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BARRIERS FOR ADOPTION OF CLOUD COMPUTING IN THE PALESTINIAN INDUSTRIES

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ABSTRACT: *Cloud computing is a term that refers to sources and computer systems available on demand through the network, which can provide a number of computer integrated services without being restricted by local resources. Organizations seek to reduction of in-house data centers and the delegation of a portion or the entire information technology infrastructure, applications, and support tasks to a cloud computing vendors. Palestinian industries respond quickly to adopt a proven ICT products and services supported by accessible telecom infrastructure. This study aims to investigate barriers for adoption of cloud computing in Palestinian industries. A survey instrument has been conducted in order to accomplish the research objectives. Data were collected from 68 ICT experts of the selected organizations in Palestine which was constituted the sample size. The results show that the most obstacles were security issues and insufficient financial support. It also show that SaaS was the most cloud computing service that currently utilizes in organizations. Furthermore, data storage and E-mail were the most cloud computing applications that frequently use by Palestinian ICT professionals in their organizations. This study would like be an incentive to the Palestinian institutions overcomes these barriers. The study could be one of the primary steps for fully utilizing of cloud computing in the Palestinian institutions.*

KEYWORDS: *Cloud computing, Palestinian industries, Palestinian institutions, Barriers for Adoption*

INTRODUCTION

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g. servers, networks, storage, services, and applications) that can be rapidly provisioned and released with minimal management effort or service provider interaction (Vuyyuru, Annapurna, Babu, & Ratnam, 2012). In addition, cloud computing is a technology of computing in which internet and central remote servers are provided "as a service" to users (Meenaskhi & Chhibber, 2012). According to (Gens, 2008a; Grossman, 2009), cloud computing is the term given to the use of multiple server computers via a digital network as if they were one computer. The "Cloud" itself is a virtualization of resources, which the end user has on-demand access to it. These resources can be provided with minimal management or service provider interaction (Buyya, Vecchiola, & Selvi, 2013). They also argue that Cloud Computing offers the end user resources without the requirement of having knowledge of the systems that deliver it. Moreover, the cloud computing can provide the user and business with a far greater range of services and applications (Sajid & Raza, 2013; Vuyyuru, et al., 2012) including:

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- Access to a huge range of applications without having to install anything
- Users can avoid expenditure on hardware and software; only using what they need
- Makes the hardware and software easily maintainable.
- Applications can be accessed from any computer and anywhere in the world
- Consumption is billed as a utility with minimal upfront costs
- Companies can share resources in one place
- Scalability via on-demand resources

By 2018, IDC forecasts that public cloud spending will more than double to $127.5 billion. This forecast is broken down as follows: $82.7 billion in SaaS spending, $24.6 billion for IaaS and $20.3 billion in PaaS expenditures (Leopold, 2014). According to another research from IDC (Columbus, 2014b), by 2018, 27.8% of the worldwide enterprise applications market will be SaaS-based, generating $50.8 billion in revenue up from $22.6 billion or 16.6% of the market in 2013. IDC also estimates the overall enterprise applications market in 2013 was $135.9 billion.

Cisco Global Cloud Index acknowledges that by 2018, 59% of the total cloud workloads will be SaaS workloads, up from 41% in 2013. Cisco is predicting that by 2018, 28% of the total cloud workloads will be IaaS workloads down from 44% in 2013. Furthermore, 13% of the total cloud workloads will be PaaS workloads in 2018, down from 15% in 2013 (Cisco, 2014). A recent study conducted by Computerworld states that 42% of IT decision makers are planning to increase spending on cloud computing in 2015, with the greatest growth in enterprises with over 1,000 employees (52%) (Columbus, 2014a).

Currently, millions of people are already being used cloud computing in various manifestations including email services, office productivity applications and numerous subscription-based software as a service (SaaS) services (Kim, Kim, Lee, & Lee, 2009). In addition, several companies around the world have started to move their data and ICT operations into the cloud (Gupta, Seetharaman, & Raj, 2013). Some of the potential benefits from cloud computing can actually help companies reduce high expenditures on hardware, software and IT maintenance as well as provides businesses with a centralized, virtual data center that is accessible at any time and regardless the location (Alshamaila, Papagiannidis, & Li, 2013; Catteddu, 2010). Lina and Chenb (2012) point out that the promised benefits of adopting cloud computing can be very appealing for companies, which offers increased return on investment and maxims competitive advantage.

Despite this proliferation of cloud computing resources and interest in such resources, this technology is not being adopted with its full potential in Palestine. Furthermore, very few studies have been carried out on how businesses are adopting and diffusing cloud computing technology in emerging economies, such as Palestine. This research is an effort to fill this knowledge gap by contributing to determine the business and technology barriers hindering the adoption of cloud computing in Palestine. This study could also provide practical benefits to information technology practitioners in the successful adoption and implementation of cloud computing in Palestinian organizations.

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LITERATURE REVIEW

The Current State of ICT in Palestine

Palestinian industries quickly respond to technological offering. A study conducted by Wihaidi (2009) indicates that the Palestinian private and public sectors as well as consumers has strengths in the adoption of proven ICT products and services supported by experienced human resource and advanced and accessible telecom infrastructure.

Despite these encouraging characteristics, the Palestinian organizations faces serious challenges that need to be addressed such as: international perceptions of the technology adoption, ICT market access, travel impediments, access to equity based finance and investment, relatively high telecom cost to do business and inadequate legal and regulatory framework in support of technology industry. Moreover, there are few threats that cannot be overlooked including the ongoing political conflict, commoditization of IT products, lack of policies and government investment in the sector and a growing ICT brain drain (Tucker, 2012).

In spite of these challenges, Palestinian ICT sector is on the verge of developing into an innovative high tech industry and has the potential to become the engine of the Palestinian economy (Trust, 2012).

An Overview of Cloud Computing

In recent years, the advent of Cloud Computing has excited an interest for the various organizations, institutions and users. This is a result of the new economic model for the IT department that Cloud Computing promises. The model promises a shift from an organization required to invest heavily for limited IT resources that are internally managed, to a model where the organization can buy or rent resources that are managed by a cloud provider, and pay per use (Shimba, 2010). Moreover, cloud computing is offered in different deployment and delivery models.

Cloud Deployment Models

Many researchers (M. Avram, 2014; Behrend, Wiebe, London, & Johnson, 2011) greed that there are four models for Cloud Computing service deployment. These deployment models may have different derivatives which may address different specific needs or situations (M. Avram, 2014). According to them, the basic deployment models are public cloud, private cloud, community cloud, and hybrid cloud.

1. *Public cloud:* This cloud infrastructure is available to a large industry group and is owned by a vendor selling cloud services. In this deployment model, public cloud applications, storage, and other resources are made available to the general public by a service provider. These services are free or offered on a pay-per-use model of payment (Shimba, 2010).

2. *Private cloud:* This cloud infrastructure is managed by the organization or a third party and is operated solely for the needs of the organization. A private cloud is a particular model of cloud computing that involves a distinct and secure cloud based environment in which only the specified client can operate (Bellamy, 2013).

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3. *Community cloud:* This cloud infrastructure is shared by more than one organization and support a specific community that has common considerations. This may be managed by the organizations or a third party (Shimba, 2010).

4. *Hybrid cloud:* This cloud infrastructure is composed of two or more types of clouds listed above that remain unique entities but are connected via standardized technology that affords portability of data and applications (Shimba, 2010).

Cloud Service/Delivery Models

Regardless of the deployment models adopted, cloud computing services are divided into three classes, according to the abstraction level of the capability provided and the service model of providers (Gupta, et al., 2013). These models are Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS).

1. *Software as a service (SaaS):* The vendor provides, manages and controls the underlying cloud infrastructure, including individual applications, network, storage, servers, operating systems, etc. The customer is able to fully access the vendor's applications in the cloud via a variety of devices (e.g. cell phone, laptop, PDA). SaaS examples include MyErp.com, Salesforce.com and Google Docs,

2. *Platform as a service (PaaS):* Similar to SaaS, the vendor provides, manages and controls the cloud infrastructure, except for applications, which the customer has control over. The vendor provides tools and resources allowing the customers to create and/or acquire applications to meet their specific needs. PaaS vendor examples include Wolf Frameworks, Google App Engine and Microsoft's Azure (Reddy & Raghaveni, 2013).

3. *Infrastructure as a service (IaaS):* The vendor provides, manages and controls the general cloud infrastructure but provides the customer control over operating systems, storage, processing, and networks on demand. IaaS vendor examples include Rackspace and Amazon's Elastic Cloud Compute (EC2) and their Simple Storage Service (S3).

Since this study focuses on Palestinian enterprises, as classified mostly to small and medium enterprises, they do not have the capital to invest in their own data centers to create a private cloud, nor do they have the infrastructure to offer a community cloud, the public cloud will by default become the chosen platform.

CLOUD COMPUTING CONCERNS

The concerns of cloud computing adoption are different for emerging economies than they are for larger economies (Hinde & Belle, 2012; Kim, et al., 2009). According to (Kim, et al., 2009; Lin & Chen, 2012), adopting cloud computing also incorporates some notable technical and business potential risks. However, several studies identified the most important challenges that could inhibit the adoption of cloud computing as follows.

Security and Privacy

According to the survey of International Data Corporation (IDC), the biggest concerns about cloud computing adoption are security and privacy (Gens, 2008b). Corporate executives might hesitate to take advantage of a cloud computing because data stored, processing and

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movement carry outside the controls of their organizations (Sajid & Raza, 2013). Several authors (Alshamaila, Papagiannidis, & Stamati, 2013; Catteddu, 2010; Cohen, 2012; Lin & Chen, 2012; Tan & Lin, 2012; Zhang, Cheng, & Boutaba, 2010) argue that most of the security and privacy issues in cloud computing are due to a lack of control over the physical infrastructure. In other words, enterprises are wary of who monitors and controls the data center in the cloud.

In addition, cloud computing composed of several deployment and service delivery models that have their own security limitations and strengths with no current standards. These cloud deployment and service delivery models require new mechanisms for security and privacy for each model type depending on the consumers' requirements and the information sensitivity (Hwang & Li, 2010). As emphasized before, cloud computing provides one IT infrastructure shared by multiple users. This increases the possibility of storing some organization's data at the same server with other competitors, which may lead to security and privacy concerns such as data breach and malicious access (Kaur & Wasson, 2015; Rathi & Parmar, 2015).

Trust

According to Donovan and Visnyak (2011), "*There is a need for solutions that addresses trust and security derived from combining dedicated and shared infrastructures*". Horvath and Agrawal (2015) stress that the lack of trust of potential consumers in clouds is one of the key obstacles to the spreading of cloud computing.

More specifically, the loss of consumer's confidence in cloud computing stems from a lack of control over their own data, they are left with no knowledge of who is accessing their confidential data and the location of data storage (Kaur & Wasson, 2015). These factors lead to trust concerns over consumers' data being lost or misused (Chen and Hoang, 2011a). Moreover, control and management of personal data is an essential part of establishing the trust that consolidates adoption of cloud computing services. Without trust, consumers will be unwilling to use cloud-based services (Pearson & Benameur, 2010). Researchers Pearson and Benameur (2010) identify two key factors affecting consumers trust of cloud-based services, namely: weak trust relationships and lack of customer trust.

Kaur and Wasson (2015) acknowledge that trust issues in cloud computing can be divided in four sub-categories, they are:

- How to handle information that is recommended as malicious.
- How to adjust, reflect, and monitor trust relationship potent change with space and time.
- Which attributes should be used to define and evaluate trust in cloud computing.
- According to which degree of trust, level of security should be provided.

Compliance

Various countries have numerous regulations and laws pertain to the storage and use of data on cloud, but similar or different laws may apply in other legal countries (Sidhu & Singh, 2014). Cloud service customers may often need to be aware of the legal and regulatory differences between the jurisdictions. For example, data stored by a cloud service provider may be located in, say, UAE and mirrored in the US (Wikipedia, 2015).

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Consumers require reporting and audit trails, which cloud service providers must enable them for comply with these regulations. Furthermore, the data centers maintained by cloud service providers are also subject to compliance towards the regulations (Kelkar, 2015; Rao, Patra, & Chakraborty, 2014).

Indeed, customers are ultimately responsible for the security and integrity of their own data, even when it is held by a service provider. Traditional service providers are subjected to external audits and security certifications. Also, cloud-based service providers who refuse to undergo this scrutiny are signaling that customers can only use them for the most trivial functions (Oh et al., 2010).

Reliability and Availability

Cloud computing customers demand 24/7 access to their services and data, reliability remains a challenge for cloud service providers everywhere (Bills, 2012). Put another way, customers normally expect services provided by cloud computing to deliver at least the same service reliability and service availability as traditional service implementation models (Bauer & Adams, 2012). Sajid and Raza (2013) argue that reliability denotes how often resources are available without disruption and how often they fail. According to these authors, availability can be understood as the possibility of obtaining the resources whenever they are needed with the consideration to the time it takes for these resources to be provisioned.

In addition, design and implementation of a reliable and available architecture for cloud computing platform is still an open issue and needs generic architecture in term of its adoption (Ghobadi, Karimi, Heidari, & Samadi, 2014). Hinde and Belle (2012) acknowledge that outage of the service provider or connection affects the cloud computing service availability which, in developing countries, depends critically on the reliability of internet infrastructure. Avram (2014) emphasizes that the lack of Internet connections is a considerable barrier for cloud computing as it relies on the Internet to deliver its services. Moreover, uncertainty of service reliability and availability especially the concern over unexpected system disruption and downtime could hinder organizations from adopting cloud computing because it increases business risks (Lin & Chen, 2012; Shimba, 2010).

Performance

Performance considerations are essential for the success of cloud computing, including the optimum cost of cloud services, scalability and reliability (Mauch, Kunze, & Hillenbrand, 2013). According to IDC's survey, performance is the second concern in cloud computing adoption (Gens, 2008b). Generally, performance measured by capabilities of applications running on the cloud system (Ghanam, Ferreira, & Maurer, 2012; Sajid & Raza, 2013). Sajid and Raza (2013) stress that poor performance could results in end of service delivery, loss of customers, reduce bottom line revenues.

Khanghahi and Ravanmehr (2013) identify various factors that could influence the performance of cloud computing and its resources including security, recovery, service level agreements, network bandwidth, storage and buffer capacity, number of users, workload, and location. Furthermore, a study conducted by Stahl et al., (2012) highlights the key performance and capacity considerations for cloud computing, they are: response time, elapsed time, bandwidth, processor speed, service scalability and reliability, and many others.

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Integration

Organizations need to adopt different types of applications from different cloud providers and these applications might need to interact with each other. Consequently, the integration between the data from these different applications needs to be achieved and this issue poses many technical and business challenges for cloud providers and adopters (Kim, et al., 2009; Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011). However, cloud computing also extends the need for and range of information systems integration: mixed cloud-/on-premise-IT-landscapes extend integration of data, cross-enterprise collaboration, and components and processes beyond the boundaries of a single enterprise combining them with B2B integration (M.-G. Avram, 2014; Kleeberg, Zirpins, & Kirchner, 2014).

According to MuleSoft (2015) integration is a major obstacle to successfully adopting and deploying Software as a Service (SaaS) and other cloud-based applications. In a recent survey conducted by consulting firm Saugatuck Technology, 32% of respondents indicated that integration between SaaS and on-premises legacy applications is a top concern, second only to data security and privacy at 39% (Bakker, 2015). Of the 270 executives surveyed by technology analyst Gartner, 56% cited integration into existing environments as the primary reason for choosing to transition from a SaaS solution to an on-premises solution (MuleSoft, 2015).

Other Concerns

The lack of standardization of application program interfaces and platform technologies means that interoperability among platforms is poor and organizations will not be able to transfer easily from one cloud provider to another. Consumers hence face vendor and data lock-in. This perceived lack of control can discourage companies from adopting cloud computing (Bellamy, 2013; Tan & Lin, 2012). Other concern cited include the lack of existing skills and knowledge of IT professionals' in organizations to implement and manage cloud computing resources (Alshamaila, Papagiannidis, & Stamati, 2013; Hailu, 2012; Khajeh-Hosseini, Greenwood, Smith, & Sommerville, 2012). Other underlying concerns are legal and regulatory issues (Feuerlicht, Burkon, & Sebesta, 2011; Marston, et al., 2011; Miroshnychenko, Stankov, & Kurbel, 2012). There is an urgent need for the government and international agencies to be proactive in dealing with the unique challenges presented by the cloud computing environment. The underlying idea of cloud computing is to store data and information on virtual data centers that can be located in distributed locations in the world. However, conflicts may arise as there are no of internationally accepted set of rules and regulations (Ghanam, et al., 2012; Shoshtari & Farid, 2013).

In summary, cloud computing poses many opportunities and challenges in general. However, various issues of cloud computing adoption have been discussed in this section; still there are many other compelling issues particularly relevant for organizations in emerging nations such as Palestine needs to be considered.

METHODOLOGY

This study aims to investigate barriers for adoption of cloud computing in Palestinian Industries. A survey instrument was utilized to collect the data from experts from academic and technical field. The survey was piloted and some minor changes were made. The

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questionnaire of this study was divided into two sections. The first section measured the demographic information; the second section measured the cloud computing in terms of practice, usage, and barriers. All questions used in the research questionnaire are closed-ended questions. 68 ICT experts of the selected organizations in Palestine constituted the sample size, which was purposefully drawn from the population. They were made up of IT Manager, IT Consultant, IT Specialist, Systems Analyst, Software Developer, and Network Administrator.

FINDINGS

General Information

The study found that 41.2% the respondents have an experience from 1-5 years, 32.4% have an experience from 6-10 years, and 26.5 have an experience more than 10 years. When they asked about the current position, majorities were IT Manager, Software Developer, and Network Administrator made up the largest groups of respondents 32.4%, 22.1%, and 14.7% respectively, Table 1 shows Current positions of all participants. Furthermore, most of participants were working in Education or Software/Internet institutions (see Table 2).

Table 1: Current positions of the participants

Current Position	Frequency	Percentage
IT Manager	22	32.4
Software Developer	15	22.1
Network Administrator	10	14.7
IT Specialist	7	10.3
Database Developer	3	4.4
Systems Analyst	2	2.9
Designer	2	2.9
Business Analyst	1	1.5
CEO	1	1.5
Others	5	7.3

Table 2: Organizations' primary industry

Primary Industry	Frequency	Percentage
Education	24	35.3
Software/Internet	19	27.9
Telecommunications	7	10.3
Government	5	7.4
food/beverage	3	4.4
Healthcare	2	2.9
Computer Manufacturing	1	1.5
Others	7	10.3

Table 3 shows that counts of employees working at the institutions were in different scales from less than 10 employees to more than 1000 employees.

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Table 3: Employees count of the institutions

Count of employees	Frequency	Percentage
10 - 50	13	19.1
101 - 500	10	14.7
501 - 1,000	10	14.7
51 - 100	4	5.9
Less than 10	20	29.4
More than 1000	11	16.2

Cloud Computing Practice and Usage

When participants asked "what does cloud computing primarily meaning for your organization?" 64.7% of them declare that it is an "interesting technical offering"; while only 1.5% saw it as a tool they use daily (see Table 4). However, Table 5 shows that the majority (45.6%) of the organizations discussed, formally, the cloud computing issues and they incorporated it into the organization's strategy. 11.8% of them planned to incorporate it as part of their organization's strategy.

Table 4: Primarily meaning of cloud computing for organizations' participants

Primarily Meaning of Cloud Computing	Frequency	Percentage
A hype that will subside	2	3
A Tool we use on a daily basis	1	1.5
A type of outsourcing of IT	12	17.6
An interesting technical offering	44	64.7
Cloud computing is an unknown or unclear subject	6	8.8
Main Technology	3	4.4

Table 5: Merging the cloud computing with organizations

Merging Status	Frequency	Percentage
Has been discussed formally and it is part of our IT strategy	31	45.6
Has not been discussed as a topic within our organization	11	16.2
Has only been discussed informally	18	26.5
Our organization plans to incorporate it as part of IT strategy	8	11.8

Regarding the benefits that expected from cloud computing, Cost Saving was the highest ranking with total weight 82.4, followed by Advanced Technology and Better Scalability with total weight 57.4 and 54.4, respectively. "No upfront investment" was at the lowest rank. However, Table 6 reflects the positive expectation of participants on their organizations.

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Table 6: Benefits' ranking of cloud computing

Benefit	Total	Weight	Rank
Cost savings	56	82.4	1
Advanced technology	39	57.4	2
Better scalability	37	54.4	3
Ability to grow and shrink IT capacity on demand	34	50.0	4
Better functionality	31	45.6	5
Ability to rapidly launch new products and services	27	39.7	6
Improved security	26	38.2	7
Complexity reduction	23	33.8	8
More (core) business focus	20	29.4	9
Better collaboration	18	26.5	10
Convenience for the development teams	12	17.6	11
No upfront investment	10	14.7	12

Table 7 shows that SaaS was the most cloud computing service (type) currently utilizes in organizations' participants. Furthermore, "Data storage", "E-mail and messaging" were the most cloud computing applications that use by participants in their organizations followed by "Office software" and "Application hosting" (see Table 8).

Table 7: Current usage of cloud computing services

Service	Total	Weight	Rank
Software-as-a-Service (SaaS)	38	55.9	1
Internal cloud	24	35.3	2
Infrastructure-as-a-Service (IaaS)	18	26.5	3
Network-as-a-Service (NaaS)	17	25.0	4
Platform-as-a-Service (PaaS)	16	23.5	5
Others	8	11.8	6

Table 8: Usage of cloud computing's application

Application	Total	Weight	Rank
Data storage	35	51.5	1
E-mail and messaging	34	50.0	2
Office software	27	39.7	3
Application hosting	22	32.4	4
Application development	14	20.6	5
Business specific	13	19.1	6
Server capacity	12	17.6	7
Enterprise Resource Planning (ERP)	11	16.2	8
Customer Relationship Management (CRM)	10	14.7	9
Business Intelligence (BI)	7	10.3	10

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For the next 12 months' plan, as shown in Table 9, the same cloud computing applications will be utilized in the organizations' participants but with different weights.

Table 9: Future use of cloud computing's application

Application	Total	Weight	Rank
Application hosting	25	36.8	1
Data storage	24	35.3	2
E-mail and messaging	22	32.4	3
Office software	20	29.4	4
Enterprise Resource Planning (ERP)	18	26.5	5
Customer Relationship Management (CRM)	16	23.5	6
Application development	13	19.1	7
Business Intelligence (BI)	13	19.1	8
Server capacity	13	19.1	9
Business specific	13	19.1	10

The greatest barriers for adoption of cloud computing in the organizations' participants were the "security issues" and "Insufficient financial support" followed by "Legal issues", "Lack of Management", "Understanding/Willing to Innovate", and "Lack of ICT private sector" (see Table 10).

Table 10: Greatest barriers for adoption of cloud computing

Barrier	Total	Weight	Rank
Security issues	25	36.8	1
Insufficient financial support	22	32.4	2
Legal issues	21	30.9	3
Lack of Management Understanding / Willing to Innovate	21	30.9	4
Lack of ICT private sector	21	30.9	5
Geographic Location of Cloud Provider Data Centers	20	29.4	6
Organizational Politics	17	25.0	7
Integration with Existing Systems	11	16.2	8
Network infrastructure capacities	11	16.2	9
Lack of functionalities	9	13.2	10
Lack of Ability to Customize	9	13.2	11
Lack of technical and operational capacities	9	13.2	12
Cloud Provider Lock-In	7	10.3	13
Lack of Performance	7	10.3	14
Compliance issues	7	10.3	15
We did not have any concerns	7	10.3	16

CONCLUSION

This study intended to investigate barriers for adoption of cloud computing in Palestinian industries. Cloud computing has concern of all ICT organizations' activities. ICT Specialists

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of Palestinians institutions have the ability to deploy and implement cloud computing in their institutions. They believe that it is an interesting technical offering to enhance the organization in terms of cost savings, advanced technology, and better scalability. This can interpret why 45.6% of the participants declared that they have discussed formally cloud computing technology to be part of their IT strategy. However, there are some obstacles faced the Palestinians institutions for to adopt cloud computing. The most obstacles were security issues and insufficient financial support. The results show that SaaS was the most cloud computing service that currently utilizes in organizations. Furthermore, data storage, and E-mail were the most cloud computing applications that frequently use by Palestinian ICT professionals in their organizations, followed by office software and application hosting. This study would like be an incentive to the Palestinian institutions overcomes these barriers. The study could be one of the primary steps for fully utilizing of cloud computing in the Palestinian institutions.

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