

# Cloud Computing's Impact on Enterprises In Term of Security and Cost

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## Abstract

Cloud computing technology has acquired a vast vogue in the business technology area over the years. It has offered huge services and features; however, many challenges affect enterprises to adopt cloud computing. The primary concerns are cost advantages and security risks. By conducting two types of surveys (interview, questionnaire), this research has discovered the primary security and cost challenges that affect the enterprises. The cost-benefit is the main challenge that leads enterprises to migrate into the cloud, while the security risk is the main concern. The result states that enterprises have different scenarios and work needs. The cloud types are selected based on several factors such as cost, company strategy, current challenges, and future roadmap. Small and medium enterprises are suited toward the public cloud, while large enterprises favor the private cloud due to security and the hybrid cloud because of the flexibility and risk balance. Finally, this study discovered the main challenges and suggestions to mitigate the indicated risks related to security and cost before migrating into cloud computing.

**Keywords:** Cloud Computing, SaaS, PaaS, IaaS.

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## 1. INTRODUCTION

Cloud computing is one of the significant promising IT innovations within the technology market today. It is very attractive and recommended to organizations due to the potential that they bring about increased efficiency and value savings. It initiates a fundamental shift within the way organizations are supplied with computing resources. Cloud computing comprises providing several forms of services through the internet; consumers can access any computers by just having internet access [1]. Many IT operators like Google, Amazon, Microsoft Azure, IBM cloud services, etc., are involved in developing and delivering cloud services. Cloud computing has changed the way organizations use computers and the internet. This alteration relates primarily to how information is stored and applications used. In cloud computing, data is stored within the cloud rather than desktop computers. It provides users with access to their data, documents, and applications after they are connected to the web. Users no longer need their desktop computers, and it is easier for them to collaborate from different locations [1]. The consumers usually do not have an issue with uploading the data to the internet. Occasionally they are willing to do that, as they need to publish their data over the internet, such as sharing their videos, photos, or writing any personal information. However, this may create problems since they need to ensure that their confidential data are safe and secure. IT's efficiency increased gradually after developing this new technology that has come out arising on the internet. Moreover, the IT cost reduced and made this technology fascinating. Due to the compression to cut off the cost, enterprises are thinking to migrate into the cloud if they are not already using it. Nevertheless, when considering security, enterprises are still worried about their data while using cloud services due to the

complexity of their architecture and its concept [2]. Organizations aim to cut back their computing costs. Many of them started to do this by integrating IT operations and implementing virtualization technology, which improves the servers' ability to store and process data by hosting servers in their workplace. With cloud computing, organizations can further reduce costs by improving the utilization and reducing infrastructure and administration costs and faster deployment cycles. It provides them with excellent availability, virtualization, and dynamic resource groups [2]. Many enterprises have started building their public cloud in cloud computing. It means they have already begun the investment, incorporating Amazon, Google, MS Azure, and other cloud providers. Those providers are usually launching their new features and latest updates on their services offering for the enterprises. As an instance, Amazon web services launched a middle associated with security and price on their website to make a community to advise about the present issues. It demonstrates that there are still plenty of problems regarding the cost and security of cloud computing; this is why there is always the requirement to research cloud computing issues. The research questions presented in the following:

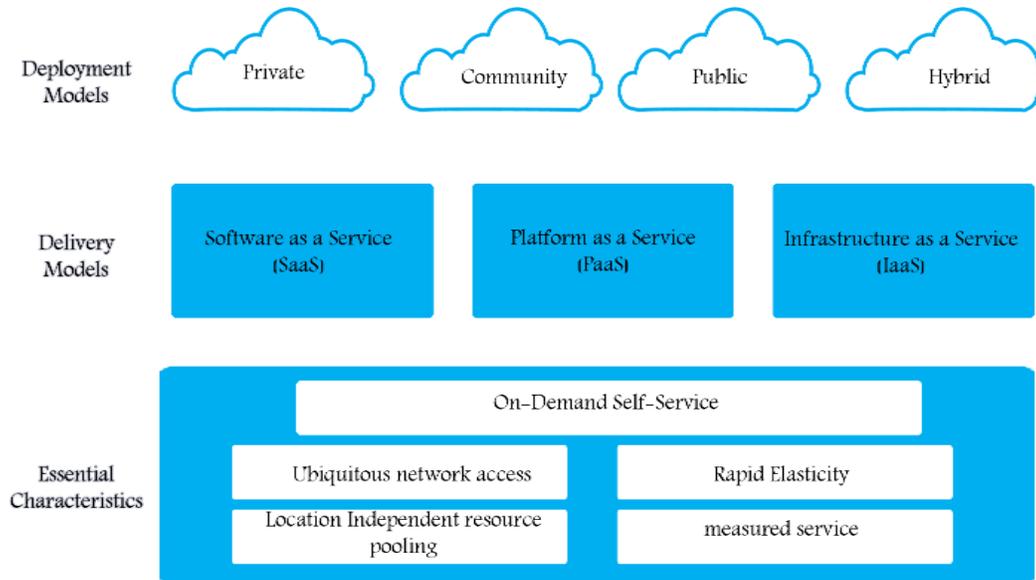
1. What are the comprehended advantages and disadvantages related to cost and security for enterprises to acquire cloud computing?
2. What is the best cloud deployment and service delivery models for enterprises?

## **2. LITERATURE REVIEW**

In this section, a comprehensive overview of related literature is given to set the scene for the remaining parts described in this study. To have a clear view and realize the influences of cloud computing on enterprises regarding cost and security, it is a prerequisite to concluding the definition of cloud computing, background, cost-benefit, and security risks.

### **2.1 Definition of Cloud Computing**

There are many definitions of cloud computing; thus, experts and organizations have tried to explain cloud computing differently. After the evolution of cloud computing, numerous researchers have stated definitions attempting to emphasize and explain what it exactly is. Yet, there is no comprehensive definition that awards an absolute realization of this new technologys' nature. There is a famous and well-known definition that was developed by the National Institute of Standards and Technology: "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., network, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." [3]. The above definition demonstrates with clarity cloud computing. It addresses the main features and characteristics and collects all the advanced definitions between many illustrations of the phenomenon. The figure below demonstrates the NIST definition of cloud computing [3]:



**FIGURE 1:** Cloud Computing Definition.

## 2.2 Background

Cloud computing is the new evolution of the IT environment that provisions computer resources and the infrastructure as a service. When using the cloud, the winning of a company depends on significant features like comprehensible management, decreasing the costs, and speed up the processes and procedures. Cloud computing technology is performed by various deployment and services according to the vast amount of designs. Enterprises are using the cloud to switch from the current running infrastructure to the functional dynamic environment. When enterprises take over cloud computing, their business performance is accomplished with less difficulty and more efficiency. Cloud computing provides so many features for enterprises and consumers as they can get it very quickly. The cloud-computing model is not a new idea; it has been developed over many stages, including utility and grid computing and services like application. Moreover, the concept of computer utility was so common in the 1960s, and then evolutions and development in computer technology result in having an advanced computing environment [4].

## 2.3 Cloud Computing Cost Benefit

The main interest that brings the business enterprises and consumers into the cloud environment is the benefit and advantage of cost. Thus, the researchers always concentrate on the cost advantages in their studies and explain how they influence enterprises. That is why the cost advantages and benefits of cloud computing are reviewed in this study. Although cloud computing comparatively is a new technology, with having various service development, there are many untested use cases related to the cost risks. Yet, the existing researches still have difficulties in addressing the risks of cost for enterprises [5]. The existing research states that cloud computing allows enterprises and consumers to decrease hardware costs once utilizing cloud services. When adopting cloud services, they do not need expensive and powered computers when using their applications on the cloud. The reason behind this comes from reducing the storage and power processing. Unlike the standard software, executing applications in the cloud required lower memory since there is no need to install it. For this reason, enterprises no longer need to expand their IT infrastructure, mostly concerns with more prominent companies [6]. In addition, one more advantage of the cost is that the enterprises no longer need to pay for upgrading their software into the latest version since the cloud provider upgrades the applications automatically in the cloud, this is an instance of decreasing the maintenance cost, and this includes the software and hardware maintenance. When discussing the cost concept, and in financial accounting, there are to terms of business expenses; they are capital expenditures (CapEx) and operating

expenditures (OPEX). Simply, CapEx includes the main purchases which will be used in the future, and Opex represents the daily costs. With regard to income tax, enterprises generally prefer operating expenses over capital expenditures. For this reason, companies will rent devices from the seller instead of buying them directly. Equipment purchase is capital expenditures, so not all prepaid funds can be deducted. The amount paid to the seller for the lease is the operating expenses as it is incurred as part of the day to day business operations. Therefore, the enterprise can deduct the cash that it spent that year. The most famous cloud provider, Amazon, has developed a new pricing model, which means that the users will pay according to the total hours they used the cloud services; consumers are paying for what they only have used. It will let consumers think about cloud computing as an economic expression [7].

Many challenges let the customer move into the cloud, including saving money, availability, business continuity, etc. However, economically wise, and according to the existing researches, five main points lead to improving the operations and saving money as follow [8]:

- Hardware Scalability
- Energy Cost
- Disaster Recovery
- Regulating the Staff
- Advanced Cost

## **2.4 Cloud Computing Security Risks**

Although the cost advantages are the primary concern that encourages enterprises to swap into cloud computing, the security problems are the major obstacle for the enterprises. The security risks are various based on the delivery and deployment model utilized by the enterprises. This is why enterprises must study the risks and recognize the connection between the deployment and service model. Selecting cloud computing and using it means enterprises face security issues, and almost all the risks belong to the security of data. Enterprises must ensure having data protection and privacy of their processed data and storing their data safe when using cloud applications by the cloud providers [9]. According to some surveys conducted by the researchers, the primary fear related to data security is the possibility of losing data, then utilized by prohibited parties, and this is the outcome of inappropriate data protection from cloud providers [9]. Security is improving gradually in cloud computing by identifying the risks; however, some risks are uncovered overdue to block the accident. It is difficult for all stakeholders to realize the risks and prevent them. To mitigate the risk, the provider must construct security in all network layers [10]. In reference to some of the existing research, there is an important challenge related to security, which is the privacy issue. The privacy always has an immediate influence on enterprises to decide whether to go for a cloud or not because they are indicated straight on the consumers' dependence. Moreover, these issues have side effects and concerns related to economic, legal, and personal involvement. The major problems of privacy when using cloud computing are [11]:

- Assumptions and risk investigation.
- Emerge new models that influence the privacy of the users.
- Respond with the applicable laws and regulations.

## **3. THEORETICAL BASELINE**

This section contains a comprehensive theoretical concept of cloud computing. Including the cloud's architecture and its components and presenting the deployment and service delivery model in detail to understand what cloud computing is and how many types and services do cloud computing offers for the customers. Besides, the main characteristics of the cloud are highlighted.

### **3.1 Cloud Computing Architecture**

Since cloud computing became important in the virtual digital world, its architecture and components must be clear. In general, cloud architecture is entirely compatible with every item,

piece, and feature. It belongs to all details and parts required for cloud computing. Cloud computing architecture composed of two parts as following [12]:

- Front End Platform: It is about the client
- Back End Platform: Includes the servers, network, applications, management, storage, and database.

### **3.2 Cloud Deployment Model**

Selecting a convenient cloud deployment model to be practiced by enterprises is a significant milestone accomplished to succeed in the cloud computing environment. Because cloud computing has several models and requires various resources and skills to manage them. Many enterprises fail in executing cloud computing due to selecting the wrong cloud model [12]. In general, and according to the previous researches on cloud computing architecture, there are four types of deployment models, which are presented and explained in the following:

1-Private Cloud: This type of cloud deployment is performed mainly by big enterprises, and managed even by internal IT resources or by private cloud providers. This kind of model is not accessible as public; it belongs to a particular company. It can be accessible inside or outside the infrastructure's existing location, and the users may belong to a different unit. They still belong to the same enterprise so that they can access the private cloud. This type considers as the utmost secured cloud model due to the procedure of securing data. In the private cloud, the infrastructure is created by the enterprises; however, it can be rented from the cloud provider. In both cases it can be managed and run either by the enterprise itself or by the cloud provider. It brings several consequences to the public cloud, for instance, Amazon virtual private cloud [12].

2-Public Cloud: This type of cloud model offers several countenances such as storage, applications, database, and other services to the cloud providers' end-users. This model depends on the specific part as you go service. The third-party has created this type to supply unlimited storage extended data transportation over the internet to all enterprises. Commonly, this type is owned, monitored, and managed by the cloud service provider. Besides, it considers every requirement that comes from the enterprise. It is the simplest structure to install as releases that defender loads of applications and equipment [12].

3-Community Cloud: This type of cloud is utilized by several enterprises with joint commercial businesses, programs, projects, and shared frameworks in terms of software or application, so the existing cost to be decreased. Thus, this model can be managed by united enterprises or by a third party. For instance, the online study platforms for universities are community cloud [12].

4-Hybrid Cloud: It is one of the cloud deployment models built by combining two or more cloud types, such as public, private, and community cloud, and it is shared among various enterprises when having the same requirements and profits. Usually directed internally, or it can be handled by the cloud provider [12].

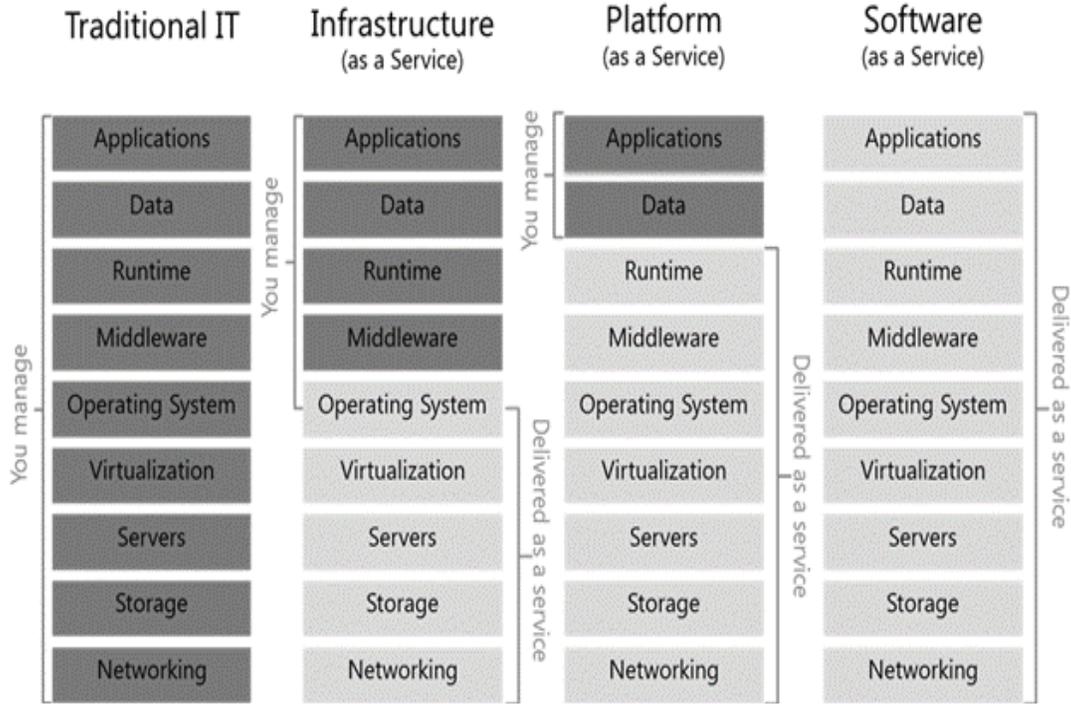
### **3.3 Cloud Service Delivery Model**

Cloud computing is providing various services to consumers to meet their business strategy and needs. Mainly, and according to the NIST, there are three fundamental service models that are capable of satisfying the enterprises, as explained in the following [13]:

- Software as a Service (SaaS): This model has the capacity to offer the end-user run their applications in the cloud platform.
- Platform as a Service (PaaS): This service model can provide users with a platform to create their applications by programming and other tools. In the PaaS, the customers do not administrate the platform, including network, OS, servers, and storage; they are only managing the deployed application and other required configuration.
- Infrastructure as a Service (IaaS): This service model offers consumers the ability to access the storage, processing, network, and other essential computing assets. The

customers can deploy their applications, running the OS, or upgrading the software. The consumers cannot touch anything implied by the cloud framework; however, they can manage the operating system, network components (firewall), and storage.

A representative diagram of the cloud service delivery model that is obtainable to cloud users is shown in the following [11]:



**FIGURE 2:** Cloud Computing Service Models.

### 3.4 Cloud Computing Characteristics

With the growing cloud computing in technology and trading, enterprises can simply increase the prospective of advantages. Moreover, to have a better understanding of what cloud computing is and its characteristics. In reference to the previous researches and according to the NIST, below are the main five essential characteristics of cloud computing, which presented in the following [13]:

- On-demand self-service
- Broad network access
- The resource pooling
- The rapid elasticity
- The measure service

## 4. METHODOLOGY

In this section, the research methodology is presented and covered in several circumstances.

### 4.1 Research Approaches

In scientific research, there are two approaches to the theoretical findings; they are inductive and deductive approaches. The inductive approach is linked with qualitative data gathering; besides, the deductive approach refers to quantitative data gathering. Moreover, sometimes also the qualitative data can be used in the deductive approach [14]. Furthermore, the deductive approach

linked to positivism, and the inductive belongs to interpretivism. Nevertheless, it is considered that this designation does not have worth and may result in confusion. In addition, the procedure of gathering the information in the answered questions from surveys or interviews to achieve the objective of research named inductive reasoning. Moreover, the difference between both approaches is that the deductive approach is closely structured than the inductive approach; accordingly, the inductive approach is elastic for the researcher during the whole process in the research [14].

#### 4.2 Research Design and Strategy

When selecting a research design, it influences the research and provides a huge value because it constructs the research to be more effective by providing massive information with the least time and effort. Thus, the researcher has to choose a proper design to rectify the ideas in an appropriate trend [15]. Enough aggregate of existing research in the literature review is crucial to ensure and address enterprise issues and risks when utilizing cloud services. Moreover, highlighting the cost, security advantages, risks, and suggestions to mitigate these issues. The chosen literature was conducted to extract the needed result, and the outcome of this study was analyzed and compared with the result of the survey conducted in the research.

#### 4.3 Data Collection and Analysis

The mechanism for collecting the main data in this research conducted by the researcher were interviews and questionnaires. The interviews are to collect the needed information from the experienced people from the cloud service providers and the main operators that use cloud services, as this information represents their opinion of cloud computing subjects [14]. The main data collection method used in this study is called the mixed-method by gathering information using qualitative and quantitative data collection. A mixed-method supports the data gathering to be validated over the outcomes from the methods used in this study that are qualitative and quantitative methods [14]. Data analysis is the procedure of collecting statistical data and other techniques to report, evaluate, explain, and summarize the data. In fact, the researchers are always analyzing all kinds of observations for all the gathered data during the data collection milestone [16]. The raw qualitative data that is collected from the interviews reproduced and explained in Table II and Table III. Moreover, the needed coding and analysis were completed for an appropriate data demonstration and analysis. For the quantitative data collected from the questionnaire, the data were analyzed using SPSS statistics and presented through tables and charts such as bar charts and pie charts [16].

#### 4.4 Sampling

The sampling method is to sort out the group from a population to collect and gather the research data. The data sample size is stated that the quantitative study is more prominent than qualitative research. The popularization has a minimal concern in the qualitative analysis [17]. The sampling goal is to discover more extensive populations' characteristics by selecting a limited sample of the population as representative. The chosen sample of the respondent for questionnaires and interviews is the audience that experienced in cloud computing technology, and IT consultant or solution engineers in the cloud providers, and the enterprises that are utilizing cloud services. The number of respondents for the survey are presented in the following table:

| Organizations    | Number of Interviews | Questionnaire Respondents |
|------------------|----------------------|---------------------------|
| Cloud Providers  | 7                    | 0                         |
| Operators/Others | 3                    | 56                        |
| Total            | 10                   | 56                        |

**TABLE 1:** Number of the respondents for questionnaire and interview.

#### 4.5 Survey

This study completed based on the survey to collect the needed data to achieve the objective of this study. The questions are formulated according to the research question that is related to security risks and cost benefits. A sample of interview questions presented in Table II.

Furthermore, the targeted people for the interview survey are IT experts working at cloud service provider; the interviewees are from different countries (Dubai, Iraq, Lebanon, Jordan, Kuwait, and Australia). The author targeted those samples due to the following reasons:

- To collect the needed data
- They are certified in cloud computing
- The result to be valid and reliable
- To achieve the objective of this study

For the questionnaire survey, the targeted people were chosen are those that working at any type of organization that already using the cloud services in order to be able answer the questionnaire question properly. A sample questionnaire survey presented in Table III. The author targeted these people due to the following reasons:

- To address how the migration from on-premise to cloud environment done.
- To address which type of cloud services they are using.
- To identify if the cost benefit is the main concern to move into cloud, and security is the main risk.
- To identify which deployment and service delivery model suits small, medium, and large enterprises.

## 5. RESULT AND DISCUSSION

The objective of this section is to report the collected empirical data from the questionnaires and interviews; it presents the results by tables and charts to be more understandable by the readers. It includes the ideas from the respondents of the conducted survey related to the cloud computing challenges concerning cost and security.

### 5.1 Result

After conducting an online questionnaire with the related IT experts working in organizations that uses cloud services, the total participants that answered the questionnaire were 56 respondents. They were all using cloud computing services and agreed on that that adopting cloud technology by their company is a wise decision, their respondent presented in the below figure:

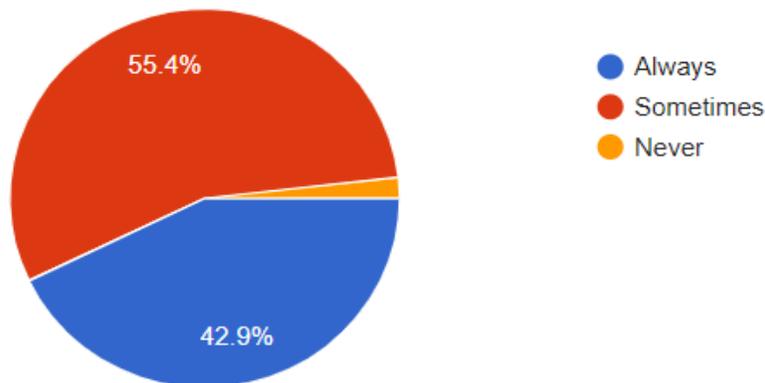
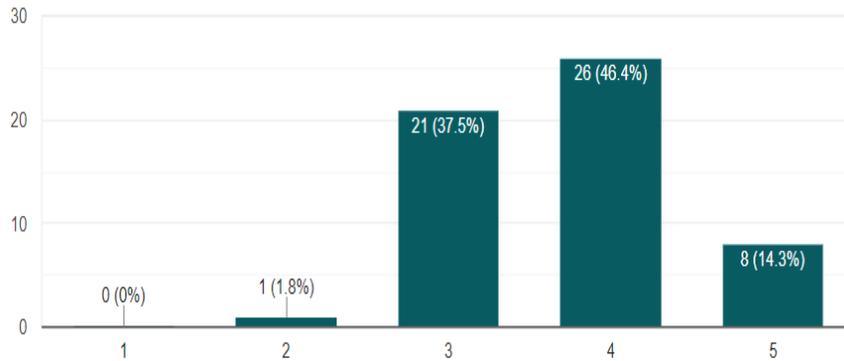


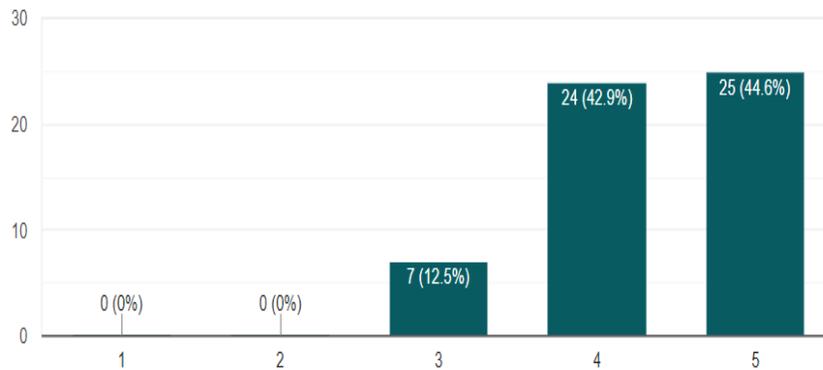
FIGURE 3: Cloud Computing Adoption is a Wise Decision.

From the respondents' opinions, it states that most of them are agreed that cost-benefit is the biggest challenge that leads the enterprises to use cloud-computing services; the answers are presented in the following figure:



**FIGURE 4:** Cost Benefit Leads Enterprises to Migrate into Cloud Computing.

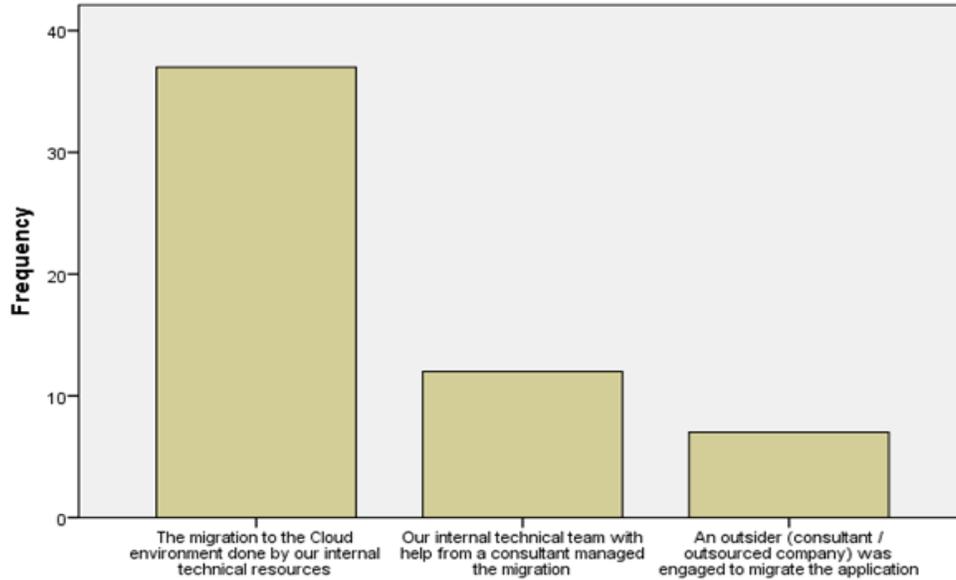
Related to the security, they agreed that security is the most concern for enterprises before going to cloud computing. The following figure represents the answers:



**FIGURE 5:** Security Concern from Participants Perspective.

From the interviewees' results, Table IV illustrates the respondents' opinions related to the cost-benefit of cloud computing and its advantages when enterprises using cloud services. Moreover, Table III represents the interviewees' opinion on security risks that face enterprises when migrating into cloud computing.

Based on the answer to question (2), how the migration of the application to the cloud handled? Out of 56 respondents, 37 of them have migrated their application by their technical staff, and 12 of them used technical staff with the help of a consultant; the rest used outsource company for the migration as presented in the following figure:



**FIGURE 6:** Security Concern from Participants Perspective.

## 5.2 Discussion

The purpose of this section is to discuss and compare between the analyzed data from the conducted survey and the literature review conducted in section two. Based on the study objective, the discussion explored each variable that influences cloud computing on enterprises.

**1-Cost Benefit:** In reference to the previous research explained in the literature review, it states that cloud computing allows enterprises and consumers to decrease hardware costs once utilizing the cloud services; they do not need expensive and powered computers when using their applications on the cloud [6]. The respondents stated that reducing the hardware and IT spending cost is the main advantage of the cost when enterprises using cloud computing, as presented in Table IV. Besides, according to the research in the literature review, it states that the enterprises no longer need to pay for upgrading their software into the latest version since the cloud provider upgrades the applications automatically in the cloud, this is an instance of decreasing the maintenance cost, and this includes the software and hardware maintenance [7]. According to the conducted interview, the interviewees have stated that moving from a CAPEX model into an OPEX is another cost advantage; the enterprises are not responsible for any software or licenses upgrade, maintenance, and daily operation, as presented in Table IV.

**2-Security Risks:** The previous research mentioned that security in the cloud needs extra resources to ensure that the data is secure [8]. From interviewees, they stated that a skilled security resource required managing the environment, and risks always exist, such as data loss, attacking, etc. In reference to the research mentioned in the literature review, the privacy problems always have an immediate influence on enterprises to decide whether to go for a cloud or not because they are indicated straight on the consumers' dependence. Moreover, these issues have side effects and concerns related to economic, legal, and personal involvement [11]. From the interviewees, they highlighted that the privacy issue is one of the enterprises' obstacles because the cloud vendor either does not have the visibility tool to give them to their customers or operate in a black-box style due to legal and geopolitical restrictions. Furthermore, a research highlighted that resource sharing is another issue that faces enterprises [9]. The interviewees are mentioning that when enterprises are using cloud computing, they share resources over the cloud. It means that maybe the data from a particular user is shared with other parties, which is another security problem. Moreover, the previous studies highlight that the deployment models security is different, according to the experience; the public cloud is more vulnerable compared to

the private cloud [9]. The collected data from interview surveys stated that the public cloud has a risk of theft of intellectual property to sensitive data by the cybersecurity attacker. However, the private cloud is more secure than other types of cloud computing. The interviewees' opinions related to security risks are presented in Table III.

## 6. CONCLUSIONS AND FUTURE WORK

This study has discovered the impact on enterprises related to cost and security. The previous studies have demonstrated that cloud computings' main challenge is cost-benefit, and the main concern is security risks. After conducting interviews with cloud providers and some operators and questionnaires with enterprises that use cloud services, this study has collected qualitative and quantitative data to address the impacts on enterprises concerning security and cost. Cloud providers take care of the clouds' security, and they are responsible for security; they are investing deeply in securing their customer data and confidential information. This study finds many implications related to cloud computing challenges; it has discovered how the main challenges influence the enterprise to adopt cloud computing in terms of security and cost. The cost-benefit is the primary concern by enterprises to migrate into cloud computing as it reduces the cost of hardware, staff, maintenance, operation, and data center. Security is the biggest concern. Since the cloud environment connected over the internet, many security issues need to be concerned by enterprises, such as sharing resources on the cloud, sensitive data, data protection, data privacy, data loss, malware infections, and attacks. According to the cloud experts' feedback in the interviews, the solution is that enterprises have to classify their data and do proper security controls to their data that needs to be hosted in the cloud. Moreover, having a skilled security consultant ensures that the cloud vendor is appropriately protecting their information and data. This study states that each organization has a different scenario and work needs; therefore, the cloud deployment model is selected based on several factors such as cost, company strategy, current challenges, and future roadmap. Commonly, the public cloud is the way to go, and it is a good option for small startup enterprises; however, it is not a good option in terms of security. On the other hand, the private cloud is the right choice for big enterprises as it is more secure for sensitive data. Moreover, most enterprises with sensitive data are using the hybrid cloud; for example, using the private cloud for sensitive data and data security, and using the public cloud for some features such as MS office 365 and Salesforce services.

In addition, the primary cloud service models are SaaS, PaaS, and IaaS, and all these services are valid for all types of enterprises. However, according to the interview and questionnaire respondents, the SaaS can be used by SMB enterprises, and it is the right choice for small enterprises. The PaaS, which provides the platform and database, is usually used by a medium-sized company. The IaaS is providing all computer resources to the customer, and it is more expensive than other services; thus, it is more used by big companies.

Finally, cloud computing technology has a significant impact on enterprise companies. Cloud providers are pushing the enterprises to use cloud services by offering many services that may not be available in an on-premise environment. Enterprises need to consider the risks before migrating into the cloud; this will be done by evaluating the risks and having a good plan to reduce and mitigate the risks. The future research direction will focus on fog computing. Fog computing has emerged because cloud computing is too far away from the point of origin. Due to having large amounts of data in the cloud, and the timing for transferring all these data will result in latency, and this is the primary concern by enterprises and unacceptable. Several methods and algorithms are used to mine a large amount of data present in databases, data warehouses, and data repositories to explore data mining for fog computing using fog-engine. This technology is currently a fascinating topic, and it is an innovation and extension of cloud computing technology.

**TABLE II: A SAMPLE OF INTERVIEW QUESTIONS**

| No. | Question Scope   | Research Objective & Justification                               |
|-----|--|--|
| Q1  | Why do enterprises need to migrate into the cloud computing?   | To identify the challenges and the advantages of cloud computing |
| Q2  | Before going to cloud computing, what are the essential things | To identify the main concerns and                                |

|    |  |  |
|----|--|--|
|    | to be taken into concern by enterprises?   | risks that face enterprises before going to cloud computing            |
| Q3 | What are the cost advantages?  | To find out the benefits of using cloud computing by enterprises       |
| Q4 | What are the cost risks?   | To find out the risks of the cost when using cloud services            |
| Q5 | What are the security risks?   | To find out the security concern or risks that enterprises think about |
| Q6 | What are the security benefits for enterprises to go for cloud computing?  | To discover the security benefits when using cloud services            |
| Q7 | Which type of deployment models (public cloud, private cloud, and hybrid cloud) are suitable for (small, medium, and large) enterprises? | To find out which deployment model is fit all sized enterprises        |
| Q8 | Which type of service delivery models (IaaS, PaaS, and SaaS) are suitable for (small, medium, and large) enterprises?                    | To discover the suitable cloud service model for all-sized enterprises |
| Q9 | How indicated cost and security risks could be avoided? What is your suggestion?   | To collect the suggestion by cloud practitioners before adopt to cloud |

**TABLE III: A SAMPLE OF QUESTIONNAIRE QUESTIONS**

| No. | Question Scope  |
|-----|---|
| Q1  | Which type of cloud services your organization is using or you see suitable to use?                             |
| Q2  | Based on the answer to question (2), how is the application's migration to the cloud handled?                   |
| Q3  | Which solution do you suggest the most suitable for your organization according to cloud computing taxonomy?    |
| Q4  | Do you agree or believe that adopting cloud technology by your company is a wise decision?                      |
| Q5  | Do you agree that cost-benefit is the biggest challenge that leads enterprises to migrate into cloud computing? |
| Q6  | Do you agree that security is the most concern for enterprises before going to cloud computing?                 |
| Q7  | Do you agree that cloud computing is a computing technology that used to minimize the cost of a company?        |
| Q8  | Which type of service delivery solutions are more suitable for all sized enterprises?                           |
| Q9  | Which type of cloud computing models is more suitable for all sized enterprises?                                |

**TABLE IV: INTERVIEWEES' OPINION RELATED TO COST-BENEFIT**

| Interviewee | The result of their opinions about cost advantages  |
|-------------|---|
| A           | The minimized cost are IT spending, maintenance, hardware, administrative, staff, and physical location.                    |
| B           | The cost-benefit is that it reduces the cost of IT spending, staff, and resources, management, maintenance, extra hardware. |
| C           | Enterprises do not need to purchase hardware or software. The providers are responsible.                                    |
| D           | The major cost advantages are pay based on consumption; it helps them to build their environment less costly.               |
| E           | Cloud services require less cost and easy to manage, with no need to purchase physical hardware and manage them.            |
| F           | It minimizes the cost of expenses such as hardware, IT spending, IT staff, data center, power, cooling, and etc.            |
| G           | It saves the cost as they no longer deploy the data center, purchasing hardware, storage, servers, network, etc.            |
| H           | Depending on the use cases, there are tools to estimate the cost and cloud solution for downsizing to save costs.           |
| I           | Moving from a CAPEX model into an OPEX one is advantageous.   |
| J           | Saving the total cost of certain technology, operation costs controlled, and compared to CAPEX sort of investments.         |

**TABLE V: INTERVIEWEES' OPINION RELATED TO SECURITY RISKS**

| Interviewee | The result of their opinions about security risks  |
|-------------|--|
| A           | Migrating sensitive data to the public cloud has a risk of theft to the sensitive data by the cybersecurity attacker.  |
| B           | The main security risk is related to sensitive and confidential data; for example, CDRs from telecom companies.  |
| C           | There are several security risks in cloud computing like data loss, data breach, vendor lock-in, account hijacking, denial of service attacks. The major risk is data loss.              |
| D           | It is risky if a mistake happened, a security resource required to manage the environment, and risk always exists, such as data loss, attacking and etc.                                 |
| E           | The main security issues are data privacy, data breached and attacking.  |
| F           | The main security risk is cloud attack; data passes through the internet that raises the risk of sensitive data loss and internet connection loss in case of the public cloud.           |
| G           | Breaches and DDoS attacks are mainly ones the higher risk. Nevertheless, providers such as Amazon and Microsoft keep investing in security to avoid such a situation.                    |
| H           | The risks are remote access, DDoS attacks. Enterprises need to protect themselves from malware attacks.  |
| I           | Making proper use of cloud security tooling is key. Building a ground zero security culture is lifesaving.   |
| J           | The main security risk of an external cloud vendor is how it will secure the customer data and how the customer makes sure that the cloud vendor is properly protecting his information. |

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