjustment to service providers, subsidies to low-income people, and directive of the wireless spectrum. Policy interventions such as expansion of broadband capacity can be included. Policies should also consider intervening in international agreements in favor of unrestricted data flow across borders.

Third, policymakers and regulators should ensure a high standard of privacy. Cloud public providers should concentrate on the concerns about privacy, protecting data from illegal access by the government, restricting data misuse for profit-making purposes, and safeguarding data from competitors. The purpose of privacy regulation must protect people data from inappropriate government scrutiny and to define what commercial rights companies have regarding users' data.

Fourth, governments must ensure open access across public cloud services. Access to the fundamental infrastructure of cloud computing should not be driven by biased pricing and should not offer an unfair benefit to other users. Industry can play a key role in clarifying openness rules for the marketplace and governments should actively enforce existing laws designed to ensure open access. Related to this issue, policies should provide a detailed guideline to warn of the risk regarding the level of tolerable scalability. Cloud computing scalability allows users to guard against the possibility that demand might be either unexpectedly high or unexpectedly low.

Fifth, Agreements should be made between Organization and cloud service provider under government supervision.

5.2 Future Research

Investigation and results are mostly depend on the pharmaceutical industry. Results of this study concentrate on the private sector. Responses are restricted (Closed-ended), participant could not respond in more detail. This study targeted and based on only pharmaceutical from the employees' perspective future research may focus on entrepreneurs' and cloud service providers' perspectives to have a comprehensive understanding of the Cloud Computing adoption process. Finally, Research was targeted at other market sectors and areas, the outcome of this study could change.

References

[1] L. Barthelus, Online Journal of Applied Knowledge Management (OJAKM) **4**, 1 (2016)
[2] *Cloud computing in pharma it's never too late to reap the benefits* (2015)
[3] J.A. Welsh, Harvard Business Review pp. 18–32 (1981)
[4] S. Blili, L. Raymond, International journal of information management **13**, 439 (1993)
[5] L.A. Kappelman, R. McKeeman, L. Zhang, Information systems management **23**, 31 (2006)

[6] K.S. Tan, S.C. Chong, B. Lin, U.C. Eze, Industrial Management & Data Systems **2**, 224 (2009)
[7] M. Jørgensen, K. Moløkken-Østvold, Information and software technology **48**, 297 (2006)
[8] D. Truong, The Business Review, Cambridge **15**, 59 (2010)
[9] P.S. Ryan PhD, R. Merchant, S. Falvey, Journal of Internet Law **15**, 7 (2011)
[10] P. Mell, T. Grance et al. (2011)
[11] L. Schubert, K. Jeffery, B. Neidecker-Lutz, Cordis (Online), BE: European Commission. Available online: http://cordis. europa. eu/fp7/ict/ssai/docs/Cloud-report-final. pdf (2010)
[12] Q. Zhang, L. Cheng, R. Boutaba, Journal of internet services and applications **1**, 7 (2010)
[13] N. Leavitt, Growth **27**, 15 (2009)
[14] J. Gibson, R. Rondeau, D. Eveleigh, Q. Tan, *Benefits and challenges of three cloud computing service models*, in *2012 Fourth International Conference on Computational Aspects of Social Networks (CASoN)* (IEEE, 2012), pp. 198–205
[15] Q. Wang, K. Ren, X. Meng, *When cloud meets ebay: Towards effective pricing for cloud computing*, in *2012 Proceedings IEEE INFOCOM* (IEEE, 2012), pp. 936–944
[16] D.G. Chandra, M.D. Borah, *Cost benefit analysis of cloud computing in education*, in *2012 International Conference on Computing, Communication and Applications* (IEEE, 2012), pp. 1–6
[17] R.L. Grossman, IT professional **11**, 23 (2009)
[18] F. Alecu, Economy Informatics Department Academy of Economic Studies, Buchares (2010)
[19] M. Sridharan, P. Calyam, A. Venkataraman, A. Berryman, *Defragmentation of resources in virtual desktop clouds for cost-aware utility-optimal allocation*, in *2011 Fourth IEEE International Conference on Utility and Cloud Computing* (IEEE, 2011), pp. 253–260
[20] J. Hwang, T. Wood, *Adaptive dynamic priority scheduling for virtual desktop infrastructures*, in *2012 IEEE 20th International Workshop on Quality of Service* (IEEE, 2012), pp. 1–9
[21] K. Shimizu, S. Nishinaga, S. Muto, N. Uchida, *Office on demand: New cloud service platform for carrier*, in *2012 16th International Conference on Intelligence in Next Generation Networks* (IEEE, 2012), pp. 15–21
[22] D.A. Tamburri, P. Lago, *Satisfying cloud computing requirements with agile service networks*, in *2011 IEEE World Congress on Services* (IEEE, 2011), pp. 501–506
[23] C.T. Yang, W.C. Shih, G.H. Chen, S.C. Yu, *Implementation of a cloud computing environment for hiding huge amounts of data*, in *International Symposium on Parallel and Distributed Processing with Applications* (IEEE, 2010), pp. 1–7
[24] H. Wang, R. Shea, F. Wang, J. Liu, *On the impact of virtualization on dropbox-like cloud file storage/synchronization services*, in *2012 IEEE 20th International Workshop on Quality of Service* (IEEE, 2012), pp. 1–9
[25] S.S. Bharadwaj, P. Lal, *Exploring the impact of Cloud Computing adoption on organizational flexibility: A client perspective*, in *2012 International Conference on Cloud Computing Technologies, Applications and Management (ICCCTAM)* (IEEE, 2012), pp. 121–131
[26] H.T. al Feel, M.H. Khafagy, *OCSS: ontology cloud storage system*, in *2011 First International Symposium on Network Cloud Computing and Applications* (IEEE, 2011), pp.

9–13

[27] T. Miyamoto, M. Hayashi, H. Tanaka, *Customizing network functions for high performance cloud computing*, in *2009 Eighth IEEE International Symposium on Network Computing and Applications* (IEEE, 2009), pp. 130–133

[28] P. Roehrig, *Next-generation services in a reset economy* (2010)

[29] L. Bowers, Applied Clinical Trials **20**, 45 (2011)

[30] E. Mitchell, code4lib Journal (2010)

[31] F.A. Alshuwaier, A.A. Alshwaier, A.M. Areshey, *Applications of cloud computing in education*, in *2012 8th International Conference on Computing and Networking Technology (INC, ICCIS and ICMIC)* (IEEE, 2012), pp. 26–33

[32] S.A. Burney, N. Mahmood, Z. Abbas, International journal of computer applications **4**, 27 (2010)

[33] S. Ahmed, A. Abdullah, *E-healthcare and data management services in a cloud*, in *8th International Conference on High-capacity Optical Networks and Emerging Technologies* (IEEE, 2011), pp. 248–252

[34] K. Siau, IEEE Transactions on Information Technology in Biomedicine **7**, 1 (2003)

[35] D. Skobelev, T. Zaytseva, A. Kozlov, V. Perepelitsa, A. Makarova, Measurement Techniques **53**, 1182 (2011)

[36] E. MUNTEAN, N. MUNTEAN, T. MIHĂIESCU, R. MIHĂIESCU, ProEnvironment Promediu **1** (2008)

[37] R.R. Mahaffey, in *LIMS: Applied Information Technology for the Laboratory* (Springer, 1990), pp. 189–204

[38] T.J. Long, Chemometrics and intelligent laboratory systems **17**, 283 (1992)

[39] H.Y.E. Yu, M.L. Wilkerson, Laboratory Medicine **48**, e66 (2017)

[40] G. Avery, C. McGee, S. Falk, Analytical Chemistry **72**, 57 (2000)

[41] P. Lekvall, C. Wahlbin, Göteborg: IHM Förlag AB (1993)

[42] A.F. Hayes, *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (Guilford publications, 2017)

[43] J.F. Hair Jr, L.M. Matthews, R.L. Matthews, M. Sarstedt, International Journal of Multivariate Data Analysis **1**, 107 (2017)